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USES OF FARM AND MARKET
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presented by

SCOTT LOVERIDGE

has been accepted towards fulfillment
of the requirements for

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Date October 28, 1988

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USES OF FARM AND MARKET SURVEY DATA TO INFORM
FOOD SECURITY POLICY IN RWANDA

Volume I

By

Scott Loveridge

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ABSTRACT

USES OF FARM AND MARKET SURVEY DATA TO INFORM FOOD SECURITY POLICY IN RWANDA

By

Scott Loveridge

This research uses national farm and market data to improve understanding of farmer and merchant behavior in Rwanda. Beans and sorghum are major contributors to total caloric and protein intake in Rwanda, and being less perishable than other major crops, are the subject of government buffer stock schemes. The Government of Rwanda has also attempted to increase farmer incomes and production via bean and sorghum price policies. While well intentioned, these policies and programs suffered from a lack of accurate information about local agricultural production and marketing behavior.

The study shows that contrary to previous beliefs, Rwanda imports significant quantities (over fourteen percent of rural utilization) of beans and sorghum. In Rwanda, bean and sorghum sellers are a minority, and tend to have relatively larger, more productive farms than bean and sorghum buyers. Policies to increase bean and sorghum prices are not likely to increase output and would have regressive distributional consequences. Stopping bean and sorghum imports could also have negative food security effects in Rwanda, and reduce employment on both sides of Rwanda's borders.

New formulations of statistical tests of price behavior show that the Rwandan marketing system in Rwanda is competitive. Thin markets and high transfer costs appear to explain most spatial price

differences in Rwanda, and all indications are that price fixing could seriously disrupt the current system.

The effects of past temporary food shortages appear to have been minimal in Rwanda. Analysis of price behavior in past years indicates Rwanda's system of continual harvests has helped protect it against across the board price increases in poor crop years. There also is evidence that consumers with income could obtain inexpensive food in times of high bean and sorghum prices through purchases of alternative staples. Shifting to tubers is also an important farmer survival strategy when bean and sorghum crops are below average.

Land shortages and population increases will reduce per capita kilocalorie output in the near future. Solutions lie with expanded non-farm employment opportunities, and new technology to increase farm yields. Informal food imports will continue to be important in assuring an adequate diet to rural Rwandans.

RESUME

UTILISATION DES DONNEES DE L'ENQUETE AUPRES DES PRODUCTEURS ET DU MARCHE AGRICOLES DANS LE BUT DE BATIR UNE POLITIQUE DE SECURITE ALIMENTAIRE¹ AU RWANDA

PAR

SCOTT LOVERIDGE

Cette étude utilise les données au niveau national sur les exploitations agricoles et les marchés en vue d'une meilleure compréhension du comportement des agriculteurs et des commerçants Rwandais. Le haricot sec et le sorgho constituent les principaux apports protéiques et caloriques au Rwanda. Etant moins périssables que les autres principaux produits agricoles, ils ont été retenus pour le programme gouvernemental des stocks tampons. Le gouvernement Rwandais dans le but d'augmenter tant la production que le revenu agricoles des producteurs a instauré une politique des prix du sorgho et du haricot sec. Bien que l'intention était louable, ces politiques et ces programmes ont souffert d'un manque d'information sur la situation actuelle de la production agricole et le fonctionnement des marchés.

¹Note du traducteur: Le terme "sécurité alimentaire" doit être compris dans son sens plus large et est défini ici comme étant le processus d'acquisition des biens alimentaires; l'étude sur la manière dont la population rurale acquiert son alimentation aussi que les moyens mis en oeuvre par le gouvernement pour lui faciliter l'accès et la régularité dans l'approvisionnement des biens alimentaires.

Cette étude montre que contrairement à ceux que la plupart des experts en milieux rwandais croyaient, le pays importe une part non négligeable (plus de 14% de l'utilisation rurale) de sorgho et de haricot sec. Au Rwanda, les agriculteurs bénéficiant d'un surplus de production de sorgho et de haricot sec forment une minorité et ont tendance à avoir des exploitations plus importantes et plus productives que les producteurs-acheteurs de ces deux denrées. Une politique qui consiste à augmenter le prix de ces deux spéculations n'aura probablement pas d'effet escompté - c'est à dire augmentation de la production - mais plutôt des conséquences néfastes sur le système de distribution des deux produits. L'arrêt d'importation de sorgho et de haricots secs aura également des effets néfastes sur la sécurité alimentaire au Rwanda, et pourra réduire l'emploi d'un côté comme de l'autre de la frontière.

De nouvelles formulations des enquêtes statistiques sur le comportement des prix montrent que le marché de ces deux produits au Rwanda est un marché concurrentiel. Des transactions très éparpillées dans le temps et des coûts de transport très élevés pourraient expliquer les écarts de prix régionaux au Rwanda. Toutes les informations recueillies mènent à penser que le contrôle des prix pourrait perturber l'équilibre du système actuel.

Les pénuries alimentaires ponctuelles dans le passé semblent n'avoir eu que peu de conséquences. L'analyse de l'évolution des prix dans les années passées montre que la récolte saisonnière quasi-constante a mis la production et la consommation à l'abri de la hausse des prix généralisée dans les années de faible production. Il est également clair que les consommateurs jouissant d'un revenu se tournent

vers le marché des autres produits de première nécessité comme source de nourriture bon marché lorsque le prix du sorgho et celui du haricot sec sont trop élevés. Les agriculteurs se tournent vers les tubercules lorsque la production des deux cultures est inférieure à la moyenne saisonnière normale.

La pénurie des terres agricoles et l'acroissement de la population auront pour conséquence de réduire l'apport calorique par tête dans un futur proche. Les solutions sont à explorer dans l'expansion des emplois non-agricoles, et le développement de nouvelles pratiques agricoles dans le but d'augmenter le rendement par hectare. Les importations non-officielles des produits alimentaires continueront à tenir une place importante pour assurer l'équilibre alimentaire du producteur Rwandais.

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LIST OF ABBREVIATIONS

ADRA	Adventist Development and Relief Agency
BNR	The National Bank of Rwanda
CCDFP	Communal Centers for Permanent Development and Training
CIAT	International Center for Tropical Agriculture
CRS	Catholic Relief Services
CSE	Corrected Standard Error
FAO	Food and Agricultural Organization of the United Nations
FRW	Rwandan Francs (the national monetary unit)
GOR	Government of Rwanda
GREMARWA	National Granaries of Rwanda
GSI	Grand Seasonal Index
ISAR	Institute of Agronomic Sciences, Rwanda
MINAGRI	Ministry of Agriculture, Livestock, and Forests, Republic of Rwanda
MINIFINECO	Ministry of Finance and Economy, Republic of Rwanda
MINIPLAN	Ministry of Planning, Republic of Rwanda
MSU	Michigan State University
OPROVIA	National Office for the Development and Marketing of Food and Animal Products
PAK	Agricultural Project of Kibuye
PNAP	National Program for Potato Improvement
SESA	Agricultural Survey and Statistical Service, MINAGRI
USAID	United States Agency for International Development
WFP	World Food Program

DEFINITIONS OF GEOGRAPHICAL ADMINISTRATIVE UNITS

Préfecture (10)	Largest administrative subdivision in Rwanda
Commune (143)	Next subdivision after préfecture
Secteur (1489)	Communes are divided into secteurs
Cellule (8214)	Smallest administrative unit in Rwanda

CHAPTER I

INTRODUCTION

This chapter presents the objectives of the dissertation. Then a working definition of food security is introduced, followed by a discussion of the importance of food security issues in the African context. A brief description of Michigan State University's multi-country Food Security in Africa Cooperative Agreement with USAID follows. An overview of the project in Rwanda, and food security issues in Rwanda are next. Finally, basic statistics on Rwanda are presented along with a description of the research data collection methods.

1.1 Objectives of the Dissertation.

One of the objectives of the dissertation is the evaluation of the existing price data collection procedures in Rwanda, followed by analysis of prices at the farm and retail levels in order to determine if the national marketing system could be characterized as integrated and competitive. The purpose of this part of the investigation is to answer the question, "What are the problems or constraints to improving the present marketing system's performance in delivering food from producing to consuming areas?".

A second objective is to characterize, based on relatively limited data, households that might face the greatest risk of transient and/or chronic food insecurity. This will help policy makers better target food security policies.

A third objective is to increase understanding of farmer's strategies for coping with food insecurity to help decision makers complement farm level risk minimization mechanisms.

The fourth objective is to evaluate current Rwandan food price, storage and market policy alternatives.

A final objective is to help specify future data collection requirements for effective food policy.

1.2 The Problem of Food Security in Africa

Reutlinger (1984) defines the concept of food security as "Access to a sufficient and continuous food source at all times." He further notes that food security has both transitory and chronic dimensions.

Transitory food insecurity refers to the inability to obtain adequate food supplies in the short run, usually due to extraordinary natural conditions (droughts, floods, infestations) or temporary unemployment. In contrast, chronic food insecurity is characterized by inadequate food access in normal or even better than average times.

In the the last two decades Africa has been characterized by both transitory and chronic food insecurity. Per capita food production in Sub-Saharan Africa has trended downwards over the last decade. The droughts of 1973 and 1983-84 underscored Africa's inability to cope with temporary food production shortfalls.

Rukuni and Eicher emphasize that research efforts have placed too much stress on the food production side of the food security equation. Much money and effort has been spent on irrigation projects and agricultural inputs while questions of food acquisition and distribution received little attention. The literature is rife with

examples of African countries with large stocks of food concurrent with malnutrition or undernutrition of wide segments of the population.

1.3 MSU's Food Security Research in Africa

In 1984, USAID agreed to finance a new food security research thrust by Michigan State University. Dialogue between USAID and MSU resulted in the identification of the following primary research focus:

"The interaction of technological change, institutional reforms, and macro level policy in overcoming food production and marketing constraints."¹

The project also includes secondary focii on the following themes:

- 1) Managing food aid, food imports, and foreign exchange to achieve food security goals.
- 2) Planning and prioritizing research requirements to achieve food security goals.
- 3) Data analysis needs for food security planning."²

The general *modus operandi* of the research project is to conduct collaborative research in several African countries. This allows cooperation with local research institutions in each country, and provides the potential for cross country comparisons. The cooperative agreement has financed work in five countries: Mali, Senegal, Somalia, Zimbabwe, and Rwanda, and one region, southern Africa. This document reports findings of research carried out in Rwanda.

1.4 The project in Rwanda.

Discussion of possible collaboration between MSU, USAID/Rwanda and the Rwandan Ministry of Agricultural began in 1984. In June of 1985, a team consisting of Dr. Weber, Dr. James D. Shaffer, and the author

¹Crawford et al.

²Op. cit.

visited Rwanda to explore food security research topics of mutual interest to Rwanda and the Food Security in Africa Cooperative Agreement.

The final research design called for the author to join the Ministry of Agriculture's "Agricultural Survey and Statistical Service" (SESA) for 15 to 18 months, during which a series of new data collection activities would be initiated by the author and two Rwandan counterparts.

At that time, SESA had been functioning for approximately three years, and had conducted two national surveys, both of which focused on estimating national agricultural production. SESA had a field staff consisting of 78 enumerators, 10 local supervisors, and 1 national supervisor. SESA had plans to continue its data collection activities on a 1080 farm sample for 1985 and 1986. Many of the new interview schedules in the proposal for additional activities were targeted at SESA's sample.

The new data collection activities were designed to complement as much as possible both the ongoing data collection activities at SESA and existing secondary data. To keep the additional information to be collected on a reasonable scale, it was decided to limit the scope of the study to two commodities: beans and sorghum. Beans and sorghum were chosen because they are important components of the Rwandan diet, they are storable (sources of transient food security) and they are handled by one of Rwanda's government marketing boards and overall they are of considerable policy interest in Rwanda.

1.5 Agricultural Policy in Rwanda.

Rwanda's president has been actively promoting agriculture over the last few years, with a thematic approach to these promotional activities. In his speech³ proclaiming 1987 the "Year of Food Self-Sufficiency" in Rwanda, the president said,

"I would like...the Ministry of Planning...to prepare a ...viewpoint on what the concept 'food self-sufficiency in its broadest sense' means in terms of a real national development strategy, in terms of possible options, in terms of operational implications, in terms of possible priorities, and in terms of possible approaches!"

The president was intrigued by the concept of food self-sufficiency, but he did not want to commit himself to a narrow definition of the idea. He was asking for help in making the concept a useful tool in guiding policy.

By mid-January, the Minister of Agriculture had provided his definition of food self-sufficiency policy, which

"...focuses not only on the satisfaction of the food needs of the population, but focuses on creating exportable surpluses necessary to procure the foreign exchange needed for the importation of capital goods and agricultural inputs."

The president provided his definition of food self-sufficiency on Rwanda's 25th independence day celebration:

"We define food self-sufficiency in a very broad sense. It goes beyond production as the only consideration, because production is generally a consequence of so many actions and so many domains, and in particular everything which permits our producers to improve their standard of living.

In effect, when the producer realizes that his production permits him to procure the goods which improve his standard of

³Excerpts from the President's speeches in this document are taken from various issues of "Agence Rwandaise de Presse Bulletin Quotidien--Actualites Nationales et Internationales", published by ORINFOR, the Government of Rwanda Information Office. Translations from the French texts are by the author.

living, he will be motivated to produce more. The concept of food self-sufficiency therefore has something to do with increasing the purchasing power of the rural sector, with the creation of productive non-agricultural work.

Food self-sufficiency is directly related to local industrialization, adding value to national resources by transforming them, permitting support of demand for farmers' produce, which facilitates a policy of incentive prices."

Thus the president was saying that food self-sufficiency has more to do with a family's ability to generate revenue sufficient to purchase food and other goods rather than being dependent on handouts. This is really a food self-reliance approach to food security.

Food self-sufficiency is not a new objective for Rwanda. It is a recurring theme. The 1982-1986 development plan⁴ had as its priority of priorities self-sufficiency in food.

In addition to the thematic approach to stimulating agriculture, the GOR, with financing from donor agencies, has initiated a wide array of agricultural research and rural development projects. Unfortunately, due to the large number of projects, donors, and ministries involved, good coordination and collaboration between projects has been difficult.

A third arm of Rwandan agricultural policy has been the various parastatal organizations. There is a parastatal for the promotion and export of tea and coffee. In addition, the GOR and USAID, have responded to temporary bean and sorghum shortfalls by giving a parastatal, OPROVIA (Office National pour le Developpement et la

⁴"Projet de IIIeme Plan de Developpement Economique, Social et Culturel 1982-1986", Miniplan, Kigali, 1982.

Commercialisation des Produits Vivriers et des Produits Animaux)⁵ a mandate of stabilization of food prices and food supplies. OPROVIA's goal is to purchase beans and sorghum to increase farm level prices at harvest time, and sell to exert downward pressure on consumer prices when shortages occur.

Prior to 1986, the Government of Rwanda normally operated under an "indicative" pricing scheme for beans and sorghum. The government established optimal price levels for these commodities, and tried to move market prices towards its "target" prices through the market operations of its parastatal. Yet merchants were allowed to buy and sell at any price. A 1982 food strategy document by the Ministry of Planning⁶ made the following comment about the indicative pricing system:

"Although there should be a specific study done to confirm this, the official prices seem reasonably high. The problem is that they are very rarely practiced."

The document went on to propose that the commercial system be modified so as to allow farmers to "...refuse to sell products if the the price offered by a merchant is lower than the official price...". The document also suggested that OPROVIA's impact on market prices be strengthened through recruitment of more qualified personnel,

⁵The USAID financed branch of OPROVIA was originally independent from OPROVIA. At that time it was known as GRENARWA (National Granaries of Rwanda).

⁶"Mise en Place de la Strategie Alimentaire au Rwanda", MINIPLAN, 1982.

increased numbers of outlets, a larger fleet of trucks, and more operating capital.

Increased producer prices were seen as the foundation of the food strategy goal of "doubling production by the year 2000". High producer prices would make it possible for farmers to invest in inputs necessary to realize projected food production requirements.

OPROVIA was duly strengthened in subsequent years, with more buying points put into operation. From the scanty empirical evidence then available, OPROVIA's effect on producer prices appeared negligible. (As a result of the survey work performed in 1986 by the Ministry of Agriculture and MSU, more conclusive evidence is available for that year. See Chapter 3.)

At the beginning of 1986, the government, apparently dissatisfied with "indicative prices", moved to a floor pricing system. Minimum prices of most major commodities were fixed according to estimates of cost of production. Most of the new price floor levels were higher than the old "indicative prices", with prices of some commodities, such as beans, being hiked substantially. OPROVIA was now required to purchase directly from farmers, and at the official price. Government institutions were instructed to buy only from OPROVIA. Merchants not adhering to minimum prices could be (and sometimes were⁷) fined and/or shut down.

⁷One merchant was shut down by the authorities while the author and a counterpart were pre-testing an interview schedule with him!

Even these strict measures had little effect on market prices. During his Independence Day speech on July 5, 1986, the president made the following remarks about the (then) six month old price policy:

"The government, aware of the importance for farmers to obtain profitable prices for their products, decided to increase official prices for the majority of foodstuffs; in certain cases, the announced increases were large, but now they should be practiced, and farmers should be able to get the official price!

The government effort was generous, but it was quickly shown that the conditions necessary for the price increase to go to the producer weren't fulfilled, not even the measures which accompanied the price increase, which should have allowed farmers to defend themselves from dishonest merchants."

and further,

"It is obvious that high prices are an extraordinary stimulant to increase production and buying power in the rural areas. The state should guarantee, to the extent possible, the respect of the fixed floor prices."

Clearly, the president was following the reasoning laid out in the 1982 food strategy document: increased prices are a necessary prerequisite for farmer investment to increase production.

In September of 1986, the Minister of Finance issued a memorandum outlining new, stricter measures meant to apply tighter control on prices received by producers. These measures included:

- 1) Dissemination of information about the new price control law via the party apparatus and the government news service,
- 2) Creation of a "commission of control of application of government measures" in each commune,
- 3) Designation of "official merchants"-merchants who conform to the price regulations,
- 4) Establishment of a line of credit at the National Bank for merchants performing assembly operations,
- 5) Elevating prices paid by government agencies for supported commodities,

- 6) Increasing the legal maximum level of exports, stricter control on food imports from neighboring countries,
- 7) Mandating that communal authorities report merchants violating the pricing system, and
- 8) Institution of a policy of encouraging farmer specialization by agricultural region.

In his January 1, 1987 speech, the president commented on the 1986 price policy, which was now generally known to have failed to effect producer prices:

"The firm desire of the Government, with respect to price policy, is to favor by every means, a real transfer of our resources towards the rural areas. We have always said this."

and further the Rwandans should

"...not get discouraged by problems recorded for some products for which the floor prices could not be respected. It is inevitable, especially at the outset, that this big effort should experience some small setbacks. We... must improve...waiting until the administrators revise some of the fixed prices, if it is shown that these were set unrealistically, waiting until these proposed prices take into account regional and seasonal characteristics of our production..."

It is significant that the government is more concerned with farm gate prices than it is with consumer prices. With over 90% of the population in the rural areas, the GOR made the reasonable assumption that the majority of the people are producers, not consumers.

In summary, Rwandan food policy is characterized by a concern for self-sufficiency (usually defined in terms of self-reliance). The government is concerned for the well being of the farmer, and shows some signs of being anti-merchant. Government of Rwanda actions in the bean and sorghum subsectors have taken the form of market interventions to increase prices at harvest, and decrease prices during

periods of food scarcity. A more recent intervention has been to introduce pan-territorial and pan-seasonal floor pricing to increase farmers output and income. An objective of the research is to assist SESA in informing the GOR on the above issues.

1.6 Some Basic Characteristics of Rwandan Agriculture

Rwanda is the most densely populated country in Africa. With a population of over 5.5 million, it has almost as many people per square mile as India (233 people/square mile versus 231 people/square mile⁸). Per capita income in Rwanda is also roughly the same as in India. The comparison with India stops with population density and income, as Rwanda's size, literacy rate, urbanization, access to world markets, and technologies of production lag far behind those of India.

The Government of Rwanda estimates that over 90% of the population lives in the rural areas⁹. To date, the Government of Rwanda has dealt with population pressures by expanding land under cultivation (through reclamation of swamp lands and settlement of parks), with some improved varieties¹⁰ and limited technological changes (such as stall feeding rather than grazing for cattle), and a national anti-erosion campaign.

Rwanda has managed to maintain a reasonable growth rate in total food supply. However, official statistics in recent years show the 3.8% annual population growth rate outstripping the 2.9% average annual increase in food production¹¹ by 31 percent. Still, total food output

⁸World Bank, 1987.

⁹Proulx.

¹⁰Monares.

¹¹Proulx.

per capita appears to be better in Rwanda than in many other African countries.

Rwanda's reliance upon area expansion as its primary source of increased food production is not likely to be a viable strategy in the future. The area cultivated in the country is fast approaching the maximum, assuming no reductions in the surface area devoted to parks. Average farm size is dwindling as farmers divide their holdings among their sons¹². A growing land shortage is also reflected in shorter fallow periods. In 1986, average farm size was 1.2 hectares, while the modal farm size was only 0.5 hectares¹³.

Climatically, Rwanda is well endowed, enjoying high rainfall during its two growing seasons. Recent work has shown that Rwandans harvest crops continuously throughout the year¹⁴. Crops which can be stored in the ground (manioc, sweet potatoes) or on the tree (bananas) tend to be harvested in periods when stocks of more seasonal crops such as beans, sorghum, and maize have run low. Rwandan farmers thus juggle the timing of their harvests to try to maintain a fairly even level of food availability throughout the year.

As with its interseasonal food supply, Rwanda's year to year food supply has remained stable. Rwanda has experienced a few periods of production shortfalls in beans, sorghum, and to a lesser extent, sweet potatoes. But these shortfalls have not approached the magnitude of

¹²Morris, W.H.M., June 1979.

¹³Source: Previously unpublished data from a survey fielded by the author in conjunction with Rwanda's Agricultural Survey and Statistical Service and Michigan State University.

¹⁴DeJaegher and Ngarambe.

those in the Sahelian and northeast African countries in recent years. Even in 1984, often referred to in Rwanda as a drought year, the quantity of rainfall was normal¹⁵, although the timing of the rains was poor for the first season bean crop.

Beans play a critical role in Rwandan food security for several reasons. First, meat production, though historically and culturally significant, has trended downward over the last few decades, as land was converted from grazing to farming. In recent years beans have been the largest source of protein in the Rwandan diet. Vis, Yourassowsky, and Van Der Borght found that beans were the most important source of protein in eight of the nine Communes (in seven Prefectures) that they studied¹⁶. Beans provided over 50% of the proteins in the diet of study participants in four of the nine Communes. The same study found that meat provided no more than 4% of protein consumed in eight of the nine Communes, while in one Commune meat supplied 13% of protein intake.

Second, Table 1.1, developed using data from the "normal" 1986 crop year, shows that beans are the third most important form of caloric food production in Rwanda, accounting for almost 20% of total calorie production.

Third, bananas, sweet potatoes, and cassava are also major sources of calories for Rwandans (see Table 1.1), and store well prior to harvest. They are therefore important in mitigating the effects of short term production shortfalls at the local level. Unfortunately,

¹⁵Source: Rwanda Meteorological Service Records.

¹⁶Vis, Yourassowsky, and van der Borght.

these products spoil quickly once harvested. Their usefulness in mediating localized production shortfalls via interregional trade is limited by the lack of sophistication in the national and international marketing system. Thus beans and sorghum are the most important locally grown storable (post-harvest) commodities in Rwanda. The Government of Rwanda and the population of Rwanda see bean and sorghum harvests and stocks as critical to national food security.

Table 1.1
Rwandan Foodcrop and Kilocalorie Production 1986

	Metric Tons (x1000)	Kilocalories (billions)	%
Dry Beans	224	679	
Fresh Beans	54	169	
Total Beans	275	848	19.7%
Dry Peas	15	47	
Fresh Peas	4	13	
Total Peas	19	60	1.4%
Sorghum	159	624	14.5%
Dry Corn	92	300	
Fresh Corn	43	149	
Total Corn	135	449	10.4%
Sweet Potatoes	862	932	21.7%
Irish Potatoes	362	208	4.8%
Cassava	241	246	5.7%
Cooking Bananas	451	362	
Beer Bananas	1351	265	
Sweet Bananas	382	306	
Total Bananas	2104	933	21.7%

Source: Adapted from DeJaegher and Ngarambe.

Note: Fresh beans, fresh peas, and fresh corn weights given in dry weight equivalent. Conversion factors from metric tons to kilocalories taken from "Resultats de L'Enquete Nationale Agricole 1984", Rapport 1, Volume 2, Republique Rwandaise, Minagri, March 1986.

1.7 Sources of Data - Surveys Fielded and Basic References

Data were collected at three levels in the course of fieldwork: at the farm, merchant, and national market level. The farm level surveys varied in scope as shown in Table 1.2. The following paragraphs give more detailed descriptions of the characteristics of each of the surveys. In cases where only five prefectures were included in a survey, the prefectures were chosen to be representative of Rwanda in terms of per capita production of beans, corn, sorghum, and starches.

National Market I. SESA supervisors were instructed to assemble monthly urban price data collected by Ministry of Planning statisticians in each prefecture, in order to facilitate the transmission of these data to SESA, and their timely utilization.

National Market II. SESA supervisors in five prefectures were assigned merchants from which they collected monthly price data on beans, sorghum, and potatoes.

Table 1.2
A Summary of Surveys Fielded and Other Data Assembly Activities

Survey Name	Topics	Sample Size . /Char.	Frequency	Fielded By
National Market I	Retail Prices	Ass'y of Miniplan data	Monthly 12 months	Supervisors
National Market I	Retail Prices	5 Prefectures: 5 Merchants ea.	Monthly 12 months	Supervisors
Farmer I	Bean/Sorghum Transactions	1080 Farmers	Weekly 14 months¹⁷	Enumerators
Farmer II	Farmer Strategies and Cond.	120 Farmers	1 Visit	Supervisors
Farmer III	Bean Production Technologies	15 Farmers	3 Visits	Analysts
Farmer IV	Farmer Strategies and Cond.	1080 Farmers	1 Visit	Supervisors
Merchant I	Descriptive Chars.	40 Merchants in 5 Prefs.	1 Visit	Analysts
Merchant II	Standard Operating Procedures	40 Merchants in 5 Prefs.	1 Visit	Analysts
Baseline I	Age, Sex of Family Members, Animals on Farm	1080 Farms	1 Visit	Enumerators
Baseline II	Surface Area of Farm	1080 Farms	1 Visit	Enumerators

¹⁷The Farmer I Survey was extended to 20 months for Sorghum.

Farmer I (Transactions survey). SESA enumerators visited each household in the 1080 farm sample once a week for fourteen months to collect data on quantities exchanged and prices paid for beans and sorghum. Quantities have traditionally been difficult to measure in Rwanda due to lack of standardized units. This survey capitalized on a SESA innovation in measuring quantities in Rwanda: SESA issues each respondent a graded bucket with which to measure production. The Farmer I survey used the same buckets to measure quantities transacted.

Farmer II. SESA supervisors in five prefectures each visited twenty-four non-randomly selected farms one time. Retrospective questions concerning farmer reactions to drought, marketing habits, and constraints were asked. Farms were selected according to their production (in kilocalories) during the second season of 1985.

Farmer III. The author and one Rwandan counterpart worked with International Center for Tropical Agriculture bean researchers to develop questions to be asked of fifteen farms in two communes of Kigali. The farms selected were evenly divided between net purchasers of beans, net sellers of beans, and farms that were self-sufficient in beans. The questions focused on farmers' bean production technologies.

Farmer IV. A revised and streamlined version of the interview schedule used in the Farmer II survey was taken to the entire 1080 farm SESA sample by the ten prefectural supervisors.

Merchant I. One of the author's Rwandan counterparts visited approximately 40 merchants in five prefectures for a single interview.

Questions covered storage size, marketing margins, rotation period, suppliers, and clientele.

Merchant II. Merchant II followed a strategy similar to Merchant I. Questions covered seasonality of activities, imports, and strategies for sales and acquisition of stocks.

Baseline I. The interview schedule was fielded on SESA's entire sample by SESA enumerators, and was designed to produce an inventory of persons living on the farm, and large and medium size livestock on the farm. This survey was a streamlined version of a similar survey conducted by SESA in 1984.

Baseline II. Enumerators measured farm land holdings for each household in SESA's sample on a field by field basis using methods previously developed by SESA¹⁸.

The surveys described above were part of the joint SESA/MSU effort. SESA also collected its normal crop production data on the entire sample. Farmers were asked to measure production with plastic buckets issued to them by SESA. SESA enumerators visited each household twice per week in order to record production.

Annex I contains interview schedules for the surveys described in Table 1.2. For information on the method used by SESA to record production, see "Resultats de L'Enquete Nationale Agricole 1984"¹⁹. For information on the procedure used to draw SESA's nationally representative random sample, see Annex IV.

¹⁸See MINAGRI, May 1985.

¹⁹ MINAGRI, Sept. 1985.

Succeeding chapters of this document are laid out as follows.

Chapter II gives a basic introduction to selected aspects of bean and sorghum marketing and production in Rwanda, from the perspective of farmers, merchants, and public policy. Chapter III focuses on bean and sorghum prices, insights price behavior provides for public policy, and how price data are collected in Rwanda. Chapter IV deals with chronic food insecurity issues: trends in consumption and production, identification of types of farms which may be chronically food deficient, and farm as well as national strategies (current and potential) for coping with chronic food insecurity. Chapter V addresses transient food security issues. Included in Chapter V are discussions of the frequency of severe disruptions of the food supply, potential techniques for development of an "early warning system" to forecast production shortfalls, as well as public policy alternatives in establishing disaster relief mechanisms. Chapter VI is a summary chapter, and Chapter VII outlines potential uses of survey data in future policy research.

CHAPTER II

INTRODUCTION TO THE BEAN AND SORGHUM SUBSECTORS

This chapter presents basic production and marketing characteristics of the bean and sorghum subsectors in Rwanda. The focus is on national characteristics at the farm, merchant, and public policy levels. Data presented in this chapter demonstrate that Rwanda is a net importer of beans and sorghum. Material in this chapter also describes the functions performed by the public and the private sectors in marketing beans and sorghum. An evaluation of market efficiency is followed by the chapter summary.

2.1 Scope

A subsector study¹ examines vertical and horizontal relationships in the production, marketing, distribution, and consumption of a commodity or group of related commodities. The advantage of focusing on many aspects of one or two commodities is that it provides a framework for tailoring data collection activities while maintaining a system wide perspective. This allows the analyst to develop an impression of how the system is functioning as a whole so that more realistic policy prescriptions can be made.

It has already been shown (Table 1.1) that beans are an important commodity by virtue of the fact that they are Rwanda's largest source of proteins and a large source of calories. Sorghum plays an important role in Rwandan society as a drought resistant crop, and as a social

¹For a more complete discussion of subsector studies, see Shaffer.

lubricant in the form of sorghum beer. Local brewing is one of the rural Rwandan's few sources of labor intensive, non-cropping income, as value is added in processing.

2.2 Objectives of the Subsector Study in Rwanda

The objectives of the subsector study on beans and sorghum in Rwanda are to develop a picture of how these commodities are produced and marketed. An understanding of who is producing and selling, and who is consuming these products allows formulation of policies tailored to the Rwandan environment.

In designing the research on these two commodities, it became clear that the country lacked baseline data for policy formulation.

Information on prices, marketed surplus, imports, directionality of product flows within the country, and merchant behavior was often based on informal observations and assumptions. Thus an initial objective of the research was to design and implement data collection activities to develop a picture of the important processes in the bean and sorghum production-marketing-consumption chain.

A second objective was to use the information collected to inform Rwandan policy makers about various types of participants and problems in the marketing and production system. A third objective was to begin to identify the effects policy (both current and future) could have on different groups, to allow a more targeted approach to policy.

2.3 Production and Transactions by Farmers

A. Sorghum

Table 2.1 gives national sorghum statistics produced by extrapolating results of weekly enumerator visits to 1076 households in 78 sectors over the 1986 agricultural year.

Table 2.1
Basic Figures on Sorghum in Rwanda
(1986 Agricultural Year)

Activity	1986 Total (Metric Tons)	Standard Error
National Rural Production	158,901	9.8%
National Rural Purchases		
Dry Grain:	65,834	14.9%
Germinated Grain:	4,113	27.4%
Flour:	1,552	29.3%
Total Purchases:	71,499	
National Rural Sales		
Dry Grain:	33,084	13.9%
Germinated Grain:	655	54.7%
Flour:	0	n/a
Total Sales:	33,739	
National Rural Gifts Given		
Dry Grain	2,835	15.5%
Germinated Grain	189	48.3%
Flour	111	73.3%
Total Gifts Given:	3,135	
National Rural Gifts Received		
Dry Grain	3,417	12.7%
Germinated Grain	113	28.6%
Flour	289	32.3%
Total Gifts Received:	3,839	

Note: Conversion factors from dry grain to germinated grain and sorghum flour (technically ground sorghum) are assumed to be 1 to 1.

Comparison of these figures to each other in the form of ratios and differences provides good insights into the sorghum subsector. The percentage of sorghum marketed (sales divided by production) stands at 21.2%. This figure does not reflect sales of sorghum beer. Marketing of home brewed sorghum beer is an activity which 18% of the rural farm population undertakes. Sorghum is also an important ingredient in banana wine. Haggblade reports that each eighty liter batch of banana wine requires 9.1 kg of sorghum, and that the average rural Rwandan household produces 347 liters of banana wine while consuming only 184 liters of banana wine. (In contrast, the same report shows average rural household sorghum beer consumption, at 175 liters, only slightly below average rural household sorghum beer production, at 197 liters.) Banana wine is therefore an important outlet for sorghum. The percentage of the population selling banana wine and the quantities of own-production sorghum going into marketed banana wine are unknown. If marketings of sorghum in the form of beer and wine could be accounted for, the percentage of sorghum marketed by farmers would probably be higher than 20%.

Rural sorghum utilization (Production minus gifts given minus sales plus purchases plus gifts received) is 197,365 metric tons, or about 34 kilos per capita annually.

The most striking number that comes out of Table 2.1 is calculated with the following net informal import identity:

$$P - S - GG + GR - NSR = NII . \quad (2.1)$$

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

Prior to this research, it was commonly believed that Rwanda was self-sufficient in sorghum. These new estimates show rural Rwandan households purchasing and receiving as gifts 38,464 more metric tons of sorghum than they are selling and giving as gifts. This means that 19.5% of rural sorghum utilization in 1986 came from sorghum imports². Since 1986 was a normal to good crop year, sorghum imports must fall at or above the 19% level in most years. Assuming urban areas import more sorghum per capita than rural areas, national sorghum imports are probably even higher than 19% of national utilization in most years.

That Rwanda is somewhat at the mercy of conditions in nearby nations is highlighted by the finding that over 50% of the sorghum in rural markets in 1986 was imported. Prices and food availability in the border nations which supply Rwanda's sorghum will have a large effect on prices in Rwanda.

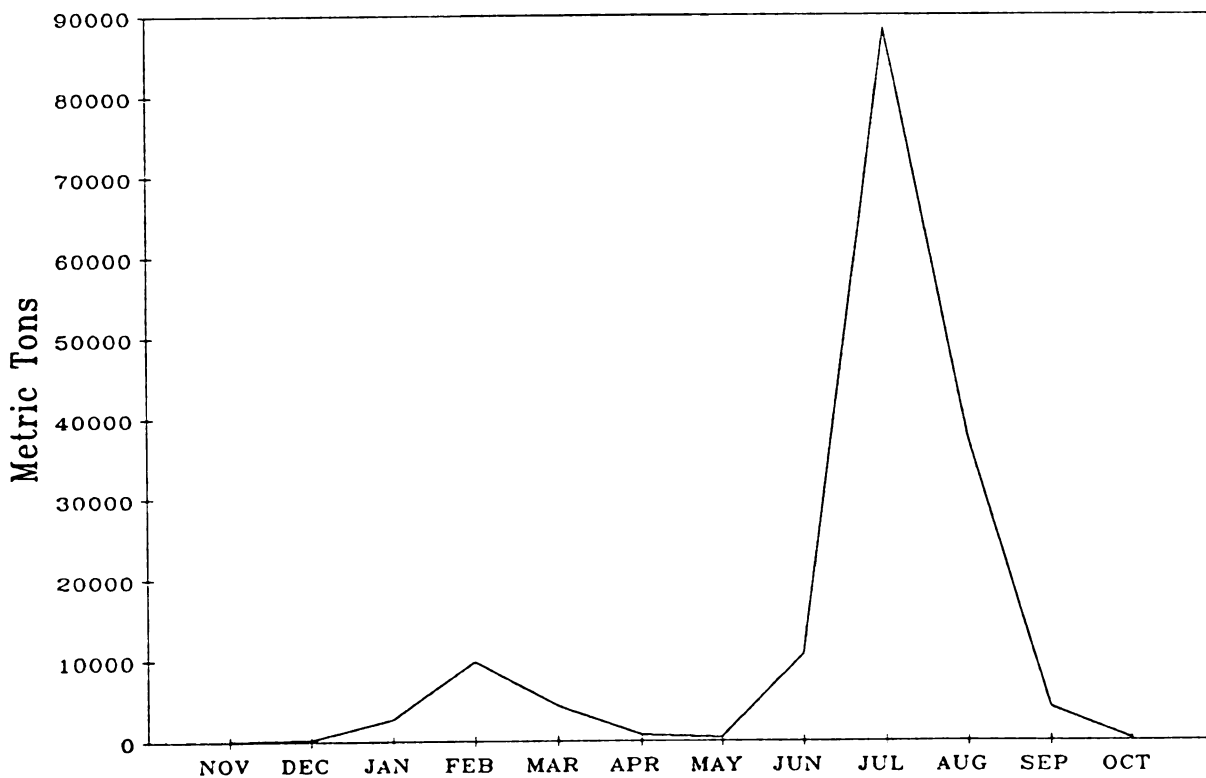
Figure 2.1 shows monthly sorghum production for the 1986 agricultural year. Production is highly concentrated in the second

²This assumes no net changes in stock positions. Retrospective questions in the SESA/MSU Farmer IV survey support this assumption.

agricultural season, with approximately 11% of production in the first (November-April) season, and about 89% of production in the second season. Small amounts of sorghum are produced every month of the year with the exception of November.

Figure 2.1

Monthly Sorghum Production in Rwanda, 1986 Agricultural Year



The seasonality of sorghum production is highly variable along geographic lines. For example, Byumba accounted for over a third of the small February peak in production, but less than twenty percent of the year's total crop. Ruhengeri harvested more sorghum in February than it did in any other month. Six of the ten Prefectures harvested

sorghum during seven or more months of the year, but less than 11% of rural households harvested sorghum during more than three months in 1986³. The variation in seasonality between and within prefectures can be seen both in a positive and a negative light in terms of the nation's food security. With respect to transient food security, the geographic variation in the timing of the harvest is undoubtedly a great advantage, as the harvest is unlikely to fail universally. Rwanda's various agro-ecological zones can therefore be seen as miniature buffer stocks. The highly varied micro-climates in neighboring countries probably serves a similar function, which is important given Rwanda's reliance on foreign supplies to augment local production.

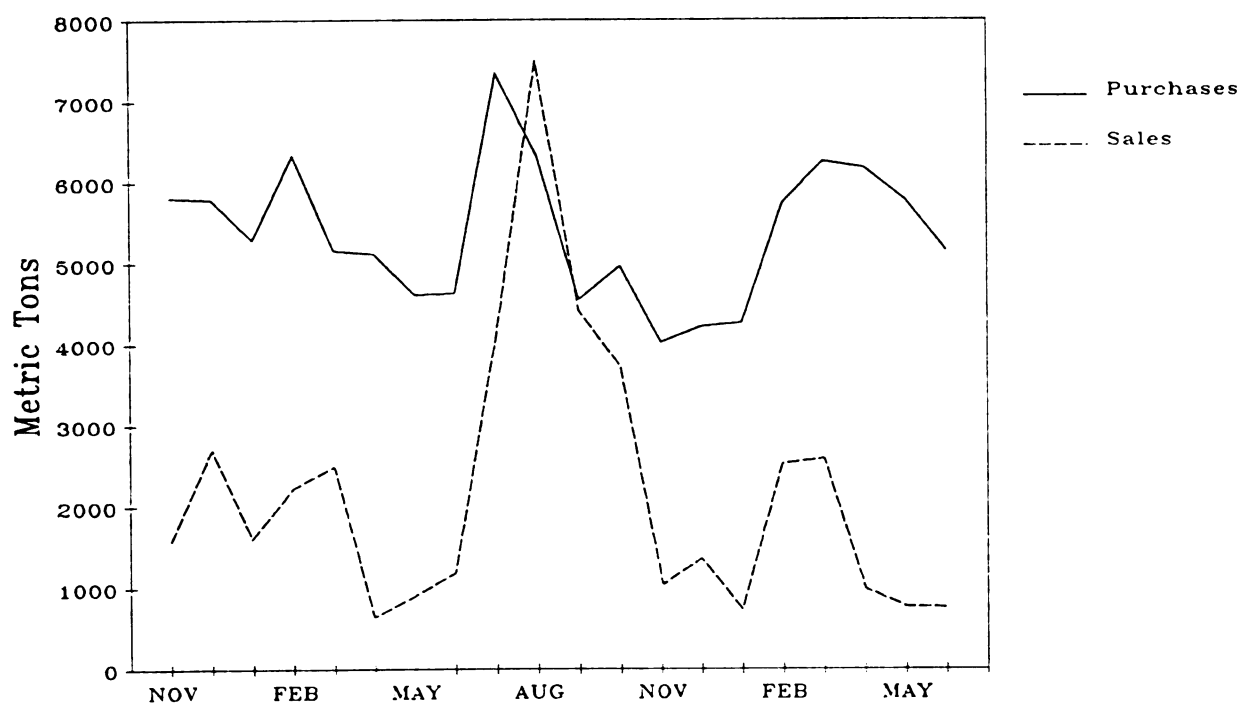
On the other hand, for chronic food security, the immense diversity of rainfall, elevation, and soil types renders the job of developing improved sorghum production techniques extremely difficult.

Figure 2.2 shows the levels of farmer purchases and sales on a monthly basis during 1986. In every month except September, national rural purchases exceed national rural sales. Both purchases and sales trend downward from November through May, increase dramatically with the June - July harvest, and then begin to drop off again. Of particular interest is that sorghum purchases peak before sorghum sales. Why would farmer sorghum purchases increase at harvest time?

³Source: Original national surveys by SESA and MSU. See Annex II for a detailed breakdown of sorghum production by month and by Prefecture, and also a breakdown of the number of months individual families harvested sorghum by Prefecture.

Figure 2.2

National Monthly Rural Sorghum Purchases and Sales in Rwanda November 1985 - June 1987



Perhaps the best explanations are social rather than economic. A major traditional Rwandan holiday is *Umuganura*. *Umuganura* falls on the first of August, and celebrates the harvest of the second season crop. The major event of *Umuganura* is the giving of sorghum beer, banana wine and food to the family elders as a sign that the harvest has been sufficient. This assures the elders that the family will have enough

food to care for them in the upcoming months. Rwandans practice this custom even if sorghum supplies are not sufficient out of respect for the elders. Since sorghum beer and banana wine⁴ brewing is a several day process, most family sorghum purchases for *Umuganura* necessarily fall in July.

A second social phenomenon which may contribute to peak sorghum purchases in July is marriages. Sorghum beer and banana wine toasts are important aspects of the celebration of marriage in Rwanda. Several factors converge to make July a preferred month for marriages in Rwanda. The harvest is coming in so food is plentiful, and farmers have money. School is not in session in July, so children and school employees have more time to make the trip and participate in the ceremonies. July is also the dry season, which means the likelihood of rain is slight--an important consideration because the majority of the marriage festivities take place outdoors. Secondary roads and paths are more passable in the dry season as well, making it easier for guests to attend the ceremonies.

A third explanation has to do with prices. Analysis in Chapter III, Section 3 shows that prices are lowest at harvest--the average national rural weighted farm level purchase price was exactly the same in July and August of 1986, so farmers may have purchased simply because prices were low. Prices may have been low due to expectations of the Rwandan harvest, which caused merchants to want to liquidate old stocks. Alternatively, the harvest may have come a little bit earlier in neighboring countries than it did in Rwanda.

⁴Sorghum is an ingredient in banana wine.

A fourth explanation may be related to the essentially unimodal nature of sorghum production (see Figure 2.1 above). Unimodal production may influence farmers with an inadequate sorghum harvest to stockpile for use later in the year. This may be especially true of farms which need large quantities of sorghum for beer making purposes.

Farmer sales are very concentrated around the harvest period; almost half of the volume sold by farmers is marketed in July, August and September. (See Annex II for a breakdown of purchases and sales by month and prefecture.) Comparison of monthly production and sales at the prefecture level (see Annex II) shows clear tendencies for off-season sales to coincide with off-season harvests. Annex II shows results of a test of probable time elapsed between farmer harvests and farmer sales of grain. The percentage of sales transactions coming within one to four months of harvest was estimated by comparing transactions data with production data. The data do not allow determination of the specific month during which the sold grain was harvested, but a clear tendency is revealed: most sales were within two months of a harvest. It is probable that few farmers store more than two months before selling.

There may be several reasons which cause farmers to sell most of their surplus almost immediately. Most obvious is the cash flow problem--farmers need cash to purchase other goods and services. On-farm storage losses due to pests and spoilage appear to be minimal in Rwanda; a recent survey found that farmers were losing less than 3% of their sorghum stocks during storage⁵. Storage risks due to theft do

⁵Dunkel et al.

appear to be a problem in Rwanda. Researchers working on traditional storage methods have indicated (personal communication) that the traditional outdoor storage silos have been abandoned in all but the most isolated areas of Rwanda because of problems with theft. Thus theft may discourage farmer storage, resulting in higher sales in the period immediately following the harvest.

The geography of sorghum production, marketing, and disappearance is illustrated in Figures 2.3 through 2.5. Figure 2.3 shows rural per capita sorghum production by prefecture in 1986. Kigali had the highest per capita production, followed by Byumba. The Northwestern and Southwestern prefectures produced relatively little sorghum on a per capita basis. The East-West dichotomy is repeated in Figure 2.4, which presents the percentage of rural sorghum availability⁶ obtained through transfers by prefecture: the East produces a much larger proportion of local disappearance than do the western prefectures. Transfers help some low production prefectures bring their utilization of sorghum up to levels which equal or surpass areas of relatively higher sorghum production, as shown in Figure 2.5. Gikongoro has the highest sorghum utilization per capita yet is in the lowest sorghum production category. This is probably explained by the lack of bananas in Gikongoro, which may cause substitution from banana wine to sorghum beer in that prefecture. Brewers may prefer importing sorghum to importing bananas because of the perishability of bananas.

⁶Availability is defined as production plus purchases plus gifts received minus sales minus gifts given. Availability therefore includes storage losses and production destined for seed. Results of retrospective questions indicate that farmer stocks did not change in 1986, so stock changes are assumed to be zero.

Figure 2.3

Per Capita Rural Sorghum Production
by Prefecture
1986 Agricultural Year

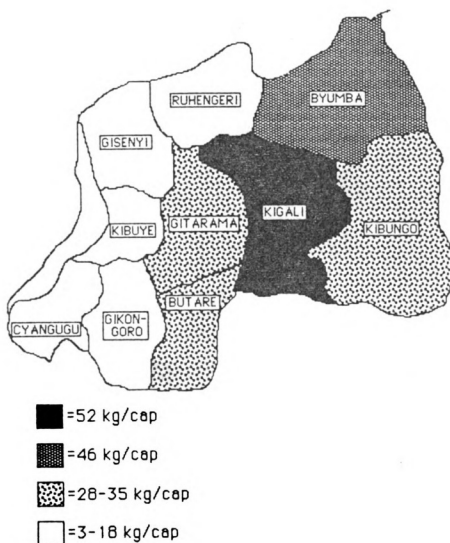


Figure 2.4

PERCENTAGE OF RURAL SORGHUM AVAILABILITY THAT IS
TRANSFERRED INTO THE PREFECTURE
(GIFTS INCLUDED)
1986 AGRICULTURAL YEAR

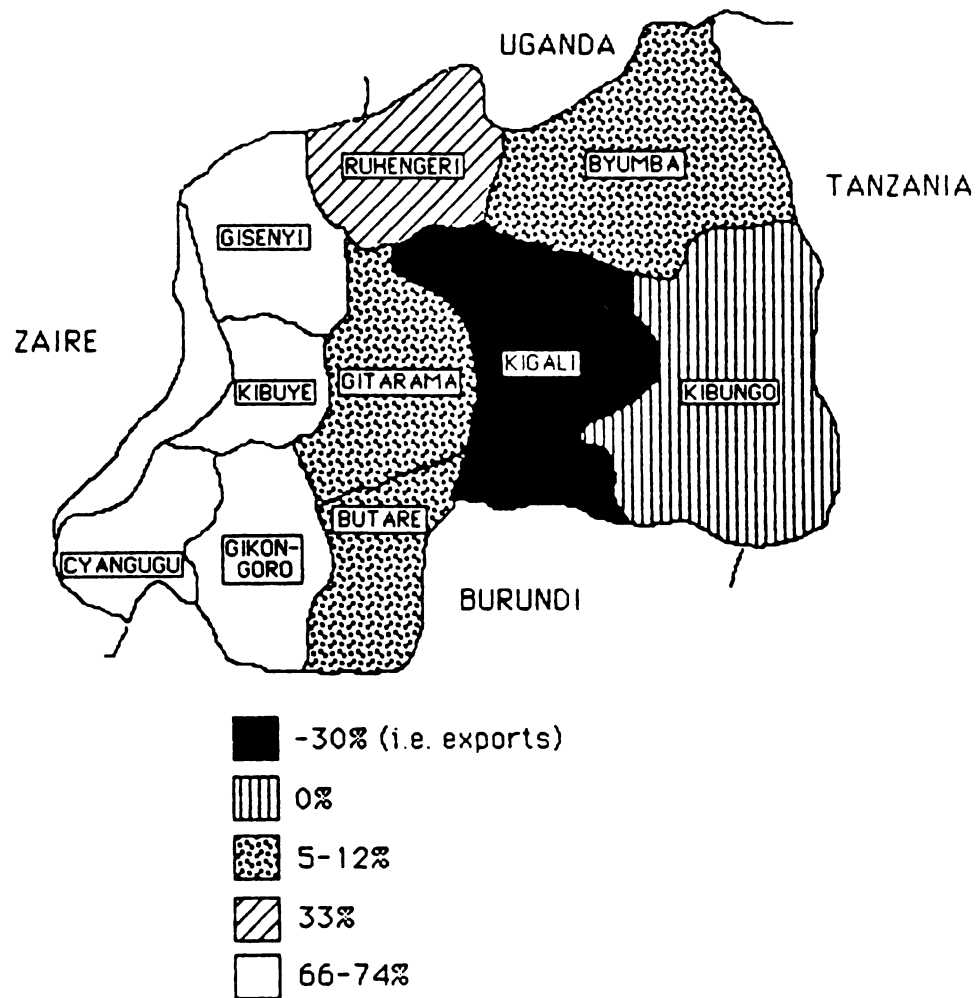
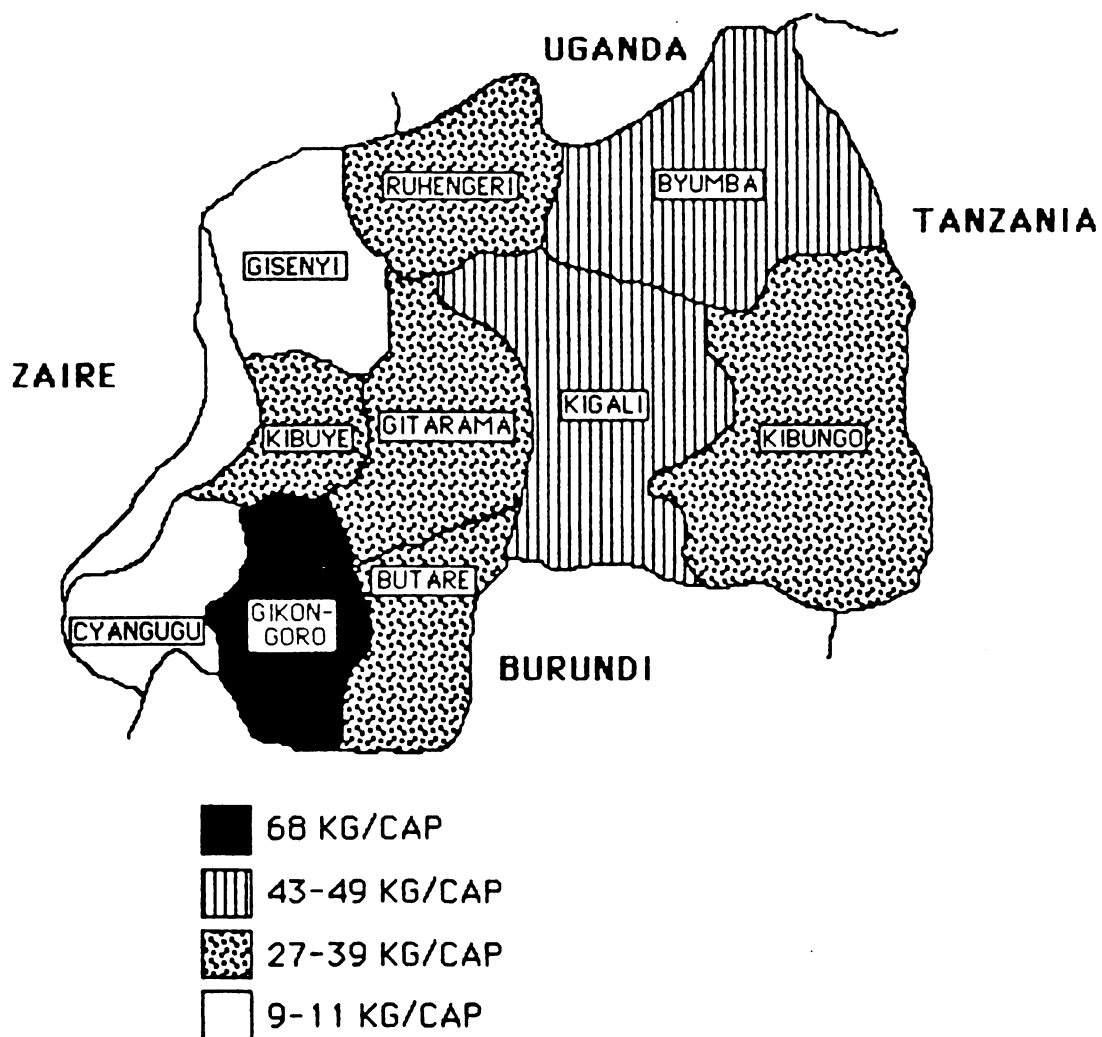


Figure 2.5

**PER CAPITA SORGHUM AVAILABILITY
IN RURAL RWANDA
1986 AGRICULTURAL YEAR
(GIFTS INCLUDED)**



B. Beans

This section follows the format established above for sorghum. To avoid needless repetition of some arguments that are equally valid for beans and sorghum, the reader will occasionally be referred to the preceding section. Table 2.2 lists basic dry bean production and transactions figures for the 1986 agricultural year in rural Rwanda.

Table 2.2

Basic Figures On Dry Beans In Rural Rwanda
(1986 Agricultural Year)

Activity	1986 Total (Metric Tons)	Standard Error
National Production	224,516	6.5%
National Sales	23,023	18.6%
National Gifts Given	9,069	14.2%
National Purchases	60,492	7.7%
National Gifts Received	7,764	11.5%

Data in Table 2.2 allows the calculation of several differences and ratios which shed light on the bean subsector in Rwanda. The percentage of harvest that farmers market is calculated by dividing rural sales by rural production (23,023/224,516) and is equal to only 10.2% of the crop, which is significantly lower than previously believed. For example, OPROVIA reported that in 1981, 32% of the beans harvested in Rwanda were marketed⁷. 1981 was a normal agricultural year. OPROVIA's overestimation of the percentage of beans marketed is probably a result of reliance on official estimates of marketings--

⁷Maniraho and Jomni.

these official estimates are based on benchmarks which have not been updated for many years.

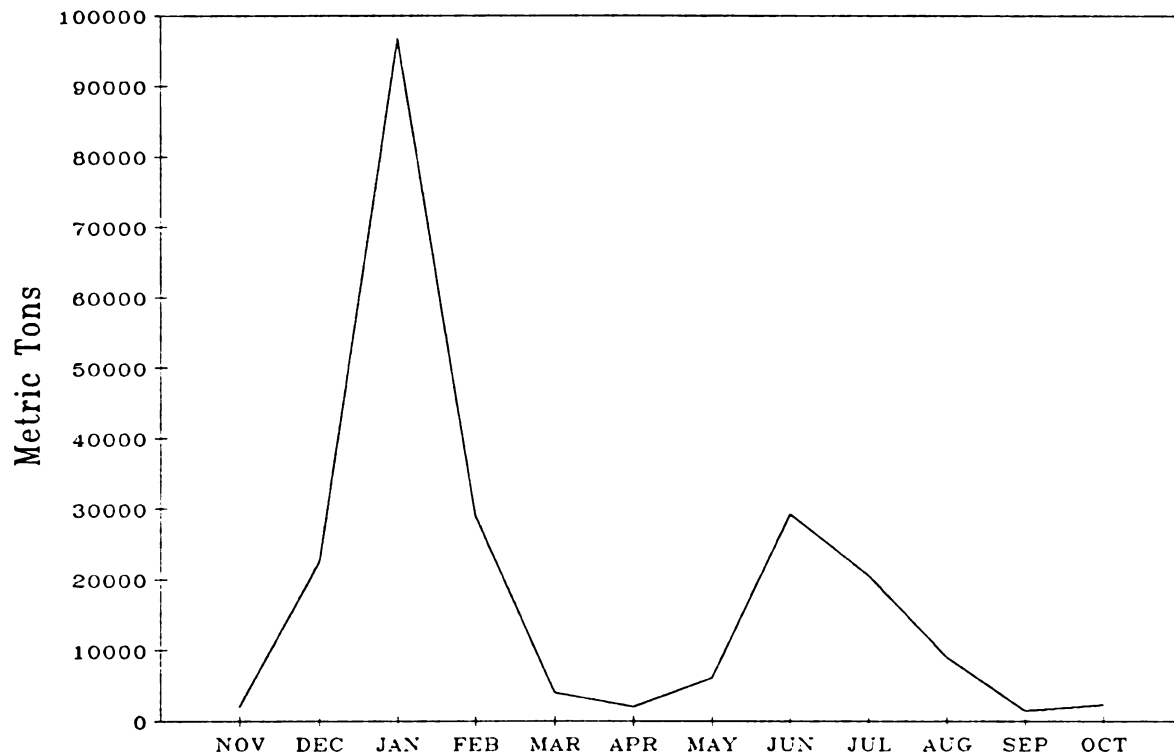
Rural utilization of dry beans (Production minus gifts given minus sales plus purchases plus gifts received) stands at 260,680 metric tons. This means that on average rural Rwandans had available for consumption and planting approximately 45 kilos of dry beans per capita in 1986.

Rural Rwandans are net importers of dry beans. Rural net imports of beans (Rural sales plus gifts given minus rural purchases minus gifts received) was 36,164 tons in 1986. Rural imports divided by rural utilization gives the percentage of rural utilization which is imported: 14%. This finding also runs contrary to previous conceptions about Rwandan agriculture, which had Rwanda self-sufficient in beans. A full 60% of what rural Rwandans purchase in their markets comes from neighboring countries (Rural imports/Rural purchases).

Figure 2.6 reports monthly dry bean production for the 1986 agricultural year. On an aggregate basis, beans are harvested every month of the year, with two peak harvest seasons: December-February and June-August. The first harvest is significantly larger than the second, but production of beans is much more evenly distributed between the two peak seasons with beans than it is for sorghum. In 1986, over 59% of the rural households harvested dry beans three or more months of the year. This figure is quite large when compared to the less than 11% of households that reported three or more months of harvest for sorghum.

Figure 2.6

Monthly Dry Bean Production in Rwanda, 1986 Agricultural Year



The fact that bean production is more evenly distributed temporally than sorghum production has implications for food security. Farmers can rely on at least partial replenishment of their bean stocks through their own production during many months of the year. This may eliminate the need for farmers to carry bean stocks for more than a few months. An analysis presented in Annex II indicates that of the few families selling, most do the bulk of their marketing within two months of a bean harvest.

The timing of bean production appears to be much more uniform throughout the country than the timing of sorghum production. All ten Prefectures experience their peak production during the December-February harvest period. All ten Prefectures harvest some dry beans at least ten months per year. (See Annex II for monthly dry bean production figures by Prefecture). Joint research by OPROVIA and ISAR⁸ found that over 280 varieties of beans are grown in Rwanda. The same research showed that many of these varieties are specific to particular crop mixtures, soil types, and soil humidities. Evidently farmers are doing a good deal of complex plant selection and experimentation. Rwandan farmers may be using these varieties to prolong the harvest period or add additional harvests during the year. The task of developing better varieties that can still provide some of these intra-annual advantages and which are well adapted to Rwanda's many micro-climates seems daunting. Perhaps the best strategy is to concentrate on improving one or two frequently planted varieties, and continue to rely on traditional varieties for the smaller ecological niches.

Bean researchers from the International Center for Tropical Agriculture working in Burundi, Rwanda, and the Kivu Province of Zaire believe the seasonality of bean production in Burundi and in the Kivu Province of Zaire is opposite from Rwandan bean production seasonality⁹. More beans are harvested in these neighboring countries during the June-August season than during the December-February season. This reversal of seasonality may play an important role in

⁸Clarke, February 13, 1987.

⁹Personal communication.

contributing to the short term food security of all three countries as product flows back and forth from one country to another. Rwanda may export small quantities of beans at certain times even though it is a net bean importer in most months. The ability to rely on adjoining countries for bean supplies in the short season probably reduces the need for storage facilities in all three countries.

Since seasonality of bean production within Rwanda is relatively invariant with regard to geography, trade between different areas of Rwanda is not likely to dampen seasonal price peaks. Here beans are different from sorghum.

Figure 2.7 shows national quantities of beans purchased and sold in the rural areas in 1986. In every month except January and February, purchases exceed sales. January and February are peak harvest months, and farmer sales increase concurrent with decreased purchases. This is a clear demonstration that both dry bean market supply and demand are a function of production.

Figure 2.8 shows rural per capita dry bean production by prefecture in the 1986 agricultural year, with Kigali prefecture the highest in the country at 58 kg per person. The eastern and southeastern prefectures have the next highest per capita dry bean production levels. The western prefectures produce considerably less per capita than other areas of the country. Per capita production levels in turn influence the level of dry beans imported per capita, as shown in Figure 2.9. The western prefectures tend to import a much larger percentage of their beans than do other areas of the country. These differential levels of imports even out dry bean availability

between different parts of the country to a certain extent.

Nonetheless, Figure 2.10 shows differences in dry bean availability persist even after net imports are taken into account. Rural per capita dry bean availability in Cyangugu, Gikongoro, and Kibuye is roughly half that of Kigali and Byumba.

Figure 2.7

National Monthly Rural Dry Bean
Purchases and Sales in Rwanda
November 1985 - December 1986

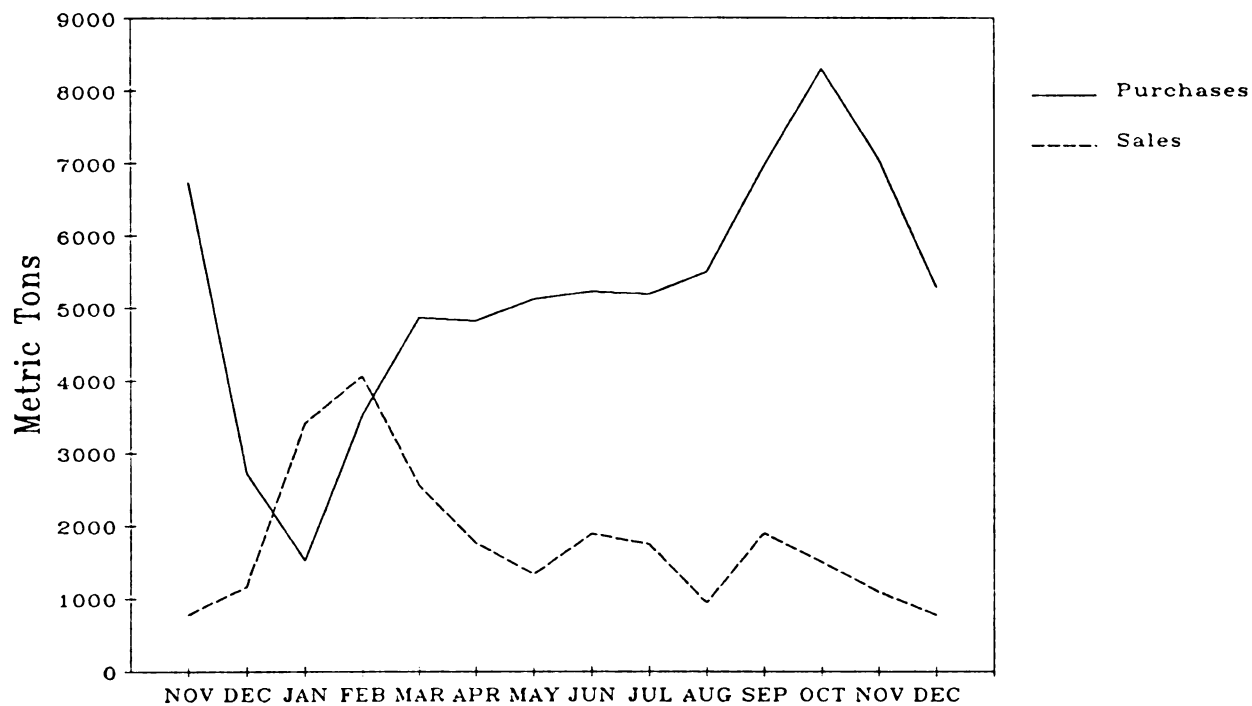


Figure 2.8

**Per Capita Rural Dry Bean Production
1986 Agricultural Year**

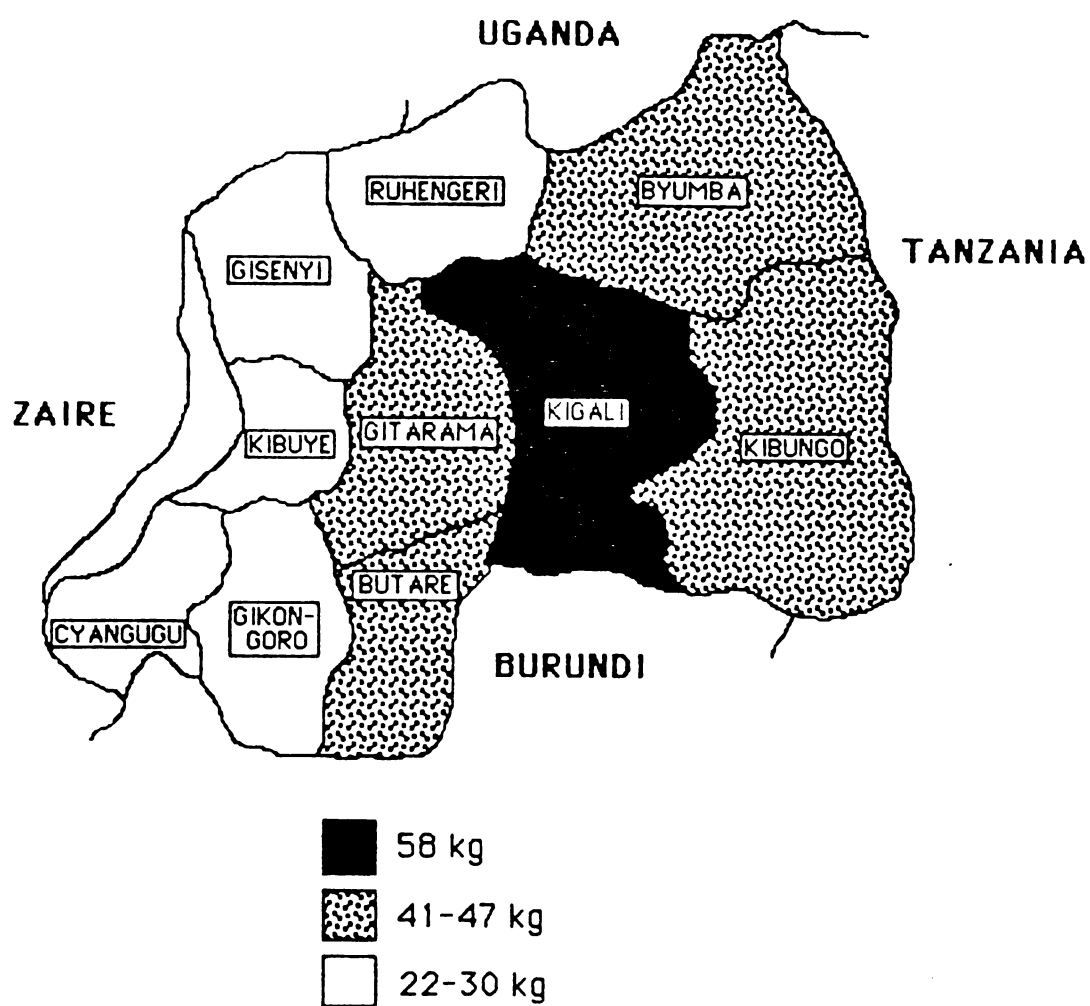


Figure 2.9

**Percentage of Dry Bean Availability
Coming From Imports, by Prefecture
Rwanda,
1986 Agricultural Year**

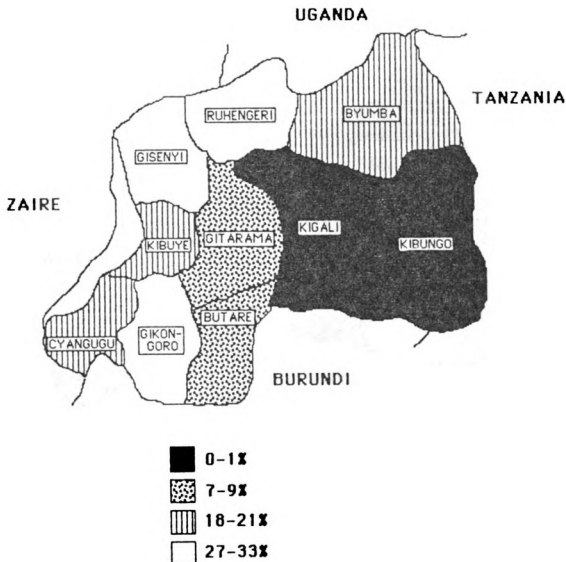
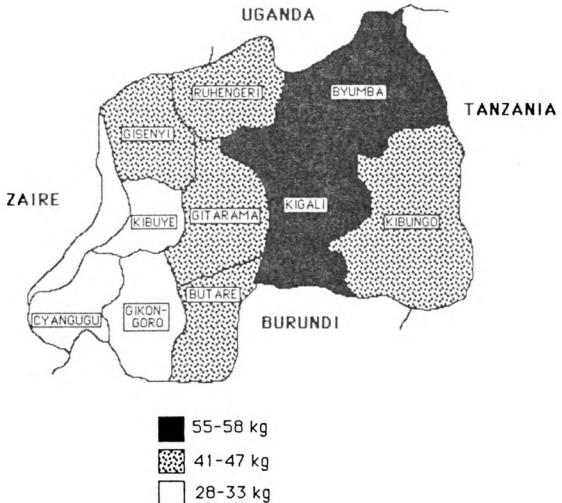


Figure 2.10

**Per Capita Dry Bean Availability
in Rural Rwanda
1986 Agricultural Year
(Gifts Included)**



Note: availability is calculated by the following identity. Production minus sales plus purchases minus gifts given plus gifts received.

2.4 Constraints on Production

In order to round out the above discussion on Rwandan production and farmer marketings of beans and sorghum, it is necessary to investigate briefly what factors keep Rwandan farmers from producing and marketing more beans and sorghum.

Pre-testing of retrospective questions on specific farmer constraints on bean and sorghum production revealed that farmers generally had difficulty differentiating between constraints on production of one crop versus another crop. Many farmers did not perceive constraints as being crop specific (i.e. land for beans but labor for sorghum). Therefore a general question on production constraints was asked as part of the SESA/MSU Farmer IV (single visit 1080 household) survey. Farmers were simply asked what the most important constraint is that keeps them from expanding production. Responses to this question are presented in Table 2.3.

Table 2.3
Farmers Responses to a Retrospective Question on Their
Biggest Production Constraint by Prefecture

Biggest Production Constraint	But	Byb	Cya	Gik	Gis	Git	Kbo	Kby	Kig	Ruh	Rwanda
Fertilizer/soil Fert.	25%	35%	23%	66%	17%	24%	13%	37%	39%	27%	30%
Surface Area	17%	18%	58%	14%	60%	29%	15%	28%	21%	35%	29%
Labor	23%	8%	10%	5%	3%	23%	54%	5%	16%	8%	16%
Not Enough Rain	29%	19%	7%	4%	17%	15%	12%	25%	19%	12%	16%
Too Much Rain	2%	17%		6%	4%	2%	1%	5%	2%	11%	5%
Seed	1%	1%				1%	2%		1%		1%
Low Crop Prices		1%					1%		1%	2%	1%
Lack Of Pesticides									1%		0%
Other	2%	1%	1%	5%		5%	1%		1%	5%	2%
No Response			1%								0%

To test the quality of the farmer responses to this question, the farm size of households listing surface area as their major constraint was compared to farm size of other households. On average, farmers listing surface area as a major constraint had farms half the size of respondents listing some other major constraint.

Table 2.3 shows large regional differences in farmer production constraints in Rwanda. In more densely populated areas such as Gisenyi and Cyangugu, the land constraint was most frequently mentioned. In Kibungo, a relatively sparsely populated area, lack of labor was listed most often as the biggest constraint. This serves to highlight that there is no single reason for Rwanda's food security problems. Policies must be flexible enough to meet the needs of the very heterogeneous mix of conditions found in Rwandan agriculture. For example, research on drought resistant crops might be focused on those areas which appear to have the most problems with low rainfall. Areas where lack of land is the major problem might be targeted for experiments with high value labor intensive crops such as vegetables or climbing beans. Methods to build soil fertility or new sources of off-farm employment might be tried in regions with low soil fertility.

The problem of constraints is treated again in more detail in Chapter IV, where results of the retrospective question presented above in Table 2.3 are crossed with net farm position in beans and sorghum.

2.5 Role of OPROVIA: Intended, Recent

Chapter I, section 5 introduced OPROVIA's role in price policy. OPROVIA (National Office for the Development and Marketing of Food and

Animal Products) is a government of Rwanda parastatal charged with a wide range of food marketing activities. The discussion here will treat only those components of OPROVIA activities which relate to the bean and sorghum subsectors. A subcomponent of OPROVIA, GREMARWA (National Granaries of Rwanda) was begun in 1975 under USAID financing as an independent unit. Later GREMARWA became a part of OPROVIA.

In the late seventies, GREMARWA was a centerpiece in USAID's priority program of helping Rwanda improve food storage and marketing. The first phase of USAID's food storage and marketing project (1975-1981) focused on the creation of GREMARWA, which was intended to be a national storage and marketing organization. As part of this project an administrative and research unit was set up in Kigali, and eight silos with a capacity of 10,000 metric tons were constructed in various locations in the country. The purpose of the silos was to "...increase the availability of food for Rwanda's population..." by attempting to "...stabilize regional and seasonal supplies and prices of the country's staple: haricot beans."¹⁰ GREMARWA was to accomplish this goal by purchasing beans from farmers at above market prices, storing, transporting beans to deficit areas, and selling them at below market prices.

By 1981, the original price and supply stabilization objective had been broadened into the management of food aid and inter-annual food security stocks in addition to the previously described intra- and inter-seasonal market interventions. A cable from USAID/Kigali to the

¹⁰"The Future Role of GREMARWA?", USAID/Kigali document, Dec. 4, 1981.

Secretary of State in Washington dated October 27, 1981 summarized GRENDARWA's new objectives for 1982-1986:

"1) Enable GRENDARWA to be a catalyst in stimulating and assisting the marketplace by strengthening its ability to conduct market and marketing studies (role of private sector, consumer acceptability of stored beans, etc.) and improving its market data collection, analysis, and dissemination services.

2) Strengthen GRENDARWA's capacity to assist local storage and marketing units. The majority of local storage facilities are small silo operations of non-speculative organizations (cooperatives, missions, etc.)...GRENDARWA efforts to collaborate with them should be increased in order to pass a higher percentage of benefits directly to producers and consumers.

3) Assist the Government to determine the feasibility of long-term storage of beans in Rwanda, a crucial problem in increasing food availability and maintaining a long-term food security stock.

4) Strengthen GRENDARWA's ability to maintain a food security stock."

The cable went on to state:

"The project's first purpose is to strengthen GRENDARWA's organizational capacity to be a catalyst in stimulating the marketplace to respond to regional and seasonal imbalances in foodcrop supplies and prices. Presently GRENDARWA...purchases beans and sorghum during the harvest period, stores them...and then transports and sells them as the demand increases into the hungry season in those deficit areas which have the greatest need, as evidenced by rising prices. GRENDARWA affects prices in the market by increasing competition through changing the available supplies of beans and sorghum.

The effectiveness of Grenarwa's storage and marketing activities on price stabilization is difficult to objectively measure. However, it is generally believed that it will be difficult for GRENDARWA to achieve the price stabilization role envisaged for it...by direct intervention in the marketplace... A preferred solution is a food storage and marketing system which allows a variety of agents to be encouraged. The private sector, including cooperatives, can take on many activities in this area with the role of the state being limited. Such an approach could improve market functioning...through the provision of better information on crop sizes and prices, via radio and other means.

In the Rwanda case, this approach approximates the status quo. This project proposes that the future emphasis of

GRENARWA be oriented toward a supportive and facilitative role in the marketplace, de-emphasizing direct market intervention to stabilize prices...

The above is not to say that GRENARWA will abandon all marketing activities. In fact, further development of GRENARWA's marketing department is essential, both to allow it to fulfill the catalytic role now envisioned (e.g., conduct market studies, including one of the role of the private sector; improve the market data collection, analysis and dissemination service), and allow for rotation of stocks held under the food reserve system...

Purchases for the food reserve will, as much as possible, be from cooperative and non-speculative organizations in order to advance their development as an alternative agent in the marketplace. Other purchasing sources, e.g., private traders and farmers, will be continued. GRENARWA will sell to major institutional buyers as well as retain the option to sell in major deficit production regions of the country, although this latter choice depends on the ability of the people to purchase and on the ability of the private sector to respond."

To summarize, GRENARWA was seen as an institution that would complement private bean and sorghum traders. Emphasis in GRENARWA activities was placed on information collection, analysis, and dissemination, and on the establishment of a strategic food reserve. Market interventions in normal years were to be limited to the rotation of the strategic food reserve and the stimulation of the private sector. Institutions were seen as important buyers for GRENARWA's food reserve rotation operations.

Tables 2.4 through 2.8 show how OPROVIA/GRENARWA has operationalized its mandate. Until 1986, purchases from cooperatives and producers accounted for a small percentage of total bean and sorghum purchases in most years. OPROVIA's major suppliers of beans and sorghum in most years were private merchants. MINIFINECO and the World Food Program accounted for most of OPROVIA bean and sorghum flour sales in most years. OPROVIA retail outlets sold the bulk of the sorghum grain in most years.

Table 2.4
Suppliers of Beans Purchased by OPROVIA¹¹
(% of Annual Total)

Year	Total (tons)	Producers	Cooperatives	Merchants
1979	3327	3	0	97
1980	4901	0	0	100
1981	4876	2	12	86
1982	4029	1	8	91
1983	4825	1	3	96
1984	5405	5	1	94
1985	3885	12	0	88
1986	3290	50	40	10

Table 2.5
Purchasers of Beans Sold by OPROVIA¹²
(% of Annual Total)

Total Year (tons)	MINI- FINECO	Schools, Churches, Coops & Communes	World Food Program	Mer- chants	Retail	Cath. Relief Serv.	Other
1979 4040	48	8	8	25	11	0	0
1980 3169	19	6	58	8	8	0	1
1981 5039	44	0	52	0	2	2	0
1982 5673	28	2	30	1	13	21	5
1983 4587	52	3	31	0	11	0	3
1984 5386	55	6	23	2	10	0	4
1985 3135	47	0	52	0	1	0	0
1986 4053	89	0	11	0	0	0	0

Notes:

- 1) "Other" includes purchases by parastatals and private companies.
- 2) Figures for 1986 are estimates.

¹¹Source: "The Feasibility of Implementing Quality Standards within OPROVIA's Operations", by Sharon Bylenga, Steven A. Clarke, and Joel Kayumba. OPROVIA/Univ. Minnesota document, February, 1987.

¹²Source: Op. Cit.

Table 2.6
Suppliers of Sorghum Purchased by OPROVIA¹³
(% of Annual Total)

Year	Total (tons)	Producers	Cooperatives	Merchants
1979	1623	3	0	97
1980	1838	0	18	82
1981	2339	0	6	94
1982	602	0	12	88
1983	2609	5	12	83
1984	2954	5	7	88
1985	3302	24	11	65
1986	4167	38	31	31

Table 2.7
Purchasers of Sorghum Flour Sold by OPROVIA¹⁴
(% of Annual Total)

Year	Total (tons)	MINIFINECO	World Food Program	Merchants	Retail
1980	227	100	0	0	0
1981	N/A	N/A	N/A	N/A	N/A
1982	501	21	71	1	7
1983	2525	9	89	0	2
1984	2378	19	75	0	6
1985	2067	18	81	0	1
1986	198	67	33	0	0

Notes:

- 1) N/A indicates that the figures are not available.
- 2) 1986 figures are estimates.
- 3) During all years shown in the table except 1986, the World Food Program received sorghum flour but paid for sorghum grain. According to OPROVIA, the 3 RWF/kg fee for grinding was paid by the Ministry of Foreign Affairs (MINAFET). In 1986, the WFP started milling the sorghum itself.

¹³Source: Op. Cit.

¹⁴Source: Op. Cit.

Table 2.8
 Purchasers of Sorghum Sold by OPROVIA¹⁵
 (% of Annual Total)

Year	Total (tons)	MINIFINECO	Churches, Coops, & Communes	World Food Program	Merchants	Retail	Other
1979	865	4	3	0	56	37	0
1980	948	0	3	11	51	35	0
1981	1352	N/A	N/A	N/A	N/A	N/A	0
1982	952	0	2	74	2	22	0
1983	118	0	6	0	0	94	0
1984	1733	4	9	0	1	28	62
1985	107	N/A	N/A	N/A	N/A	N/A	N/A
1986	2961	0	1	13	0	86	0

Notes:

- 1) N/A indicates that the figures are not available.
- 2) 1986 figures are estimates.
- 3) "Other" for 1984 is divided into two parts. Four percent includes sales to OPROVIA, GREMARWA, and OVIBAR researchers. The remaining 58% was purchased by the Ministry of Public Health (MINISAPASO).
- 4) The sorghum grain purchased by the World Food Program in 1982 was distributed to drought victims in Uganda.
- 5) In 1986, the majority of sorghum was sold at retail during March-June. The sorghum was old and suitable for beer making.

¹⁵Source: Op. Cit.

2.6 Market Regulations

Rwanda inherited much of its current legal code from its Belgian colonial administration. The commercial laws which survive the colonial period are most concerned with the regulation and protection of large commercial enterprises with the capacity to keep and report a detailed accounting of their operations on an annual basis. This bias has continued even for many laws enacted in the post-colonial period.

For example, in order to conform with the law, every merchant must be inscribed in Rwanda's "Registry of Merchants". In order to be inscribed, the prospective merchant must present a detailed accounting of activities undertaken within the last five years, other commercial activities, and the amount and sources of capital to be invested in the enterprise. The bean and sorghum merchants described in Section 3 of this chapter must find such requirements bewildering. Many of them are not in the registry, partially because of the relatively high fees which accompany registration. Once registered, the merchant faces a high penalty for moving the location of his or her business from one town to another, which may reduce the ability of the marketing system to respond to changing demographics and economic circumstances.

It was not until 1982 that "commerce ambulant"--the frequenting of several local markets for the purpose of buying and reselling--was recognized and regulated by Rwandan law. For the most part, the legal system has only slowly, if ever, recognized either the structure or the needs of the food marketing system.

The colonial period also established precedents for government intervention in food markets: a 1942 law which is still on the books (but apparently unenforced) prohibits merchants from selling locally purchased foodstuffs to anyone but employers of local labor during the first thirty days after the harvest. A December 1961 law forbids the export of local products other than potatoes, barley, and wheat flour.

In 1967 the Rwandan Government took its intervention in food marketing further, with the creation of a "Price Control Commission". The Price Control Commission is made up of representatives from the Ministry of Finance, the Ministry of Agriculture, the Ministry of Posts and Telecommunications, the National Bank, the Chamber of Commerce, and other government officials. It is this commission that is responsible for the establishment of the ceiling and floor price targets in Rwanda. The law states that the purpose of the price control commission is to "...assure the equilibrium of markets, to prevent abuses of economic power, especially in price formation, to protect the interests of the economically impotent such as consumers and users, and to maintain the purchasing power of the national currency..." The history of food price control policy in Rwanda is discussed in Chapter I, Section 5. Chapter III, and in particular, Section 3, evaluates current price policy in light of data collected in the course of this research. It is sufficient to note here that the law implies that the merchant may be in a position to abuse economic power and take advantage of the economically disadvantaged. While economic power may be a problem in other arenas, it is hard to conceive of the typical bean merchant

described in Section 7 of this chapter as holding sufficient economic power to justify the provisions of this law.

What is suggested here is the need to review of Rwanda's legal code as applied to small merchants dealing in agricultural products. The current legal framework seems to assume a market structure and a uniformity among firms which may impose unnecessary costs on the government and on traders. The regulations appropriate for an importer of Peugeots with an inventory worth perhaps 1 billion Rwandan Francs may not be appropriate for the bean merchant whose inventory may be worth less than 1000 Rwandan Francs.

2.7 Marketing Channels¹⁶

The first merchant survey conducted in the course of the project was designed to describe the characteristics of merchants buying and selling beans and sorghum, as well as provide some insights on their relationships to market participants both "upstream and downstream". This information allows the characterization of the movement of each commodity through the marketing system. Approximately forty merchants were interviewed in five prefectures. Limitations on field time and vehicles meant that the interviews were confined, in most cases, to the prefectural capital.

Copies of the interview schedule and the form filled in by the enumerator are included in Annex I. Annex VI is a summary of the results from the Merchant I survey.

¹⁶Portions of the material in this section are translated verbatim from Loveridge and Ngirumwami.

A. Salient Characteristics of the Five Prefectures Sampled

Kibuye.- For the most part, the survey was limited to the administrative center of each prefecture, but a visit to Kibuye Ville uncovered little commercial activity in beans or sorghum. Kibuye Prefecture's largest center of trade in agricultural commodities is located about twenty kilometers from Kibuye Ville, at Kibilize. Kibilize is a relatively small, undeveloped center. It is characterized by small merchants who open their shops surrounding the market place only during the two market days. Most of these merchants buy from truckers and farmers. The majority of their business is done in retail. Per capita production statistics¹⁷ indicate that Kibuye is most likely an importer of beans and sorghum, thus assembly activities are limited.

Ruhengeri.- Ruhengeri Ville has a relatively large, well developed business district with many stores dealing in agricultural commodities. A majority of the merchants interviewed are open more than five days per week. Merchants in the area emphasize retail activities. This is surprising given Ruhengeri's standing as the highest per capita potato producer in the country. Apparently, most of Ruhengeri Prefecture's potatoes are marketed through channels which bypass Ruhengeri Ville. This may be because the very high potato producing areas of Ruhengeri Prefecture are relatively far away from Ruhengeri Ville. Alternatively, the perishability of the potato may induce a more direct marketing link; potatoes may shipped out of the prefecture directly

¹⁷MINAGRI, Sept. 1986.

from farms and assembly points rather than going to Ruhengeri Ville for transshipment.

Butare.- Butare Ville is the second most developed of the commercial centers visited in the course of the survey. Most merchants interviewed there are open more than five days per week. Some merchants have begun to develop contracting systems with potential clients, and a fair amount of wholesale activity was registered. These developments are probably due to Butare's population density, age, and location within Rwanda's road network.

Kibungo.- Kibungo Prefecture lacks a dominant center of commercial activity. As a result, three commercial centers were visited before an acceptable number of interviews could be obtained. The lack of a dominant commercial center is not surprising given Kibungo's low population density, and the fact that many areas of Kibungo have recently been settled. Kibungo is characterized by a high proportion of merchants engaging in assembly activities from their small shops. This should be expected given the high per capita production of beans in the prefecture, and the fact that there are no large urban centers in the prefecture.

Kigali.- Kigali is the largest commercial center in the country, with very diverse types of merchants. One group of merchants serves as a conduit for products moving from one side of the country to the other. This group buys from truckers and in turn sells to other truckers or institutions. Another group serves Kigali urban consumers directly. Kigali merchants tend to be both retailers and wholesalers. Very little direct assembly activity for beans produced in Kigali

prefecture was uncovered by the survey. Kigali Ville merchants thus appear to act as intermediaries between deficit and surplus regions. In comparison to other prefectures sampled, Kigali merchants have higher average gross returns per month and higher rents.

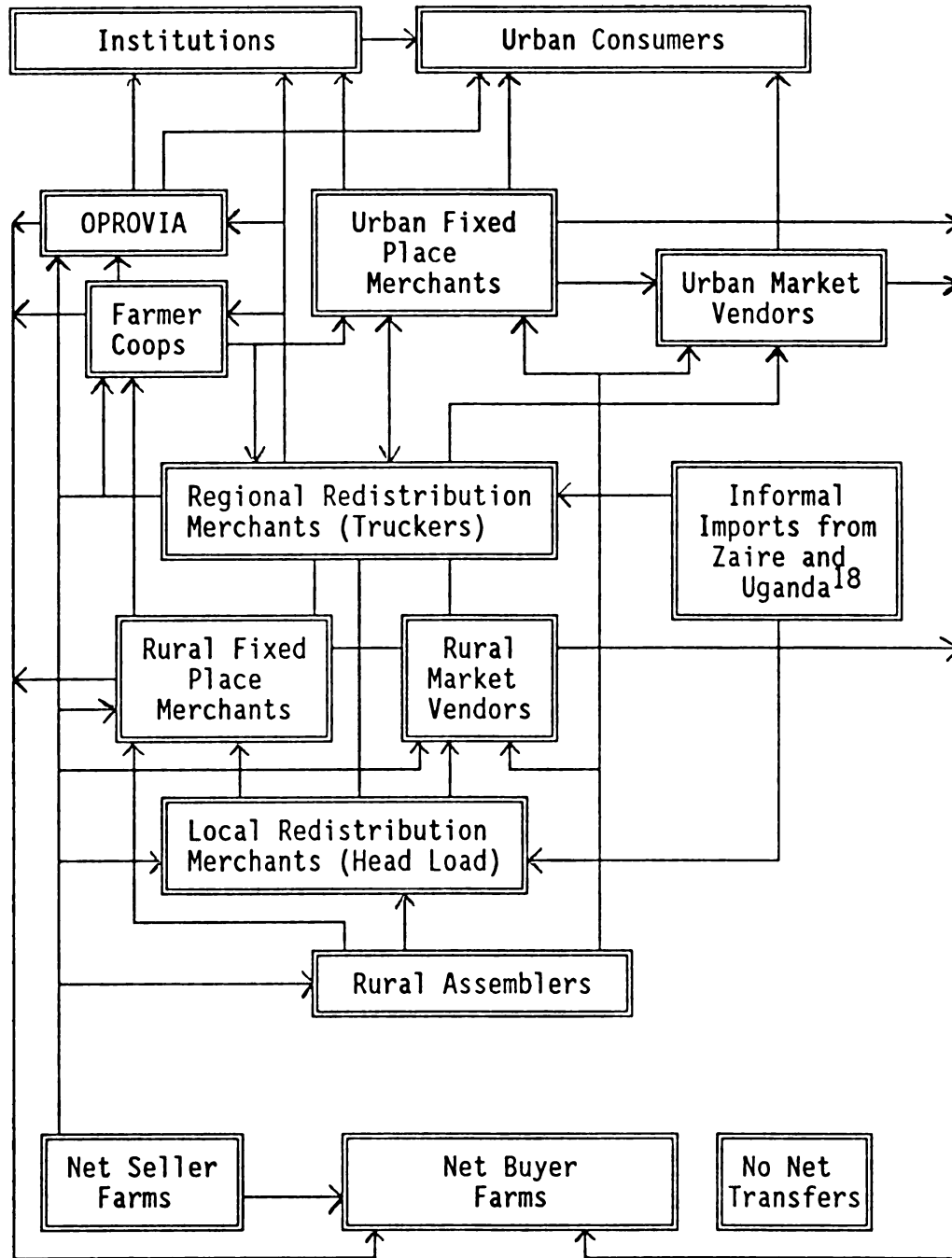
B. A Summary of Bean and Sorghum Marketing Channels

The following paragraphs synthesize data collected in the Merchant I and II surveys, informal observations, and unstructured interviews with knowledgeable persons. To put the role of each type of market actor into perspective, a schematic of bean and sorghum marketing channels is presented in Figure 2.11.

Each box in Figure 2.11 represents a particular type of operator in the marketing system. Some enterprises may take on operations typical of two or more boxes in Figure 2.11. For example, merchants with fixed place operations that use trucks to acquire product are simultaneously (urban or rural) fixed place merchants and regional redistribution merchants. The arrows in Figure 2.11 indicate the directionality of product flow. Lines with two arrowheads indicate that product may flow in either direction. On the other hand, more than one type of merchant may be represented by only one box. For example truckers with and without storage are both represented by the "trucker-transporter" box.

Most of the merchants interviewed fall into the category of urban fixed place merchants. Depending on one's definition of urban, merchants interviewed in the smaller market towns such as Kibilizi and the market towns in Kibungo Prefecture might be characterized as rural fixed place merchants.

Figure 2.11
Schematic of Bean and Sorghum Marketing Channels



¹⁸Some observers assert that during certain periods the year there are informal exports of beans and sorghum to Burundi. Data from the SESA/MSU surveys permit neither acceptance nor rejection of this hypothesis. Such exports, if present, are outweighed by imports from Zaire and Uganda.

The Merchant I & II surveys did not directly collect information about other types of operations important in transferring beans and sorghum from the producer to the consumer. As indicated in Figure 2.11, there is quite a diversity of operations in the Rwandan marketing system.

Urban fixed place merchants are retailers and/or wholesalers who operate from a storefront. Urban fixed place merchants in Kigali appear to serve as a central exchange for beans in Rwanda. Movement of locally produced beans tends to be from the east of the country towards the west. Most wholesalers in Kigali tend to turn over their product quickly (within a few days), operating with a one franc per kilo margin. They tend to buy from independent truckers and sell to truckers coming from deficit areas or to institutional buyers such as schools and prisons. A few wholesalers store beans up to three months after the harvest. Kigali wholesalers tend to have larger storage capacities than the small assemblers in rural areas.

Wholesalers usually get their market information from suppliers and competitors. When fresh supplies at lower prices arrive, they lower their prices, absorbing a loss in order to maintain working capital, and to avoid risk of stock deterioration. Most merchants have limited supplies of working capital, so they must liquidate old stock in order to purchase new stock. Thus they are exposed to risk in the market. Seasonal analysis of prices shows that trends are fairly regular (see the seasonal analysis in Chapter III), with bean prices stable from January to June, and with relatively predictable price increases from

June until December. Regular price movements reduce risk. The problem is that with a one franc margin, the wholesale price does not have to drop much to change a profit into a loss. When operating funds are sufficient, merchants will maintain their stocks and continue buying until the price rises enough to provide them with their margin.

Fixed place retailers in deficit zones are generally provisioned by truckers, with additional supplies coming from producers or small assemblers. One retailer buying strategy is to buy short term supplies of beans at regular intervals until after the June harvest, at which time a larger quantity is purchased to avoid the price increases at the end of the year. Hence, some people in the business are aware that returns to storage are low in the first months after the big bean harvest.

Rural fixed place merchants are similar to urban fixed place merchants. One generally finds a few rural fixed place merchants operating storefronts in close proximity to rural open air markets. Most of these merchants are only open on market days. Rural fixed place merchants may be retailers, wholesalers and/or assemblers. Most bean and sorghum assembly and retailing to rural consumers is probably accomplished by this group of merchants. One reason for the previous misconception that Rwanda is self-sufficient in beans and sorghum may be that many observers concentrate on vendors in the open air part of the market, rather than on these small fixed place merchants.

Urban and rural market vendors appear to hold very small stocks of product and operate from designated open air markets. Rural market vendors are more likely to be selling their own produce than urban

market vendors. In general, these vendors appear to account for a very small percentage of total volumes handled in market towns. They may be more important in smaller markets which do not attract fixed place merchants.

Informal imports from Zaire and Uganda have been documented in the SESA/MSU Merchant II Survey, and in informal discussions with knowledgeable individuals. The SESA/MSU Transactions Survey and a survey conducted by MINIPLAN¹⁹ in 1983 show significant informal imports of beans and sorghum. Some marketing experts in Rwanda have noticed merchants from Burundi coming to Rwanda in search of beans and sorghum at certain times of the year. Informal exports to Burundi were not uncovered by any of the SESA/MSU surveys, but such trade is possible. All available evidence indicates that these exports, if present, must be smaller than informal imports of the same commodities.

Local redistribution merchants rely primarily on head loads for transport of product. A few local redistribution merchants use bicycles or taxis to move product from one place to another. Local redistribution merchants are probably one of the most important means by which product moves into and through Rwanda. Local redistribution merchants probably buy most frequently from farmers, assemblers, local markets, and markets on the other side of the border. Head load transporters probably do not sell directly to consumers but to intermediaries such as market vendors, truckers, and fixed place merchants.

¹⁹Minot and Niyibizi.

Regional redistribution merchants are truck owners. They are the other major means by which product is imported into Rwanda and moved within Rwanda. From what can be gathered from interviews with merchants included in the survey, and less formal interviews conducted with truckers, there are three types of merchant truckers. One type (which is probably the most common) does not have a fixed place operation. This type of trucker buys from small assemblers, transports the product, and sells immediately to merchants located in Kigali and other consuming regions. Transporter gross margins (as would be expected) are larger than those of the small assemblers, and are a function of distance travelled. As an example, a trucker buying in Byumba and selling in Kigali expected to receive a four franc per kilo gross margin.

Thirty-three percent of the fixed place bean merchants interviewed and thirty percent of sorghum merchants interviewed own trucks. The majority of these businessmen are part of a second class of trucker merchants. These individuals tend to use trucks to supply their own retail/wholesale fixed place operation. Their trucks usually leave their place of business empty, and come back with a load that becomes the store inventory for sale. These merchants tend to have higher volume operations. Their gross margins tend to be higher than small assemblers because they are performing a transport function in addition to retail and storage functions.

The merchant trucker with a fixed place wholesale/retail operation does not generally make backhauls. That is, they are generally loaded on the trip to the store only. A diversified trucking firm using a

truck for a variety of clients may be able to provide cheaper transport services than a merchant who is specialized in foodcrops. This is perhaps one reason for the apparent separation of store and truck ownership.

It is generally the more established wholesaler/retailers who own trucks. This follows, because they have had more time to establish a steady clientele, and build the necessary capital to make the investment. On average, bean merchants included in the survey have been in business for three years. The average for sorghum merchants was six years; the average for potato merchants was five years, while the modal merchant had been in business for one year or less. Thus, another factor influencing the number of wholesaler/retailers who own trucks may be that most businessmen have not been in operation long enough to obtain the prerequisites for truck ownership.

There is a third class of merchant trucker, who does not have a fixed sales outlet, but does have some storage facilities. This kind of merchant buys, transports to his depot, and then delivers to buyers. This sort of trucker is probably less numerous than the other two classes of truckers, and is more oriented towards institutional types of buyers than the other two types of truckers. This variety of merchant is likely to have made a large capital investment, and to bear risks in storage and in long distance hauling.

The term "regional redistribution merchant" encompasses all three types of truckers identified above. These operators are vital intermediaries who interface with every other type of participant in

the marketing system except the consumer. They are probably the major force in transferring food from surplus to deficit regions.

Rural assemblers collect small lots of product from farmers for distribution to other market participants. Rural assemblers may operate from a fixed place establishment, via open air markets, or by travelling from farm to farm.

The Merchant I survey included some persons with fixed place operations who were performing assembly activities. Assemblers very rarely have trucks (with beans, for example, out of nine urban interviewees buying directly from farmers, two had trucks). The typical strategy of these assembler type merchants is to buy (generally more at harvest time) and wait for a trucker to purchase their stock. Any storage is a by-product of other functions, rather than by design. Nonetheless, they do perform some of the storage function for beans and sorghum, carrying these products for up to 90 days. Small assemblers are willing to sell retail quantities of beans, but this is not their primary occupation. The majority of the small assemblers limit themselves to purchasing locally produced agricultural commodities. Small assemblers generally operate on a fixed margin basis. One franc per kilo is a standard margin for beans and sorghum not stored a significant length of time.

Farmer cooperatives appear to be of minor importance with respect to the volumes of product they move relative to other market participants. A few coops are thriving. Many "farmer coops" are non-functional. Coop problems are often said to stem from poor management,

although lack of marketed surplus in the cooperative's region may be at the root of many coop failures.

OPROVIA is the government foodstuff marketing board, and is discussed in detail elsewhere in this document.

Institutional buyers in Rwanda include the Army and other government units, the World Food Program, schools, missions, and hospitals.

Urban consumers are net buyers that live in Rwanda's cities. Since SESA's sample does not cover urban areas, little is known about the characteristics of urban consumers.

Net seller farms are farm families that sell more of a given product than they buy. Data presented in Chapter IV shows that net sellers are a minority. Net dry bean sellers make up 22% of the rural population while for sorghum 23% of rural households are net sellers. Net seller farmers tend to bring their beans and sorghum to small assemblers with fixed place operations near open air markets. This is also often the case with potatoes, but one finds retailer/wholesalers who buy at the farmgate more often for potatoes than for the other two products included in the Merchant I survey.

Net buyer farms are in the majority for both crops. Chapter IV shows that seventy-three percent of rural households are net bean buyers and sixty-seven percent of rural households are net sorghum buyers.

Farms with no net transactions in beans and/or sorghum form a small but not insignificant proportion of the population. Data in Chapter IV indicate that 9% of rural households have no net

transactions in sorghum while 5% of rural farm families have no net transactions in dry beans.

Figure 2.11 should be considered as a picture of the marketing system which will continue to evolve as more information becomes available. Even so, it helps identify and describe the principal actors and relationships within the system. Understanding the principal market actors facilitates an evaluation of the system.

C. Comparing Marketing Channels Between Products

Beans, sorghum and potatoes, as mentioned earlier, pass through similar marketing channels on their way from the producer to the consumer. There are some differences in the marketing channels of the three products. Potatoes are not stored by any of the merchants in the marketing chain for more than one or two weeks, whereas one commonly finds bean and sorghum merchants storing for sixty days. This difference in storage patterns is related to the perishability of the potato. Merchants storing potatoes for a long time risk big losses. Perishability also influences the number of links in the potato marketing chain. Retailers tend to get their potatoes directly from the producer, presumably in order to get recently harvested potatoes, thereby reducing the risk of storage losses. This may play an important role in limiting the potential export of Rwanda's potato surplus to neighboring countries.

Beans and sorghum appear to have nearly identical marketing channels, except that the relative availability of each product on the wholesale markets varies with the time of year, and that institutions seem to be much less important customers for sorghum than they are for

beans. Also, a large proportion of the marketed sorghum is ultimately transformed into beer, whereas the vast majority of the dry beans are sold without being modified as they pass through the marketing system.

Table 2.9
Average Estimated Total Gross Margins in Five Prefectures of
Rwanda, February & March 1986
(Including Merchants with Zero Stocks)
(Rwf/month/business)

Product	Kibuye	Butare	Ruhengeri	Kibungo	Kigali
Beans	892	-166	-267	-199,860	29,173
Sorghum	437	7,000	600	7,129	37,935
Potatoes	31,333	17,785	7,504	4,935	34,380

Table 2.9 reports average estimated gross returns by product and by prefecture for the survey respondents. Estimates of gross returns per month serve as only a rough gauge of the level of business activities. The estimation is made as follows: the buying price per kilo is subtracted from the selling price per kilo to obtain the gross margin. The estimated number of kilos in stock is divided by the estimated number of calendar days to sell to obtain the number of kilos sold per calendar day. The number of kilos sold per calendar day is multiplied by the gross return per kilo to obtain the gross return per calendar day. The gross return per calendar day is multiplied by thirty to obtain the gross return per month for each merchant and for each product. The gross return per month is averaged across all merchants

who handle the product to obtain the average estimated gross return per month for that product.

Readers should be careful in interpreting the average estimated gross returns per month reported here. First, it is a gross figure. It does not take into account the merchants' costs: rent, transportation, labor, storage losses, risk, and taxes. Second, merchants' estimated amount in stock and turnover time may be inaccurate. Third, the survey format was single-visit, and as such, represents only one point in time. At other times of the year, merchant volumes may be higher or lower, and their margins may be variable as well. Thus the figures presented above represent only a rough snapshot perspective of merchant gross returns.

Beans provided negative average estimated gross returns per month in three of the five prefectures, whereas potatoes and sorghum always yielded positive average gross returns. The bean market may have been influenced by two factors. First, the government's 35 Rwf/kg bean price policy announcement coincided with the bean harvest. In at least one case, a merchant bought at the official price, and found he would have to take a large loss on his stocks by selling at the (much lower) market price. The government announcement may have destabilized the bean market in other regions as well. The official price announcement may have influenced the other two commodities less, as the sorghum and potato harvests are not large in January.

Second, the survey was conducted in the month after the bean harvest. Bean prices may be inherently instable at this time of year

as merchants and farmers are still uncertain of the size of the national harvest.

Since the survey involved special circumstances, a general conclusion cannot be made here. It is not likely that bean marketing is generally less profitable than sorghum or potato marketing. Still, the survey results show that bean marketing can be risky and that sorghum and potato marketing is potentially profitable. The survey also shows that Kigali merchants tend to have higher gross margins than merchants in the other study areas. The higher gross margins in Kigali are related to the higher volumes transacted. Profits in Kigali may not be any higher because higher rents and higher taxes may offset the higher gross margins. A follow-up survey asked the same type of merchants what they paid in rent for their places of business. Table 2.10 presents average rents paid by respondents. Kigali rents are over twice as high as the next highest prefecture included in the survey, Ruhengeri.

Table 2.10
Average Rents Paid by Store Operators²⁰

Prefecture	Average Rent (Frw/mo.)
Butare	3500
Kibungo	4000
Kibuye (Kibilizi)	2500
Kigali	25000
Ruhengeri	9000

²⁰Source: Ngirumwami and Loveridge.

D. Who Stores the Beans?

A glance at bean price movements within a normal year²¹ shows that storing beans is a very low (or zero) profit operation from January to May or June. Yet this is the time when most Rwandan beans are harvested and sold by farmers (see section II.3 on production and transactions). Who takes on the profitless function of bean storage during those months? An answer begins to emerge in comparing results of this survey with farmer storage surveys: everyone stores beans, but no one stores them for very long.

Household storage surveys (Dunkel, Wittenberger, and Read; Durnez and DeJaegher) have shown that producers do not store beans for more than six months after the harvest. Further, that which is stored in the last few months is probably sufficient only for home consumption and planting. Data from the bean and sorghum transactions survey (see Annex II) indicate that some farmers hold some beans for two or three months after harvest before marketing them; thus they provide storage services. Some farmers may prefer to store until they can approximate the size of the upcoming harvest before selling.

The merchant survey described above shows that merchants at different levels in the marketing system also store beans for short periods. Assemblers may store for one to three months. Wholesaler/retailers and retailers may store for one to three months. A least a few truckers may store, too. Beans which are imported into Rwanda may be stored in their country of origin. Since half of the

²¹See the section in Chapter III on seasonal price movements and the section in Chapter IV on the frequency of food shortfalls.

beans on the market are imported, imports beginning three or four months after harvest must help keep the pipeline full after farmers sales drop.

Section 3 of this chapter shows that the bean harvest is much less concentrated than previously imagined; there are peak production months, but Rwandans harvest some beans every month of the year. (See Annex II for a breakdown of production by month and by prefecture.) The need for storage may be less than previously hypothesized.

Beans are stored for brief periods at each level in the marketing system: farmers, assemblers, truckers, wholesaler/ retailers, retailers, and consumers all do some storage of the product. The sum of these storage periods probably exceeds the shelf life of beans under current storage practices in Rwanda. All participants in the chain appear to minimize risk by limiting the amount of time that they store beans.

2.8 Indications of Competition

A. Structure Conduct Performance Approach

The structure-conduct-performance paradigm is useful in evaluating the degree of competition (whether competition is workable) in the market and marketing efficiency. Scherer summarizes the structure-conduct-performance paradigm:

"Structural norms include the following:

- (1) The number of traders should be at least as large as scale economies permit.
- (2) There should be no artificial inhibitions on mobility and entry.

- (3) There should be moderate and price-sensitive quality differentials in the products offered.

Conduct criteria include:

- (4) Some uncertainty should exist in the minds of rivals as to whether price initiatives will be followed.
- (5) Firms should strive to achieve their goals independently, without collusion.
- (6) There should be no unfair, exclusionary, predatory, or coercive tactics.
- (7) Inefficient suppliers and customers should not be shielded permanently.
- (8) Sales promotion should not be misleading.
- (9) Persistent, harmful price discrimination should be absent.

Last, we have a number of *performance criteria*:

- (10) Firms' production operations should be efficient.
- (11) Promotional expenses should not be excessive.
- (12) Profits should be at levels just sufficient to reward investment, efficiency, and innovation.
- (13) Output levels and the range of qualities should be responsive to customer demands.
- (14) Opportunities for introducing technically superior new products and processes should be exploited.
- (15) Prices should not intensify cyclical instability.
- (16) Success should accrue to sellers who best serve customer wants."

The following paragraphs use Scherer's criteria point by point to develop a basis for determining whether there is workable competition in the marketing system for beans and sorghum in Rwanda. For five criteria, there is either little data or the criterion is not relevant

in the Rwandan context. Criteria 8, 10, 11, 14, and 16 are therefore omitted from the discussion.

"(1) The number of traders should be at least as large as scale economies permit." A census of merchants was taken in the towns of Ruhengeri, Butare, and Kibuye/Kibilizi as part of the SESA/MSU Merchant I survey. In Kigali, the number of businesses selling beans and sorghum was deemed too large to enumerate. Table 2.11 summarizes results of the census. The number of traders of beans and sorghum in each of these towns appears to be large enough to prohibit collusive price fixing. Informal observations showed that on market days, the number of market vendors exceeded the number of fixed place operators.

Table 2.11
Number of Bean and Sorghum Fixed Place Merchants by Town,
February & March 1986²²

Town	Bean Merchants	Sorghum ²³ Merchants
Butare	15	7
Kibuye/Kibilizi	23	19
Ruhengeri	21	9

"(2) There should be no artificial inhibitions on mobility and entry". The SESA/MSU Merchant I survey found that a majority of merchants claimed to have been in business one year or less. While this number may have been inflated by merchants wishing to avoid back

²²Source: adapted from Loveridge and Ngirumwami.

²³Includes merchants selling sorghum grain, germinated sorghum, and/or sorghum flour.

taxes, information collected in the course of the Merchant II Survey²⁴ tended to confirm the finding that turnover among merchants is relatively high. While high turnovers are probably not good for the system as a whole, they do indicate that there are few barriers to entry. Of the eleven merchants who knew why the previous occupant of the building left, one third said it was because the merchant had decided to move his business. This indicates that inhibitions on merchant mobility are low despite regulations which penalize merchants who move. The illegal status of being unregistered may enable many merchants to avoid being taxed for moving.

"(3) There should be moderate and price-sensitive quality differentials in the products offered." In Rwanda beans and sorghum may be differentiated on two criteria: condition and genetic characteristics.

The condition of the grain relates to the presence of molds, mildews, damaged grain, insects, and/or foreign material. The marketing system is somewhat undeveloped with respect to grain condition. Bylenga et al found that no grades are currently in use for bean and sorghum grain condition in Rwanda, and that "...rejection is the main method buyers use for controlling quality". One might argue that repeated rejections will result in a price differential, but the system still appears undeveloped.

Genetic characteristics of the grain concern the size, taste, color, and most importantly, adaptability to local growing conditions.

²⁴For a complete description of the results of the Merchant II Survey, see Ngirumwami and Loveridge.

The majority of the respondents to the Merchant II survey (81%) said they noticed their buyers had a distinct preference for locally grown beans, but only 4% said they reduced prices of non-local²⁵ beans. Most merchants simply mix local and non-local beans. Here again, the system seems undeveloped.

"(4) Some uncertainty should exist in the minds of rivals as to whether price initiatives will be followed." In the Merchant II Survey, respondents were asked how they would react if a competitor were selling beans or sorghum at a price different than their price. Where the competitor's price was three Frw lower, 74% of bean merchants and 82% of sorghum merchants said they would change nothing, including their selling price. If the competitor's price were three Frw higher than their price, 96% of bean merchants and 100% of sorghum merchants said they would do nothing. Clearly, there will always be some difference between what merchants say they would do and what they would actually do in a given situation. Even so, human nature is to believe what you say, and to believe that others think as you do. Merchants must have some uncertainty as to whether price changes they implement will be followed. The available macro evidence indicates that long run prices change in response to changes in basic supply and demand relationships. For example, real potato prices have decreased as potato production increased in response to the distribution of improved varieties in Rwanda. Hence, there is no evidence that merchants can successfully hold prices out of line in the long run.

²⁵i.e. from another country or elsewhere in Rwanda.

"(5) Firms should strive to achieve their goals independently, without collusion." Only 4% of bean merchants and 6% of sorghum merchants said they would try to convince another merchant to raise prices if the other merchant were undercutting him by three Frw. While the potential for under-reporting is high here, the low response rate, combined with the numbers of merchants in each town indicate that collusion is probably not a big problem in Rwanda.

"(6) There should be no unfair, exclusionary, predatory, or coercive tactics." There are probably unfair tactics in the system. A case in point is the system of weights, which appears to be loosely applied, particularly by market vendors. Damez makes a similar point when he says, "Their [merchants'] margins being low because of strong competition, they make it up through other means = rigged scales, lying about weights, etc." The degree to which these practices exist is unknown.

High turnover rates in merchants and sheer numbers indicate that exclusionary tactics are minimal. Predatory tactics also appear to be minimal. The vast majority of purchases and sales recorded by the SESA/MSU Transactions Survey are on a cash basis. Merchants interviewed in the SESA/MSU Merchant II Survey were reluctant to give credit, probably because of their limited operating funds.

Coercive tactics seem to be limited to the government's price interventions in 1986 (discussed in a succeeding section). No other coercive tactics were encountered in interviews with merchants, farmers, and other persons familiar with the marketing system.

"(7) Inefficient suppliers and customers should not be shielded permanently." The high turnover rates cited previously argue effectively that the system does not brook relative inefficiency.

"(9) Persistent, harmful price discrimination should be absent." Price discrimination results when two or more different types of clients pay different prices for the same product and/or service. Vendors often set their initial bargaining price based on their estimates of the clients' ability to pay, with higher prices quoted to well dressed, healthy looking individuals. The well dressed client can usually get a fair market price, but it takes more bargaining, so the practice cannot be classified persistent.

Tables in Chapter IV show average prices paid and received for dry beans and sorghum by family net transactions category. These tables, developed from the 1986 SESA/MSU national transactions survey, show little difference in average prices paid and received between groups. Large sellers of beans and sorghum both received, an average of one franc per kilo less than other groups. This slightly lower price is probably related to supply and demand conditions in farms adjacent to the large net sellers. Where supplies are plentiful, prices should be lower. Cost of production may also be lower for large sellers. On the buying side, large net buyers of beans and sorghum paid slightly less on average than other groups of buyers. This may arise from reduced selling costs associated with volume purchases. On neither the buying nor the selling side can these price differences between groups be termed harmful. Price discrimination therefore does not appear to be a problem in Rwanda.

"(12) Profits should be at levels just sufficient to reward investment, efficiency, and innovation." High turnover rates, poor physical facilities, and little evidence of innovation indicate that profits may be too low in most areas.

"(13) Output levels and the range of qualities should be responsive to customer demands." Informal observations in many areas of Rwanda indicate that where there is purchasing power and demand for beans and sorghum, product is delivered. However, demand for assembly services may exceed provision of assembly services. Based on analysis of the SESA/MSU Farmer II survey, Loveridge and Weber found that:

"...a total of twenty-one farmers²⁶ mentioned having problems finding outlets for various surplus crops. Potatoes were hardest to market in Gisenyi, while Kibungo farmers mentioned difficulty selling beans most frequently..."

It has also been shown (see item 3) that the range of qualities do not appear to meet customers' demands.

"(15) Prices should not intensify cyclical instability." The analyses in Chapters III, IV, and V indicate that when farmer supplies run low, prices go up, and the system responds by bringing more beans and sorghum into the country. Thus prices reduce cyclical instability.

In summary, eleven of Scherer's sixteen criteria for workable competition are relevant in this context. The marketing system meets eight criteria without reservation (numbers 1,2,4,5,7,9,11 and 15). On one item (number 6), it meets most aspects of the criterion. The system fails to meet only three criteria for workable competition (numbers 3, 12 and 13). The system fails on criterion number 12 due

²⁶120 farmers were interviewed.

to what may be excess competition. On criteria 3 and 13, a failure of the system is to differentiate between different qualities of grain. The overall effect of this failure to differentiate between slightly higher and lower quality grain is probably small. Failure to provide certain assembly activities (a second reason for failure on criterion number 13) is probably a more serious problem. The failure to provide assembly services is probably related to the high cost of providing such services for the small volumes farmers are selling. It is difficult to judge the extent to which sub-optimal assembly services are provided. On balance, the system appears to be functioning quite well, given the resources of the country.

B. Tests for Market Integration

Testing market integration allows a statistical basis for evaluating competitive behavior using market prices as indicators. Tests for competitive behavior in Rwandan markets using the market integration approach are developed in Chapter III. Results of these tests support the conclusion that bean and sorghum markets are competitive. Market integration tests also indicate that improvements in Rwanda's transport system have helped strengthen market links between major cities. The improved roads appear to have enabled innovative truckers to reduce price differences between major cities.

2.9 Summary and Conclusions for the Chapter

Data presented in this chapter show that Rwandan policy on beans and sorghum has been based on inaccurate information about the marketing of the two commodities.

Aggregate farm level statistics collected in the course of the research show that rural Rwanda is a net importer of sorghum and dry beans even in normal to good crop years. Rural purchases are significant, and over 50% of the dry beans and sorghum purchased in rural markets by farm households come from neighboring countries. This conclusion runs counter to the common belief that Rwanda is self-sufficient in both of these products. Nonetheless, the conclusion has been supported by interviews at the farm and merchant level and by parallel studies conducted by other ministries.

Purchase and sale patterns at the household level indicate that most households sell their product within two or three months after harvest. Most "off-season" sales from Rwandan farmers appear to come from off-season harvests made possible by the wide variety of micro-climates found in Rwanda. Off-season harvests therefore provide some measure of transient food security for Rwanda--if the main harvest fails, off-season harvests can fill the gap to a certain extent. These off-season harvests are found in a greater number of households and with a greater temporal and geographic dispersion for dry beans than for sorghum.

The importance of micro-climates in Rwandan farming systems is underscored by the fact that research conducted jointly by the Ministry of Agriculture, the University of Minnesota and CIAT has shown that over 280 varieties of beans are grown in Rwanda. These varietal differences are probably a large factor in Rwanda's ability to harvest beans continually, but they represent an great impediment to research on improved bean varieties. There are fewer sorghum varieties--and

sorghum appears to contribute less to the flexibility of Rwandan food supply.

A single visit survey on farmer constraints revealed that farmer opinions on their greatest constraint vary substantially from prefecture to prefecture. In the highly populated, fertile lands to the North, farm size is considered to be the major constraint, while in other areas, labor is the most binding factor. Thus the research on improved varieties is again complicated--new varieties for some regions will need to maximize returns to labor, while other regions need varieties that maximize returns to land. Soil fertility will increase in importance as the population grows. Research needs to be carried out on responsiveness to fertilizers in a vast array of conditions. If only a few varieties are improved and all have similar maturity dates, a need for more storage in the marketing system may develop. Alternatively breeders could pay attention to maturation dates in selecting varieties for eventual improvement.

Government activity in marketing of beans and sorghum has been hampered by a lack of knowledge of the current structure, conduct and performance of the production and marketing system. OPROVIA has built a large network of storage and marketing facilities, but to date its activities have been limited almost exclusively to the provision of beans and sorghum to the Ministry of Finance and the World Food Program. OPROVIA has made little progress in improving market information collection and dissemination. Some careful and interesting work has been done on bean and sorghum storage techniques by OPROVIA's University of Minnesota based research component. In practice improved

storage techniques may be of limited use to the nation's farmers, merchants, and cooperatives. Very little is stored due to the constant nature of the harvest and because the bean and sorghum crops are smaller than local consumption. Most storage of marketed beans and sorghum may be "pipeline" storage arising from the search time necessary to find buyers and sellers as product moves through marketing channels.

Rwandan policy and regulations, perhaps as a by-product of colonial times when outsiders controlled the most visible economic activities, have an anti-merchant tendency and try to treat all merchants similarly under the law. Analysis shows that food merchants in Rwanda are making significant positive contributions to both the chronic and the transitory dimensions of food security in Rwanda. The regulatory treatment of merchants needs to support and facilitate this important role and the food marketing functions that merchants perform.

Sections 7 and 8 show that most bean and sorghum merchants hold very small inventories, that turnover of stocks is rapid, and that their operating capital (as evidenced by the investments they have made in their businesses) is very limited. Merchants operating store fronts have very small margins, and are exposed to considerable risk in their operations. In short, bean and sorghum merchants are not likely be in a position to use economic power to have an undue influence over prices in the marketplace. This conclusion was borne out by the results of a single visit survey on bean and sorghum merchant standard operating procedures which shows that merchants have limited discretion in pricing decisions.

This conclusion is substantiated by the fact that survey work show a large number of participants at most stages of the marketing chain. Large numbers of participants make it very difficult for merchants to organize to fix prices. Price analysis in Chapter III verifies this conclusion. The marketing system appears to be functioning well given the underlying level of economic development in Rwanda.

It is very likely that prices are determined at the farmer-assembler interface, and that in the long run, prices are based more on production, plus assembly and transport costs, than any other factors. Local market demand appears to be inversely related to local production. When local production contracts, local market demand increases, and merchants are stimulated to bring product in from further away, increasing prices. This hypothesis is tested further in the next chapter.

CHAPTER III

PRICE DATA AND POLICY

This chapter focuses on using price data from various levels in the marketing system to help inform policy makers about production and marketing in Rwanda. The chapter also uses price data to evaluate market efficiency and government price policy initiatives. The chapter begins with an analysis of seasonality within historical price data. Study of seasonality can show what type of price behavior might be expected in a normal year and provide insights on how the market is functioning. Next historical price data and SESA/MSU price data are used to test for market efficiency both geographically and at different levels in the marketing system. A review of the price data collection methods used by different agencies is followed by a comparison of data from various series. Finally, price data collected by SESA/MSU at the farm level in 1986 are used to make inferences about the effects of specific 1986 price policy initiatives.

3.1 Seasonal Retail Price Variation of Beans, Sorghum, Bananas, and Potatoes in Three Rwandan Prefectures

A. Introduction to Seasonal Analysis

Prices can provide information useful to government planners along several dimensions. First, current price movements can be used as indicators of current food availability. Second, current market prices can help predict food scarcity in the near future. Third, study of price behavior in poor years can improve understanding of the timing, duration, and frequency of food shortfalls. These three dimensions are

all related to transient food insecurity, and are treated together in Chapter IV. A fourth dimension, the study of regular seasonal price behavior, has both chronic and transitory food insecurity aspects, and is treated here.

Prices of storable commodities in most parts of the world are generally at their lowest at harvest time, and tend to rise after harvest, reflecting the cost of storage (cost of handling stocks, storage losses, interest on money invested in stocks and equipment). In most cases, prices peak just before the next harvest, and drop as the market liquidates old stock in preparation for the new harvest.

Seasonal price fluctuations can reduce the ability of the very poor to purchase food during certain times of the year. Very high prices are generally a sign of food scarcity. Seasonal price analysis can help distinguish between a normal seasonal price fluctuation and a major food supply crisis. Seasonal price analysis can identify months when poor people may need assistance even in good agricultural years. In Rwanda, price fluctuation due to seasonality of production may be attenuated by the continual harvest of many commodities. Three factors contribute to Rwanda's ability to harvest year round.

First, some crops such as manioc, sweet potatoes, and bananas, can be stored by simply delaying the harvest. Farmers can therefore harvest these crops on an "as needed" basis, which leads to a spreading of the harvest over the entire year.

Second, Haugerud has shown that many farmers "stagger" the planting and harvesting of potatoes to obtain a more consistent food supply,

even though this may reduce yields. To the extent possible, farmers probably apply this strategy to other crops.

Third, and most important here, the multitude of micro-climates and elevations in Rwanda means that a given commodity fits into the crop rotation at different times of the year in different parts of the country. A GOR policy is to promote regional specialization. Regional specialization may mean that production of commodities previously grown in a variety of micro-climates will gravitate towards one or two least-cost areas of the country. If the number of micro-climates in which a commodity is grown is reduced, the harvest time may be limited to one or two months. The seasonal fluctuation in national production levels may therefore increase with specialization. More seasonality in production may produce higher seasonal price swings, although if these regions have significant comparative advantage average prices may drop.

Examining price seasonality also provides information on potential payoffs from storage of basic foodstuffs. Exploring seasonal price movements can help policy makers determine if benefits from interseasonal storage warrant private and/or public sector investment.

B. Methods Used for Seasonal Analysis

For a description of the methods used by MINIPLAN in collecting its retail price series, see a SESA working paper by Mukezangango. MINIPLAN data for 1980 to 1986 are from Mukezangango. The 1987 data are from Zalla (1988).

Selection of the commodities and the prefectures in this analysis was based on the completeness of the monthly MINIPLAN data. The

MINIPLAN data are the most complete for Gitarama, Kigali, and Ruhengeri. The analysis does not include Rwanda's second largest urban center, Butare, due to a large number of missing observations in MINIPLAN's data. The analysis extends from January 1980 to November 1987, or 95 months. Table 3.1 lists the number of missing observations by commodity and by prefecture.

Table 3.1
Number of Months Missing in MINIPLAN
Price Data Used in Seasonal Analysis

Prefecture	Beans	Sorghum	Bananas	Potatoes
Gitarama	5	5	5	5
Kigali	1	1	1	1
Ruhengeri	2	0	3	2

Prices for months that were not reported were estimated by interpolation. Gitarama required the largest percentage of interpolations; 5.2% of the observations were estimated. Across the three prefectures and the four commodities, 2.7% of the observations were estimated.

Price seasonality was estimated using MSTAT¹. MSTAT computes a "Grand Seasonal Index" (GSI) from monthly price data based on a ratio to moving average calculation. The GSI presents typical monthly price movements over the sample period. The GSI is expressed in terms of percentage points, varying around a base of 100. MSTAT estimates

¹MSTAT is public domain software distributed by Michigan State University's Department of Crop and Soil Sciences. A discussion of how to interpret MSTAT price analysis output can be found in Goetz and Weber.

variability in seasonal price movements--a corrected standard error (CSE). The CSE is used to establish 70% and 95% confidence intervals. If the confidence interval for even a single month does not contain the value 100, a price series can be characterized as exhibiting significant seasonality².

This section uses the grand seasonal index and its range to explore seasonal price movements in Rwanda. Annex III contains bar graphs of the GSI for each commodity in the three prefectures and a description of the method used to calculate the GSI. Graphs of monthly production in the 1986 agricultural year are also included in Annex III for the four commodities in the three prefectures. Monthly potato and banana national production is also presented in Annex III (bean and sorghum monthly production estimates are in Chapter II).

C. Results of the Seasonal Analysis

Bananas.-- At the 95% confidence level, none of the three prefectures show significant seasonal price variation. At the 70% confidence level, Gitarama and Kigali have significant seasonality.

Banana price movements do not demonstrate the expected inverse relationship with supply (production) in two of the three prefectures. This may indicate poor market performance. The reasons for this behavior may be worth study in the course of future research.

²Goetz and Weber.

Irish Potatoes.- None of the three prefectures exhibit significant potato price seasonality at the 95% confidence level. At the 70% level, all three have significant seasonality.

Potato prices tend to increase slightly from the beginning until the middle of the year (May, June and July) for Gitarama Prefecture. Prices peak in the middle of the year for both Kigali and Ruhengeri as well, although Kigali's price peak is about a month later.

In Ruhengeri peak potato production comes at the beginning of the peak price season in all three prefectures. The alignment of the major potato harvest with high prices may be one reason for the potato "boom" in Ruhengeri.

Sorghum.- Only Kigali has significant sorghum price seasonality at the 95% level, and this may be spurious. Analysis run without the 1987 data indicates that Kigali's sorghum price seasonality is not significant at the 95% level. All three prefectures have significant seasonal variation at the 70% level.

Sorghum has a marked price peak before the major July harvest in Gitarama and Kigali. Ruhengeri is different from the other two prefectures, with the highest price peak in November-January rather than in April-June. This is logical given that Ruhengeri's first season harvest is larger than its second season (July) harvest. This runs contrary to the seasonality of sorghum in most other prefectures. Ruhengeri's major harvest comes when prices peak in the other two prefectures.

Ruhengeri's sorghum price series appears to have a weak point during the years 1981-82. During that period, the reported price remained at 25 Frw/kg during all but two months.

Beans.- Contrary to the other commodities, bean price in all three prefectures show significant seasonality at the 95% level. The price seasonality is also more similar between prefectures for beans than it is for the other three commodities. All three prefectures show price increases, with higher corrected standard errors in September, October, and November. Prices begin to drop as the major December-January harvest comes onto the market. The second season harvest, with about 30% of annual production, appears to stabilize prices. But the second season harvest is not large enough to push prices down significantly.

As with the other commodities, Ruhengeri's seasonality of bean production is different from Kigali and Gitarama. In Ruhengeri the distribution of dry bean production is much more evenly divided between the first and second seasons than in Kigali and Gitarama. The large second season harvest appears have little effect on price seasonality--probably because Ruhengeri's bean harvest is small in comparison to other parts of the country.

D. Estimating Gross Returns to Storage

Examination of seasonal price patterns allows estimation of the optimal timing of stock acquisition and release in a normal year. Optimal timing and release prices can be compared in order to estimate gross returns to storage. Estimates of probable storage losses can help make the analysis more realistic. The seasonal price graphs were

used to determine optimal storage and release times. The MINIPLAN price series was inflated to 1987 levels with the BNR's consumer price index for the analysis. Annex VIII gives detailed information on the assumptions used to estimate gross returns to storage. Table 3.2 summarizes estimates of gross returns to storage.

The estimated average gross returns to storage are hypothetical. They represent what merchants would have gained if they had followed the optimal storage strategy suggested by seasonal analysis. The analysis assumes only mild storage losses. Costs such as transactions costs, transport costs, handling, physical plant, interest on capital, licenses and risk (such as major storage losses) are not included in the analysis. Thus average profits must be much lower than the gross returns presented in Table 3.2.

For each commodity in all three prefectures, the standard deviation of the gross returns to storage exceeds the mean gross returns to storage. This indicates that storage is very risky even when optimal timing of stock acquisition and release are employed. Negative gross returns to storage when employing optimal acquisition and release timing are frequent. Dry beans show the highest average gross returns to storage of the four commodities, with higher average gross returns for long term storage than for short term storage. Higher returns to storage are consistent with the more clearly defined seasonal price pattern for beans. A standard stock acquisition and release pattern is more likely to succeed where price seasonality is invariant than where it changes greatly between years.

Table 3.2

Average Estimated Gross Returns to Storage
Following an Optimal Strategy
For Four Commodities in Three Prefectures
1980-1987

Product	Gitarama	Kigali	Ruhengeri
Bananas			
Mean	-1.3%	15.1%	7.4%
Std Dev	14.6%	15.6%	34.0%
Potatoes			
Mean	-5.6%	9.4%	3.6%
Std Dev	26.9%	37.3%	31.9%
Sorghum			
Mean	16.9%	27.0%	1.0%
Std Dev	18.9%	30.8%	15.6%
Dry Beans Short Term Storage			
Mean	27.2%	34.4%	19.5%
Std Dev	37.9%	41.5%	20.4%
Dry Beans Long Term Storage			
Mean	50.1%	45.6%	26.0%
Std Dev	69.4%	63.2%	43.7%

Short term storage for dry beans is defined as the period from the second season harvest to the October price peak. Long term storage for dry beans is the period from the February price nadir to the October price peak.

Another reason for the higher returns to bean storage is that dry bean prices increased dramatically in 1984 because of a drought. The other three commodities do not show the same magnitude of price increase in 1984. Less dramatic price movement in other commodities

indicates there was not a generalized food shortfall. Consumers had the ability to shift to consumption of commodities other than beans. If consumers shifted to lower priced foods in 1984, quantities sold at high prices may have been quite small. Merchant gains may therefore have been quite small. The higher than average estimated gross returns to dry bean storage may be somewhat illusory.

In general, the potential gains to be had in storage appear to be small in relation to the risks and the probable costs involved in storage operations.

E. Section Summary and Conclusions

Of the four commodities analyzed, only beans exhibited significant seasonal variation at the 95% confidence level in all three prefectures studied.

At the 70% confidence level, significant seasonal variation exists for all three prefectures and all four commodities with the exception of bananas in Ruhengeri.

Irish potato price profiles peak in the middle of the year for the three prefectures studied. This peak coincides with Ruhengeri's biggest harvest month--which may be one reason for the success of the potato in the region.

The pattern of sorghum price seasonality is quite different in Ruhengeri than in Gitarama and Kigali. Ruhengeri's sorghum price seasonality appears to be modified by its large off-season sorghum crop. Ruhengeri's largest harvest comes at a time when prices in the other two prefectures are high.

Beans exhibit the most consistent price seasonality of any of the commodities examined. Prices are stable from January to the middle of the year, then rise sharply to peak in October-November. This is true even in Ruhengeri, where the second season harvest is much larger relative to the first season harvest than in the other two prefectures.

Can profits be made through storage of these commodities at harvest time, followed by release of stocks at peak price periods? Based on the limited data available, the answer is that storage in Rwanda is a highly risky business. Investment in storage is probably not an advisable enterprise for individuals or governments with limited capital. Variation in prices in peak periods is quite large from year to year, even for the commodity with the most significant seasonality--beans. This may explain why the surveys described in Chapter II found so few merchants engaged in interseasonal storage of food crops.

A strategy to increase transient food security which may be more effective than storage is to take advantage of Rwanda's regional diversity. For example, banana prices peak in April through June in Gitarama and Ruhengeri, but remain stable in Kigali during the same months. Merchants should (and probably do) concentrate on interregional price differences and transport instead of storage.

Seasonal price analysis for potatoes shows how a region can take advantage of an off-season harvest to maximize prices paid to farmers and/or minimize prices paid by farmers. Even small off-season harvests can greatly reduce farm family food expenses in peak price periods. Flexibility in harvest time must be considered before implementing policies that push for increased food production through regional

specialization. Regional specialization may increase seasonal price swings and the costs of storing commodities previously harvested continuously. Transfer costs would increase as more food is moved from one region to another. Data presented below indicate that transfer costs in Rwanda are high relative to the value of basic foods.

Yet there may be inefficiencies in the current production system because farmers maximize the stability of their food supply rather than output or profits. Future research could compare production, storage and transfer costs associated with regionalization with costs of the present system.

The analysis also highlights the importance of complete and accurate monthly price data in improving the understanding of a food system. The best monthly price series in Rwanda allows analysis for only the urban area of three prefectures, and for only four crops. A more complete price collection system would contribute to improved ability to develop effective food policies.

3.2 Market Integration

A. Theory and Testing of Market Integration

Tests of market integration are used to determine the degree to which two or more markets for a commodity are jointly influenced by phenomena affecting supply and demand. Market integration is an important indicator of market performance for two reasons. First, disintegrated markets can fail to send appropriate signals to producers in surplus regions. If high consumer prices are not transmitted to surplus regions, areas which export may lower production to own-

consumption levels, reducing marketed surplus. Second, as Ravallion has pointed out, "...a study of the dynamics of market integration should throw some light on one of the oldest questions concerning famines in market economies: how long can an initially localized scarcity be expected to persist?" Market integration can shed light on the ability of the marketing system to alleviate food shortages by stimulating inter-regional transfers of foodstuffs.

Poor market integration can result from inadequate infrastructure, lack of competition, lack of consistent market information, legal barriers to product movement, or "thin" markets. Thin markets are those "...with few negotiated transactions per time period."³

The measurement of market integration is problematic. Correlation of prices between markets is often used as an indicator of the level of market integration. To date, most work (see a review of studies by Jones [1974] and a manual of price analysis by Goetz and Weber) has used simple price correlations between market pairs to test for market integration in a commodity. Market pairs with high correlation statistics are judged to be more integrated than market pairs with low correlation.

Jones studied simple correlations between undeflated undeseasonalized pairs of market prices in Nigeria. He found low correlations despite the fact that merchants appeared to be acting competitively.

The "bivariate correlation" method has been criticized by Harriss and by Delgado. Problems cited in connection with the above

³Hayenga et al.

formulation of market integration include: 1) Seasonality and inflation common to both markets may bias correlation coefficients upward, causing markets to appear integrated even where there is little trade. 2) The variance of the price of a commodity may change with the time of year (hetero-skedasticity). Hetero-skedasticity violates one of the assumptions of ordinary least squares regression analysis. 3) Prices in unconnected markets may be correlated by coincidence or because of factors other than product exchange which affect prices in both markets. An example of this is legally fixed prices.

Alternatives to the bivariate correlation model for testing market integration have been proposed by Ravallion, Timmer, and Delgado. A detailed discussion of these models is provided in Annex V. The following two paragraphs summarize the models and discuss why they are inappropriate in Rwanda.

Ravallion (1986) and Timmer (1987) propose a "radial" formulation for modelling price integration. The radial model involves examining the relationships between peripheral (rural) markets and a central (urban) market. Unidirectionality of product flow (i.e. rural to urban) is an assumption of the radial model. Rwanda, with its multiplicity of deficit and surplus regions and regional differences in seasonality, violates this assumption. Sources of supplies in rural and urban markets change with the season and the abundance of the local, national, and international harvests.

Delgado's "variance components" approach to testing market integration essentially tests whether prices from a group of markets exhibit the same seasonal behavior. This assumes geographic

homogeneity of production, which is not a valid premise in the case of beans and sorghum in Rwanda.

Given the problems associated with the above models, alternative tests of market integration must be explored. A first step in developing these tests is to use the information presented up to this point to develop a conceptual framework of factors which may influence price behavior in Rwanda.

B. Factors Affecting Market Prices in Rwanda

Equations 3.1 through 3.3 illustrate the factors influencing prices in local Rwandan markets. Demand in the local, national, and international markets must be thought of as having two components: consumption demand and market demand. Consumption demand is probably quite static. Market demand is probably more dynamic. Market demand and supply in the local, national, and international market can be hypothesized to have an inverse relationship. This is because most people in Rwanda are farmers, are selling a small portion of production, and at the same time Rwandan farmers are buying the bulk of the food. Urban markets may behave quite differently.

When rural supply (production) is abundant, rural market demand may be low because many consumers are able to meet their consumption demand out of own production. Conversely, when there is a production shortfall, consumers may try to maintain consumption by purchasing a larger than normal volume in the market. A small change in aggregate production may translate into both a large reduction in marketed supply and an outward shift in market demand.

$$P_l = f(S_l, D_l, T_l, M_l, P_n, P_i, I, e_l) \quad (3.1)$$

$$P_n = g(S_n, D_n, T_n, M_n, P_i, I, e_n) \quad (3.2)$$

$$P_i = h(S_i, D_i, T_i, M_i, I, e_i) \quad (3.3)$$

Where: P_l = Prices in local markets
 S_l = Supply coming from local sources
 D_l = Demand from local consumers
 T_l = Costs associated with transferring product from local suppliers to local consumers
 M_l = Seasonal (monthly) effect on prices in local markets
 P_n = Prices of product coming from other Rwandan (national) markets
 P_i = Prices of product coming from regional (international) market
 I = Inflation
 e_l = Random effects on the local market

S_n = National Supply
 D_n = National Demand
 T_n = Costs of transferring product from producers in other regions of Rwanda to local consumers
 M_n = Seasonal (monthly) effect on prices in national markets
 e_n = Random effects on the national market

S_i = International Supply
 D_i = International Demand
 T_i = Costs of transferring product from producers in other countries to local consumers
 M_n = Seasonal (monthly) effect on prices in national markets
 e_i = Random effects on the international market

Changes in output from year to year may be different across regions. Supply may contract (demand expand) in one region while supply expands (demand contracts) in another. This situation is very relevant in Rwanda because of its diverse system of micro-climates. The location of sources of supply and vents for surplus may change

dramatically from year to year, with concurrent changes in the direction of product flow.

Transfer costs have many different components. At the local level, transfer costs may simply be the labor involved in carrying the product from the producer's home to the consumer's home and the time involved in negotiating a price. On the other hand, local level transfer costs may involve many more operations: assembly, transport and storage costs between many persons, each performing a different marketing function. Transfer costs become larger as the length of the marketing chain increases.

Average transfer costs per kilo must be larger for grain brought into a local market from other areas of Rwanda than for locally produced grain. The marketing chain is longer, involving more steps and the distances which the grain is transported are greater. The same relationship must hold for transfer costs on foreign grain brought into the local market. To generalize, transfer costs depend on distance transported and the number of transactions necessary to deliver the commodity from the producer to the consumer. All other things being equal, grain from distant places is more expensive to obtain than local grain.

But all other things are not equal. The cost of production in one area of the country or nation may be greater than the cost of production in another. Further we have seen in the above section on seasonality that the seasonal effects on prices are not homogeneous between regions. For some commodities, prices are typically low in one prefecture during the same month that they are high in another. Later

in the year, the situation reverses itself. The direction of product supply lines may change or even reverse themselves according to the time of year.

Seasonal effects on local, national, and international prices arise from seasonal changes in food availability and storage costs.

In summary prices in local markets are influenced by local transfer costs, seasonality, supply and demand. But local market prices also depend on transfer costs, seasonality, supply and demand in national and international markets. The effect of these forces on prices changes with time and across space. The price surface in Rwanda cannot be expected to look hard and flat. Rather it must look like a blanket being shaken between two people, with constantly changing ripples, height, arc and slope.

C. Tests of Market Integration Using MINIPLAN Data

A modified version of the bivariate model has been retained for analyses of MINIPLAN data. The problem of spurious correlation arising from inflation or seasonality has been addressed by detrending and deseasonalizing. To test whether heteroskedasticity across seasons biases results, regressions by season are compared with regressions on the entire data set. The analysis is confined to those commodities and towns for which the MINIPLAN data are reasonably complete (for a discussion of the MINIPLAN data see the above section on seasonality). A complete data set is necessary for deseasonalization.

Tables 3.3 and 3.4 show results of bivariate regression analyses. All treatments in bivariate models show the same ordering of the four

products: bean prices exhibited the highest correlation followed by potatoes, sorghum, and bananas. This ordering of level of price integration is logical for urban markets because beans and potatoes are heavily purchased in the urban areas for consumption. A large percentage of sorghum is consumed as beer in Rwanda. Urban retail sorghum trade is mostly in the form of beer because most beer is manufactured in the rural areas (Haggblade with Minot).

Table 3.3
Bivariate Correlation Adjusted R-Squared Statistics
Under Varying Treatments of 1980-7 Retail Price Data⁴

Crop/Pair	Nominal Prices	Deseas- onalized (Index)	Deseas- onalized and Detrended	Deseas- onalized (Difference)
Potatoes				
Kigali-Gitarama	.46	.51	.53	.51
Kigali-Ruhengeri	.32	.40	.43	.46
Gitarama-Ruhengeri	.34	.29	.29	.26
Bananas				
Kigali-Gitarama	.16	.20	.20	.30
Kigali-Ruhengeri	.06	.10	.05	.07
Gitarama-Ruhengeri	.06	.04	.04	.02
Beans				
Kigali-Gitarama	.73	.71	.69	.65
Kigali-Ruhengeri	.68	.70	.67	.75
Gitarama-Ruhengeri	.64	.59	.56	.58
Sorghum				
Kigali-Gitarama	.42	.40	.32	.37
Kigali-Ruhengeri	.06	.23	.21	.39
Gitarama-Ruhengeri	.11	.19	.18	.33

⁴Data collected by MINIPLAN from January 1980 through November 1987. The column "Deaseasonalized (Index)" indicates that the data were deseasonalized using a multiplicative index similar to the one described in Section III.1.b. The column "Deseasonalized and Detrended" shows results for data that were deseasonalized with the index method and detrended (to correct for biases introduced by inflation) using a simple time trend. The column "Deseasonalized (Difference)" reflects results on data deseasonalized using 12th order differences. All regressions and deseasonalization performed with the software package Micro TSP, Version 5.1a.

Table 3.4
Bivariate Correlation Adjusted R-Squared Statistics
Whole Year Regressions Compared with Seasonal
Regressions
(Detrended Data)

Potatoes	Oct-Apr	May-Sep	Weighted Average	Whole Year	
Kigali-Gitarama	.65	.27	.49	.47	
Kigali-Ruhengeri	.43	.20	.33	.33	
Gitarama-Ruhengeri	.33	.28	.31	.34	
Bananas	Jan-May	Jun-Dec	Weighted Average	Whole Year	
Kigali-Gitarama	.20	.13	.16	.16	
Kigali-Ruhengeri	-.02	.04	.02	.02	
Gitarama-Ruhengeri	.16	.01	.07	.06	
Beans	Feb-May	Jun-Jan	Weighted Average	Whole Year	
Kigali-Gitarama	.76	.69	.71	.70	
Kigali-Ruhengeri	.63	.66	.65	.64	
Gitarama-Ruhengeri	.78	.59	.65	.65	
Sorghum	Nov-Jan	Feb-Jun	Jul-Oct	Weighted Average	Whole Year
Kigali-Gitarama	.68	.21	.29	.35	.38
Kigali-Ruhengeri	.23	.15	.16	.17	.05
Gitarama-Ruhengeri	.30	-.02	.41	.20	.09

Notes: Seasons based on seasonal price index levels and corrected standard errors presented in the preceding section. Weighted averages are of seasonal regression results. Weights are based on the number of months in each season. "Whole year" refers to regressions run without splitting the data into seasons. Data were detrended by subtracting a value determined by regressing the data with time. Splitting the data into seasons with nominal data, deseasonalized data, and deseasonalized and detrended data yielded essentially the same results.

Deseasonalization of sorghum prices yielded significant improvement in adjusted r-squared statistics (Table 3.3) in two market pairs (Kigali-Ruhengeri and Gitarama-Ruhengeri). This result is contrary to what the literature on bivariate price correlation would lead one to expect⁵. Table 3.4 shows that splitting the regressions in two or more seasons also increased average adjusted R-squared statistics for the same two prefecture pairs. These were the only two regressions where the division into seasons had a large effect. It may be that the reversal of seasonality of production between Ruhengeri and the other two prefectures (see preceding section on seasonality) masks overall market integration. Ruhengeri may be paying to transfer sorghum into the prefecture while other areas are avoiding transfer costs due to local harvests, and vice versa.

Cursory examination of urban markets revealed that retail trade in bananas was a lower volume activity than for beans, potatoes or sorghum. It follows that markets for this product would be less integrated. The data show that two of the three market pairs studied are very poorly integrated for bananas. Banana wine rather than bananas may dominate the urban banana trade.

Thus the briskness of the retail trade appears to influence the level of market integration, with high volume yielding higher market

⁵See Harriss or Delgado. The last column in Table 3.3, showing regression results using 12th order differences (i.e. January 1981 minus January 1980) to deseasonalize, is included to demonstrate the robustness of the results under different methods of deseasonalization, because as Harvey (pp. 177-8) states, "Seasonal adjustment can introduce considerable distortion into a series, and, at the same time, there is no guarantee that the adjusted series will be free from seasonal effects."

integration. Thin markets may be a major cause of poor market integration where present in Rwanda--not lack of competition or other factors.

Casual observation of urban markets shows that banana retailers tend to be women selling in the open air areas or the stalls of the market, not from stores. Storefronts performing the wholesaler function for bananas are not evident. This simple market structure is an indication that markets are more dependent on local supplies for bananas than are the other three commodities. The poor banana market integration test results are therefore supported by less formal observation. Nearly constant local harvests, coupled with high transfer costs for this bulky, highly perishable commodity may be additional explanations for low banana market integration.

D. Road Improvements and Retail Price Integration⁶

Rwanda has consistently improved its major roads from the mid 1970s to date. To gauge the marketing system's response to decreased transport costs, tests of market integration were performed for periods prior to and after paving of major roads. The analysis relies on 1971 to 1987 MINIPLAN data detrended with the BNR's consumer price index. The model employed is the market-pair regression model.

Tables 3.5 and 3.6 show regression results. With the exception of the Kigali-Butare market pair for sorghum, the completion of a paved road between major markets is associated with increased market

⁶This approach was first explored for Rwanda in Bylenga and Loveridge.

integration. There is no clear explanation for the anomalous Kigali-Butare result.

The general results show that Rwanda's efforts to improve its road system are having beneficial effects in terms of facilitating movement of food between markets. Further improvements of the road system, particularly secondary roads for the less populated regions in the eastern part of the country, may help unlock untapped local surpluses.

Table 3.5
Market-pair Regressions on Detrended Urban Retail Dry Bean Prices
Before and After Paved Roads

Market Pair	Construction Years	Prior to Paving		After Paving	
		Adj. R ²	No. Obs.	Adj. R ²	No. Obs.
Ruhengeri-Gisenyi	1974-1977	-.03	24	.35	52
Kigali-Kibungo	1974-1977	-.07	12	.45	71
Kigali-Gitarama	1978-1983	.51	48	.83	45
Kigali-Butare	1978-1983	.48	47	.80	38

The analysis covers MINIPLAN data from the years 1971 through 1987. Construction years are excluded from both regressions for each market pair. Detrending was accomplished using the BNR consumer price index.

Table 3.6
Market-pair Regressions on Detrended Urban Retail Sorghum Prices
Before and After Paved Roads

Market Pair	Construction Years	Prior to Paving		After Paving	
		Adj. R ²	No. Obs.	Adj. R ²	No. Obs.
Ruhengeri-Gisenyi	1974-1977	.06	24	.50	49
Kigali-Kibungo	1974-1977	-.11	11	.17	80
Kigali-Gitarama	1978-1983	-.13	9	.36	45
Kigali-Butare	1978-1983	.83	24	.28	34

The analysis covers MINIPLAN data from the years 1971 through 1987. Construction years are excluded from both regressions for each market pair. Detrending was accomplished using the BNR consumer price index.

E. Tests of Market Integration Using Farm Level Price Data

With the farm level bean and sorghum transactions data collected during 1985-1987, it is possible to test for market integration of farm level prices. The purpose of such a test is to examine the extent to which price signals are being transmitted to the rural areas. Because the SESA/MSU Farmer I survey is nationally representative and includes quantity variables, three models to test market integration can be formulated. The first model uses a modified version of the Jones bivariate market-pair correlation formulation. The second model evaluates each prefecture's price behavior with respect to quantity and population weighted average prices in the rest of Rwanda. The third model employs the same basic formulation as the second, but

incorporates variables for changes in the direction of product movement.

Model 1: Prefecture Pair Test of Farm Level Price Integration.-

The test was performed by running bivariate regressions on weighted average purchase prices of beans and sorghum by prefecture-pair and by week. Adjusted R-squared statistics resulting from the market-pair regressions are presented in Tables 3.7 and 3.8. The regressions were run on undetrended prices. The short sample period and low inflation rate reduce the risk of spurious correlation due to trend. Deseasonalization with a ratio to moving average technique is impossible because this procedure requires several years' data.

Results in Tables 3.7 and 3.8 support the earlier conclusions from the analysis of the MINIPLAN data. Regression R-squared statistics for sorghum are lower than for beans. The market for dry beans appears to be much better integrated than the market for sorghum.

It is expected that adjusted r-squared statistics from regressions on farm level data should be lower than for data collected from urban markets, due to the dispersed nature of the sample farms. But the results in Tables 3.7 and 3.8 indicate a very low level of market integration. "Deseasonalizing" the sorghum data by splitting the regressions into seasons as in the analysis of the MINIPLAN data did not improve overall performance.

Table 3.7
Adjusted R-squared Statistics Resulting from Bivariate
Correlations of Nominal Weighted Average Dry Bean
Weekly Farm Level Purchase Prices

	Byu- mba	Cyan- gugu	Gikon- goro	Gis- enyi	Gitar- ama	Kibu- ngo	Kib- uye	Kig- ali	Ruh- engeri
Butare	.01	.20	.00	-.02	.15	.05	.00	-.02	.01
Byumba		.19	.71	.25	.30	.26	.50	.29	.49
Cyangugu			.14	.04	.24	.20	.19	.05	.08
Gikongoro				.03	.34	.32	.37	.22	.56
Gisenyi					.01	.05	.21	.05	.00
Gitarama						.18	.23	.16	.38
Kibungo							.24	.07	.30
Kibuye								.27	.36
Kigali									.43

Note: "Weekly" observations based on data collected four times per month from November 1985 through December 1986.

Table 3.8
Adjusted R-squared Statistics Resulting from Bivariate
Correlations of Nominal Weighted Average Sorghum
Weekly Farm Level Purchase Prices

	Byu- mba	Cyan- gugu	Gikon- goro	Gis- enyi	Gitar- ama	Kibu- ngo	Kib- uye	Kig- ali	Ruh- engeri
Butare	.03	.02	.08	-.01	.12	.16	.14	.02	.02
Byumba		-.01	.17	.00	.10	.12	.12	.02	-.01
Cyangugu			-.01	.01	.01	-.01	.02	.00	-.01
Gikongoro				.00	.32	.35	.31	.06	.02
Gisenyi					-.01	-.01	.05	.03	.00
Gitarama						.40	.31	.14	.02
Kibungo							.27	.16	.02
Kibuye								.06	.02
Kigali									.02

Note: "Weekly" observations based on data collected four times per month from November 1985 through June 1987.

Model 2: A Prefecture-Rest of the Country Test of Farm Level Market

Integration.- Model 2 takes advantage of the statistically valid sample used to collect the Farmer I survey data. The sample permits formulation of national price and quantity estimates. In criticizing the market pair bivariate correlation model, Delgado correctly points out that

"...the statistical interpretation of bivariate correlation coefficients in this [market integration] context is problematic. There is no way to compare and synthesize results once more than two markets are involved since each pair is considered in isolation."

In practice this means that a low correlation coefficient or adjusted r-squared statistic is difficult to ascribe to one or the other of the markets in a pair. This is particularly true if both markets yield high and low adjusted r-squared statistics when paired with other markets. Identifying regions with weak marketing links to the rest of the country is therefore problematic with market pair models. Model 2 overcomes this weakness of the market pair test of market integration. The model regresses population and quantity weighted average prices in each prefecture with population and quantity weighted average prices in the rest of the country. Equation 3.4 expresses the model symbolically:

$$PROC = \alpha + \beta * PPREF + e \quad (3.4)$$

Where: PROC = Population and quantity weighted
prices in all of Rwanda excluding
prefecture X

α = Constant

β = Coefficient

PPREF= Population and quantity weighted
prices in prefecture X

e = Error term

PROC is calculated by excluding the prefecture in question from aggregate estimation routines. PPREF is calculated by including only the prefecture in question in aggregate estimation routines. By regressing prices in the prefecture against prices in the rest of the country, a much better test of how local markets react to external price signals is obtained. This is because the model tests a market's adaptation to the whole system, not simply an isolated market.

The model also reduces estimation errors by increasing the number of observations used to calculate the dependent variable.

Model 2 regressions were run using weekly⁷ farm level bean and sorghum price data from the SESA/MSU Farmer I survey. Results are shown in Tables 3.9 and 3.10. In general, purchase price regressions fit better than sales price regressions. This is likely related to the number of sales observed during the survey. In some prefectures sales were recorded in only a few weeks. Reduction in the number of weekly observations has a negative effect on the Adjusted R-Square statistic. In some weeks average prices are based on a very limited number of sales. When only a few observations are used to compute an average price, the likelihood of "noise" due to measurement error or extraordinary circumstances increases. Comparisons of these results with those obtained through prefecture-pair regressions is deferred until after the presentation of a third model incorporating product flow considerations.

⁷Each month of the survey was divided into four periods roughly corresponding to weeks. The bean survey ran for 14 months or 56 "weeks". The sorghum survey ran for 20 months or 80 "weeks".

Table 3.9
Regressions of Prefectural Farm Level Dry Bean Prices
against Farm Level Dry Bean Prices in the Rest of Rwanda
(maximum 56 weekly observations)

Prefecture	Purchases		Sales	
	Adj.-R ²	Obs.	Adj.-R ²	Obs.
Butare	.48	56	.28	45
Byumba	.75	56	.39	47
Cyangugu	.53	56	.42	23
Gikongoro	.69	54	.68	18
Gisenyi	.43	56	.06	26
Gitarama	.63	56	.60	46
Kibungo	.66	53	.51	50
Kibuye	.56	56	.01	21
Kigali	.60	54	.40	54
Ruhengeri	.66	56	.53	25

Table 3.10
Regressions of Prefectural Farm Level Sorghum Prices
against Farm Level Sorghum Prices in the Rest of Rwanda
(maximum 80 weekly observations)

Prefecture	Purchases		Sales	
	Adj.-R ²	Obs.	Adj.-R ²	Obs.
Butare	.24	80	-.02	51
Byumba	.13	78	.01	68
Cyangugu	.01	80	-.04	17
Gikongoro	.24	79	-.06	17
Gisenyi	.01	80	-.05	23
Gitarama	.45	80	-.02	61
Kibungo	.38	80	.06	69
Kibuye	.20	80	.16	10
Kigali	.10	80	.01	68
Ruhengeri	.00	80	.03	54

Model 3: Including Product Flow in Testing Farm Level Market

Integration.- In Rwanda, market demand fluctuations are linked to production. In good years, demand for a commodity will be low, because more farm families are able to produce sufficient quantities of the good themselves. Demand and production costs are therefore linked--when per kilogram production costs rise (bad crop year), so does demand (insufficient local production).

Significant bean and sorghum imports into a given locality mean that local, national, and international production all play important roles in price formation. Aggregate national and international product availability should affect all local markets if they are integrated. When local production deviates significantly from national and international production (i.e. good local harvest when harvest elsewhere was bad or vice versa), then tests of market integration may be biased. In this situation, transfer costs paid by local consumers will differ from transfer costs paid by consumers in other regions, resulting in differences in the direction and magnitude of price movements. Most market integration models ignore flow considerations due to lack of data. Data from the SESA/MSU Farmer I survey allow development of a proxy for product flow. The proxy for product flow is added to the Model 2 specification.

Proxies for product flow are export dummies constructed as follows. Each prefecture's weekly net sales position was computed by subtracting estimated quantity bought from estimated quantity sold. Net sales position of the rest of the country was computed by summing the net position variable over the other nine prefectures. Two dummy

variables were constructed. One dummy was assigned a value of zero when the prefecture's purchases exceeded its sales and a value of one when sales exceeded purchases. The second dummy equals zero if the rest of the country was importing and one if the rest of the country was exporting.

The dummies allow the intercept of the regression equation to change with the net sales position of the prefecture and the rest of the country.

Model 3 simply incorporates the export dummies into Model 2. Model 3 is expressed symbolically in equation 3.5:

$$\text{PROC} = \alpha + \beta \cdot \text{PPREF} + \delta \cdot \text{DPREF} + \theta \cdot \text{DROC} + e \quad (3.5)$$

Where: PROC = Population and quantity weighted
prices in all of Rwanda excluding
prefecture X

α = Constant

β, δ, θ = Coefficients

PPREF = Population and quantity weighted
prices in prefecture X

DPREF = Dummy for exports from prefecture X

DROC = Dummy for exports from the other nine
prefectures

e = Error term

Tables 3.11 and 3.12 show results of applying Model 3 to bean and sorghum price and quantity data from the SESA/MSU Farmer I survey. A 90% confidence interval was used to determine significance of the export dummies. Export dummies are significant in six of the ten bean purchase price equations and seven of the ten sorghum purchase price equations. Sales price equations show export dummies to be significant in only one prefecture for each commodity. A 90% confidence interval gives incorrect results in one out of ten cases, so "significance" of export dummies in sales equations may be spurious.

In general, Model 3 shows that the net sales position of the prefecture and the rest of the country have an influence on prices. Net sales position appears to have a more significant effect on purchase prices than on sales prices. This is logical given that purchase prices should reflect more transfer costs than sales prices. When one or more prefecture is exporting, the joint effect on purchase prices in the rest of the country may be greater than the effect in the prefecture itself. Purchase prices in the rest of the country may drop because imports from abroad are not needed when other Rwandan prefectures are exporting.

Table 3.11
Farm Level Dry Bean Prices: Prefectural Estimates
and Export Dummies Regressed Against
Estimates for the Rest of Rwanda

Prefecture	Purchases			Sales	
	Adj.-R ²	δ	θ	Adj.-R ²	δ
Butare	.50	3.4	*	.27	*
Gikongoro	.74	-3.7	*	.65	*
Gisenyi	.52	nv	-5.3	.03	*
Kibungo	.69	*	-2.5	.52	-2.2
Kigali	.77	*	-10.4	.38	*
Ruhengeri	.69	*	-3.2	.69	*

The coefficients on dummy variables for exports from the prefecture and the other nine prefectures are represented by δ and θ respectively. The symbol "nv" indicates the variable was constant over the sample period. Asterisks indicate the coefficient is not statistically different from zero with a 90% confidence interval. None of the sales equations yielded significant θ .

Table 3.12
Farm Level Sorghum Prices: Prefectural Estimates
and Export Dummies Regressed Against
Estimates for the Rest of Rwanda

Prefecture	Purchases			Sales	
	Adj.-R ²	δ	θ	Adj.-R ²	δ
Butare	.44	-3.1	*	-.02	*
Cyangugu	.06	*	-2.2	-.08	*
Gisenyi	.08	*	-2.2	-.08	*
Gitarama	.49	-1.3	-1.0	.00	-3.3
Kibungo	.40	-1.2	*	.04	*
Kibuye	.24	*	-1.7	.10	*
Kigali	.24	-1.7	*	.00	*

The coefficients on dummy variables for exports from the prefecture and the other nine prefectures are represented by δ and θ respectively. Asterisks indicate the coefficient is not statistically different from zero with a 90% confidence interval. None of the sales equations yield significant θ .

Comparing Results from Models 1, 2 and 3.- Model 2 yields substantially better equations than almost all of the Model 1 equations (see Tables 3.7 and 3.8). Table 3.13 shows the improvement of Model 2 over the simple average of Adjusted R-Square statistics resulting from Model 1 equations. Decreased measurement error in the dependent variable may partially explain the dramatically improved fit. Another explanation is that farmers and traders probably set their prices based on information from a variety of sources. Model 2 approximates the information available to farmers and traders better than Model 1, so Model 2 provides a better fit. These results indicate that market pair formulations of bivariate correlation models may often underestimate the level of market integration.

Table 3.13 shows that incorporation of changes in the direction of product flow into tests of market integration (Model 3) can greatly improve the fit of the model in some cases. Transfer costs may be much more important in determining prices paid by consumers than previously imagined.

Table 3.13
Adjusted R-Square Statistics from Three Tests
of Farm Level Market Purchase Price Integration

Prefecture	Dry Beans			Sorghum		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Butare	.04	.48	.50	.06	.24	.44
Byumba	.33	.75	*	.06	.13	*
Cyangugu	.15	.53	*	.00	.01	.06
Gikongoro	.29	.69	.74	.14	.24	*
Gisenyi	.07	.43	.52	.00	.01	.08
Gitarama	.22	.63	*	.16	.45	.49
Kibungo	.18	.66	.69	.16	.38	.40
Kibuye	.26	.56	*	.14	.20	.24
Kigali	.17	.60	.77	.06	.10	.24
Ruhengeri	.29	.66	.69	.01	.00	*

Model 1 columns are simple averages of Adjusted R-Square statistics resulting from pair-wise regressions with each of the other nine prefectures. Asterisks in Model 3 columns indicate that neither of the export dummies is significant.

F. Non-competitive Factors Influencing Market Integration

Transactions costs and transport costs may act as barriers to market integration in Rwanda. Tests of market integration above indicate that transfer costs can be important determinants of prices paid. Evidence from the SESA/MSU Farmer I survey suggests that transactions costs are high in Rwanda. The average amount of sorghum

sold per transaction by farmers was 25 kilos. The largest sorghum sellers (more than 60 kilos sold, net per year) had an average transaction size of only 44 kilos. For beans, the average quantity exchanged per sale was even lower, at 10 kilos. Large sellers (families selling more than 60 kilos, net over the year) had a slightly higher average size of sale at 18 kilos. The number of transactions necessary to establish a large volume for transport or storage must be very high, resulting in high assembly costs.

Transport costs are also high relative to product prices in Rwanda. In 1982, a study⁸ found that fixed and variable costs for a Toyota pickup truck (the type of vehicle frequently used to haul beans and sorghum) were 43 Frw/km. Merchants with trucks interviewed in the trader survey said their trucks were usually empty on backhauls, so we can assume 50% capacity utilization. If these figures are correct, a trucker with a full 2000 kilo capacity vehicle would break even on a round trip to a market 23 kilometers away at a 1 Frw margin.

Table 3.14 illustrates how transport costs can influence prices paid by rural consumers. When local producers are not selling, market price differences should reflect differences in cost of transport from supply regions. Table 3.14 shows prices and percentages of total dry bean purchases coming from local producers in October 1986 calculated from the SESA/MSU Farmer I survey. October 1986 was the month when bean imports were highest during the SESA/MSU Farmer I survey. Discussions with knowledgeable persons indicate that bean imports are coming into Rwanda from Uganda and Northern Kivu, or the North-

⁸Miville and Comeau

Northwest of Rwanda. Table 3.14 shows that prices in prefectures supplying less than 10% of their purchases increase with increased distance from the North-Northwestern border area, with Byumba and Ruhengeri being closest and Cyangugu being most distant. Transport costs are clearly an important reason for the higher prices in the southwest. Transport costs, assembly costs, and thin markets may prevent merchants from performing arbitrage functions between Kibungo and prefectures where prices are higher.

Table 3.14
Rural Dry Bean Prices
and Ratio of Rural Sales to Rural Purchases
October 1986

Prefecture	Ratio of Sales to Purchases	Average Purchase Price (FRW/KG)
--Prefectures with local sales < 10% of purchases--		
Byumba	.08	28
Ruhengeri	.00	29
Gikongoro	.05	32
Kibuye	.05	33
Cyangugu	.00	40
--Prefectures with local sales > 10% of purchases--		
Butare	.14	32
Gisenyi	.26	29
Gitarama	.21	33
Kibungo	.31	23
Kigali	.49	29

Average absolute price differences between prefectures were calculated for the sample period using data from the SESA/MSU Farmer I survey. These are presented in Tables 3.15 and 3.16. Except for Kibungo, average absolute price differences between prefectures for

both beans and sorghum ranged between 3 and 7 Frw/kg. Given the distances involved, in many cases it would not pay truckers to haul beans and sorghum for such small price differentials. When price differences are less than transport costs, product is not moved between the two prefectures, and the price difference is not equilibrated.

Table 3.15
Average Price Differences (FRW) Between Prefecture-Pairs
Nominal Weighted Average Dry Bean
Weekly Farm Level Purchase Prices

	Byu- mba	Cyan- gugu	Gikon- goro	Gis- enyi	Gitar- ama	Kibu- ngo	Kib- uye	Kig- ali	Ruh- engeri
Butare	5	5	4	4	3	9	4	5	4
Byumba		7	3	3	4	7	5	3	3
Cyangugu			6	6	6	12	5	7	6
Gikongoro				4	3	9	4	4	3
Gisenyi					4	8	4	3	3
Gitarama						8	4	4	3
Kibungo							10	8	8
Kibuye								5	4
Kigali									3

Note: "Weekly" observations based on data collected four times per month from November 1985 through December 1986.

Table 3.16
Average Price Differences (FRW) Between Prefecture-Pairs
Nominal Weighted Average Sorghum
Weekly Farm Level Purchase Prices

	Byu- mba	Cyan- gugu	Gikon- goro	Gis- enyi	Gitar- ama	Kibu- ngo	Kib- uye	Kig- ali	Ruh- engeri
Butare	4	5	4	4	3	8	3	5	4
Byumba		6	3	5	4	6	4	5	5
Cyangugu			6	5	5	9	5	6	4
Gikongoro				4	3	6	4	5	4
Gisenyi					4	9	3	5	4
Gitarama						8	2	4	4
Kibungo							9	8	8
Kibuye								4	4
Kigali									5

Note: "Weekly" observations based on data collected four times per month from November 1985 through June 1987.

While the absolute price differences between prefectures are small, they are large relative to farm level buying prices. Average national farm level bean and sorghum buying prices remained close to 25 Frw/kg for most of the transactions survey sample period (see Section III.4). A price difference of 3 to 7 Frw/kg is small relative to transfer costs, but large relative to the prevailing market price of about 25 Frw/kg. When price differences are large relative to prevailing market prices, adjusted R-squared statistics from market pair regressions will be low.

G. Explanations for Sorghum's Performance

There are several explanations as to why sorghum markets may be less well integrated at the farm level than dry bean markets. The thin market explanation hypothesized for poor sorghum and banana urban market integration above cannot explain farm level differences between beans and sorghum. Roughly equal quantities of the two products are produced and marketed and a high proportion of the beans and sorghum in rural markets is imported.

The demand characteristics of sorghum are different than beans. Bean demand is created by a need for food or seed. Sorghum demand appears to be more complex. Sorghum has an "impromptu demand" component caused by unforeseen ceremonial needs of sorghum for beer. A second component of demand comes from needs of other market participants for an inexpensive source of nutrition. Purchasing sorghum for revenue generating activities (beer making) creates a third type of demand. Consumer willingness to pay will vary with the type of demand. Observed prices are less stable for sorghum than for beans, which may indicate multiple types of demand.

A second explanation for the poorer fit of regressions on sorghum prices relates to the geographic distribution of production. Over 97% of farms in Rwanda produce beans, while only 76% produce sorghum. A much smaller percentage of farms produce sorghum in the western areas of Rwanda than in the other regions. Where few households produce sorghum transfer costs are a much more important component of prices paid by consumers. Consumers in the west probably begin paying these

costs much sooner after the major harvest than do consumers in other areas.

H. Conclusions from Tests of Market Integration

The basic forces of supply and demand at the local, national and international levels appear to be the principal determinants of prices in Rwanda. Price differences between prefectures can reasonably be attributed to transfer costs. Transfer costs are low in absolute terms, but high in relation to farmgate prices.

Bean markets in Rwanda appear to be moderately well integrated at both the urban retail and the farm level. Farm level bean market pair price regressions yielded lower adjusted R-squared statistics than urban regressions, but this is to be expected given the nature of the rural sample, the fact that weekly observations were used and the lower number of observations.

Sorghum markets, while not the least well integrated of the four products studied, appear surprisingly disintegrated when compared to the results for beans. Beans and sorghum share many common characteristics (storability, importance in the Rwandan diet, and volume produced, marketed, and imported). Sorghum price behavior may arise from multiple types of demand and/or higher transfer costs with geographic concentration of production.

These results show that competition is reasonably well developed in Rwandan food marketing. State programs to improve competition via parastatal purchasing and selling of foodstuffs at preset prices may be unnecessary. Reasons for low market integration for certain crops

appear to be based more on the characteristics of the commodity or on the structure of demand than on a lack of market competition. For example high transport costs, perishability, and local availability in the case of bananas and multiple types of demand and regional differences in production for sorghum.

3.3 Urban-Rural Price Differences

The analysis of the difference between prices at different levels of the marketing system can provide clues about how the market functions. The MINIPLAN urban retail data and the SESA/MSU Farmer I survey are two price series collected concurrently at different levels in the system. Comparing these two series helps determine if commodity flows are from rural to urban areas or vice versa. Price differences between urban and rural settings also give a sense for the costs associated with the transfer of product from one area to another⁹.

For this analysis, three prefectures, Gitarama, Kigali, and Ruhengeri are selected based on the quality of the MINIPLAN price data. Figures 3.1 through 3.6 show the difference between prices received by farmers and prices paid by urban consumers for dry beans and sorghum. Positive margins indicate that farmgate prices were below retail urban prices while negative margins indicate the reverse. Figures 3.1 through 3.6 also show net rural grain flows as estimated from the

⁹Some caution must be exercised in interpreting the price data from Rwanda for two reasons. First, the farm level data was collected at specific, randomly selected areas in each prefecture, and some areas reported no sales during some months. The reported average price therefore reflects only those areas where farmer transactions were observed. Second, there are gaps in the MINIPLAN urban data because agents did not collect merchant level data some months.

SESA/MSU Farmer I survey. Negative net flows indicate farmers in the prefecture bought more than they sold. Positive net flows indicate that farmers sold more than they bought. Two factors contribute to incomplete data in Ruhengeri. First, MINIPLAN agents did not collect data in some months. Second, none of SESA's sample farms in Ruhengeri had sales in some months.

Figures 3.1 through 3.6 show how the direction of the flow of product is linked to the rural-urban price relationship. When the rural areas are in surplus, product moves from the rural area to the urban area. The urban consumers must pay the transfer costs associated with this movement and urbanites pay more than persons buying from farmers. When the rural areas import, product most likely passes through the urban area on its way to the rural consumers. In this situation rural buying from farmers or local vendors pay more than urban consumers, as is illustrated in the Gitarama bean graph for the months of greatest imports: July-November.

Only in Kigali do prices received by farmers remain substantially below urban retail prices during most of the year. This is logical because Kigali is the only prefecture of the three which is not a major importer of both commodities. Prices paid to farmers in rural areas approach (or exceed) retail prices in the urban areas when rural availability is very low and the alternative is to purchase at a rural market with the added cost of transfer from urban areas.

Table 3.17 shows average prices paid by Kigali farmers for beans and sorghum only slightly lower than urban retail prices. The cost of transferring beans and sorghum from Kigali producers to Kigali

consumers appears about the same regardless of whether the consumer is in a rural or a urban area.

In Gitarama and Ruhengeri, where rural bean and sorghum imports are large, prices paid to farmers are close to urban retail prices throughout most of the year. Farmgate retail margins remain close to zero (Table 3.17).

Table 3.17 shows that prices paid by farmers in Gitarama and Ruhengeri tend to be above urban retail prices. These prices paid by farmers are consistent with added costs of product transfer from outside the prefecture first to towns and then from towns to rural areas in the prefecture.

Prices received by farmers in Kigali are lower than in the other two prefectures included in Table 3.17. This may be due to larger supply relative to demand in Kigali than in the other two prefectures.

Figure 3.1

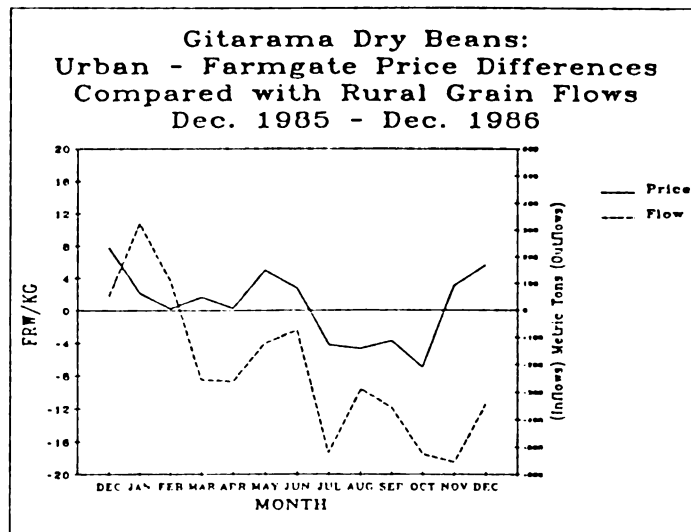


Figure 3.2

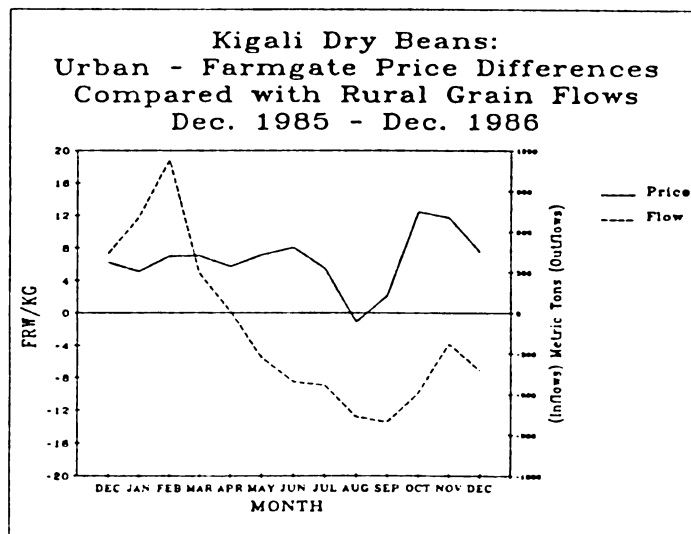


Figure 3.3

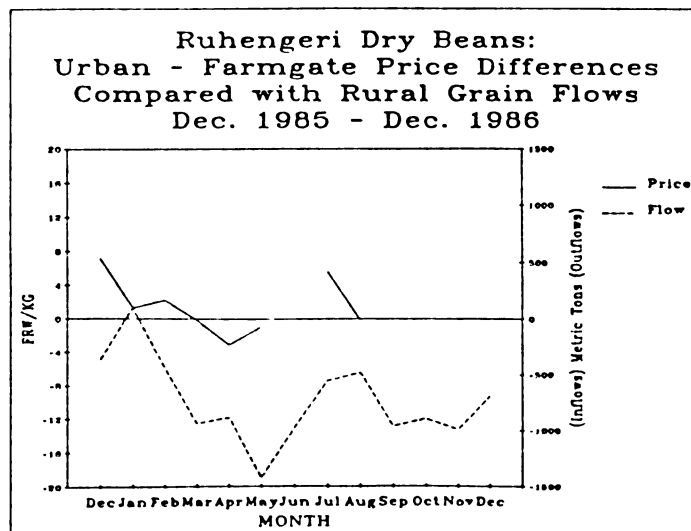


Figure 3.4

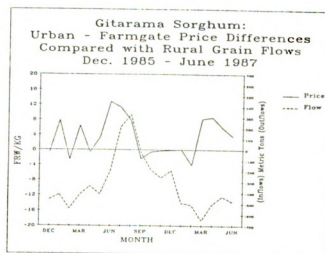


Figure 3.5

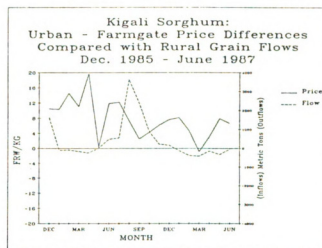


Figure 3.6

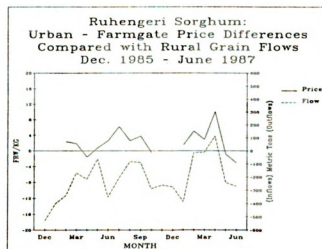


Table 3.17
Average Dry Bean and Sorghum Prices
During the SESA/MSU Farmer I Survey Period

Prefecture/ Market Channel Level	Average Dry Bean Price	Average Sorghum Price
Gitarama		
Retail	25	26
Received by Farmers	24	22
Paid by Farmers	29	29
Kigali		
Retail	29	29
Received by Farmers	22	20
Paid by Farmers	28	25
Ruhengeri		
Retail	26	24
Received by Farmers	25	21
Paid by Farmers	28	28

Notes: 1. The data start in December 1985. They run through December 1986 for dry beans and July 1987 for sorghum. 2. Average retail prices are the simple mean of reported MINIPLAN prices. 3. Average farm level prices are quantity and population weighted means estimated from the Farmer I survey data.

Another way to examine behavior of prices between different levels of the marketing chain is to regress a price series on a price series from a different level. Table 3.18 shows adjusted R squared statistics resulting from this type of regression.

Overall, dry bean prices show more correlation between different market levels than sorghum. Explanations for the low correlations of sorghum prices are similar to explanations given in the preceding section for low sorghum price correlations between geographical units. These include: a lower number of households producing sorghum, multiple

types of demand for sorghum (famine crop, ceremonial needs, income generation), and the geographically heterogeneous production cycle.

Table 3.18
Adjusted R Squared Statistics Resulting from
Contemporaneous Regressions of Selected Price Observations
during the SESA/MSU Farmer Survey Period

Prefecture/product	Market Channel Levels Regressed:		
	Prices Received by Farmers	Prices Paid by Farmers	Prices Received by Farmers
	against	against	against
	Retail Prices	Retail Prices	Prices Paid by Farmers
Gitarama Dry Beans	-0.08	0.12	0.22
Kigali Dry Beans	0.43	0.69	0.35
Ruhengeri Dry Beans	0.51	0.83	0.65
Gitarama Sorghum	-0.07	0.08	-0.06
Kigali Sorghum	-0.02	0.17	0.04
Ruhengeri Sorghum	-0.06	-0.04	-0.03

Note: The survey period starts in December 1985. It runs through December 1986 for dry beans and July 1987 for sorghum.

Kigali demonstrates the highest correlation between different market levels for sorghum, and high correlation for beans. This is probably because Kigali is the only prefecture of the three examined in which is at least self-sufficient in beans and sorghum. The flow of product is probably more unidirectional (i.e. rural to urban) in Kigali than in the other two prefectures. Unidirectionality of product flow (as opposed to seasonal reversals) should *ceterus paribus* yield higher

correlations. A larger urban area in Kigali may also improve market transparency and encourage market orientation in farmers.

With over 25% of rural utilization produced elsewhere, Ruhengeri imports a much larger percentage of its utilization of both crops than either Kigali or Gitarama. The three bean market levels in Ruhengeri appear closely linked, while for sorghum there is no correlation between market levels. An explanation for this may be the reversal of sorghum seasonality between Ruhengeri and other parts of the country discussed in Section 3.1. Ruhengeri harvests sorghum when prices are high elsewhere. There may be a reversal of sorghum imports and product flows to Ruhengeri at certain times of the year. For dry beans, Ruhengeri's seasonal production patterns are similar to the rest of the country, so a reversal of product flow is less likely.

Gitarama's low price correlations between market levels are probably due to the fact that it imports only small volumes of both commodities. When local supplies run out, product flow from rural areas to the city first ceases, and then reverses itself.

To summarize, 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 rural imports. Where there are imports into a prefecture, there are likely few farmer sales relative to total rural purchases. Hence farmers selling get a higher price as prices are bid up partially due to added transfer costs. Farmers may also be willing to pay more for local beans bought from neighbors. It may be more convenient to buy

from a neighbor than make a trip to market and farmers may prefer local beans for planting and consumption.

The relationship between urban retail prices, and prices received and paid by farmers is a function of the prefecture's net position in a commodity. Transport and assembly costs are probably the major factors determining differences in prices between each level of the marketing chain.

Figures 3.1 through 3.6 show the difference between prices received by producers and prices paid by consumers in the three prefectures rarely exceeds 10 Frw/kg, and is often less than 5 Frw/kg. This is small difference, given the high assembly costs implied by the condition of rural roads and the small lots sold by producers.

3.4 The Monitoring Function of Price Data

Sections 3.1 through 3.3 do more than shed light on various characteristics of bean and sorghum marketing in Rwanda; they also show the importance of good price data in understanding the marketing system. Price data can help policy makers understand:

- direction of product flow,
- efficiency of assembly and transport activities,
- the timing and duration of commodity shortages,
- the level of competition in the marketing system.

Price data are therefore a powerful tool in the formulation of sensible food policies.

Most price data are relatively easy to collect. The urban retail data collected by MINIPLAN in the three prefectures discussed above takes an agent less than three person days per month per prefecture to collect. Compared with measurement of physical volumes such as

production or quantity marketed, the cost of good price data collection is minimal. Given the low costs and high payoffs associated with good price data, maintenance and reinforcement of price data collection activities appears to be a good investment. If more is invested in price data collection, future price analyses can be extended to all ten prefectures, rather than limited to three prefectures. To facilitate the strengthening of price data collection activities, a review of current market price collection is included below.

3.5 Reporting of Current Market Prices; Methodologies

In Rwanda, national price data are currently collected by MINIPLAN, MINAGRI, the National Bank of Rwanda, OPROVIA, and MINIFINECO. A detailed description of the methods used by each of these agencies in its price collection activities can be found in a working paper by Mukezangango. The following five paragraphs rely heavily on that working paper's descriptions of data collection methods.

MINIPLAN prices are collected three times a month in most prefectures, at the main market of the major town (*Chef Lieu de Préfecture*). Unfortunately, data collection techniques vary from prefecture to prefecture, and could benefit from standardization and improved documentation. The biggest problem with the MINIPLAN data in some prefectures is missing observations. This may be unavoidable if the product is not sold in the market the day the agent visits, but problems arising from lack of transport or motivation should be rectified.

MINAGRI currently operates two price data collection systems. The newer system has a standardized method, and is aimed at three markets per prefecture twice monthly. The "agronomes de communes" are responsible for collecting this data, but cooperation from the agronomes has been suboptimal. The traditional system employs the "moniteurs agricoles" or the "agronomes de communes". The traditional system collects data in many markets two to four times per year and is more complete than the new system. A problem with the traditional system is that the number of observations per year limits the usefulness of the data for rigorous analysis. Another problem is that the dates of price data collection are not well specified in reports, being labelled only "recolte" (harvest) and "semis" (planting) in MINAGRI annual reports. On the surface this may seem reasonable, but planting and harvest times vary greatly between prefectures and across years. Where more than two observations are made per year, first season observations are published as an average with second season observations. The vagueness of MINAGRI's system for publishing its prices renders comparison of prices over time and across space very difficult.

The National Bank of Rwanda collects prices two times per year in roughly 20% of Rwandan markets. A Kigali based team from the Bank travels to each market to collect the data. The Bank's data collection technique is very systematic, and adequate for its purpose of establishing price indices, although its weighting factors could be treated more scientifically. As with the traditional MINAGRI system,

the number of observations per year limits the usefulness of the data for other purposes.

OPROVIA operates a price data collection system from its buying and selling outlets throughout the country. The manager of each outlet is responsible for collecting price data. OPROVIA managers appear to be becoming less cooperative in collecting prices as the system ages, and the central office does not keep the data for very many years.

MINIFINECO operates a price collection system through the "Inspecteur de Commerce" in each prefectural capital. In general, the data are not very complete, and they are published in a haphazard fashion by the Ministry in its annual reports (by month some years, annual average other years).

This review illustrates that there is significant duplication of effort in the area of agricultural price data collection in Rwanda. At the same time, there is room for improvement in the statistics produced by each service. One way to consolidate would be to build on what is already the best. This could be done by limiting regular price data collection activities to two agencies: MINIPLAN and the National Bank of Rwanda. MINIPLAN would be responsible for collecting urban price data from the ten prefectures. MINIPLAN's statistics could be improved by providing funds for a national supervisor to visit MINIPLAN agents in each of the prefectures frequently. The purpose of the visits would be to improve the regularity of data collection and standardize methods between prefectures. The National Bank of Rwanda would be responsible for collecting data in rural markets. Hopefully, the

National Bank could be given a larger budget to increase the frequency of its data collection activities. Occasional baseline studies could be used to improve the weighting factors applied by the BNR in calculating national averages. OPROVIA would continue to collect its own price data as it has in the past, since it needs information from a specific set of markets. MINAGRI and MINIFINECO could drop their price data collection activities. It is probably difficult for MINIFINECO to collect accurate data from merchants, given that MINIFINECO is responsible for enforcing commercial regulations. A consolidation of data collection activities could cost less and be much more effective in providing information necessary for food policy formulation. A consolidation of price collection systems would need to be accompanied by some means of assuring timely access to price data by other agencies. Otherwise, each agency could be forced to collect their own price information.

3.6 Evaluation of Existing Series of Price Data; Comparison of Series

One simple means of checking the validity of different price series is to plot them on the same graph. If different series show the same general price movements, then one can have greater confidence in the analysis of both series. Figures 3.7 through 3.9 show graphs of MINIPLAN bean data for Gitarama, Kigali, and Ruhengeri plotted together with data from MINAGRI and the National Bank¹⁰. These figures

¹⁰In looking at Figures 3.7 through 3.9, the reader should bear in mind that the data from MINAGRI are generally collected twice per season, and that the four observations are averaged into two data points when published. Each data point published by MINAGRI is represented twice in the graphs: once for each season. Data from the

make it clear that reported prices from the three series do not diverge greatly for most observations. Bean prices reported by the National Bank are somewhat lower than prices reported by the other two series. The Bank's bean prices are lower than MINIPLAN prices because it collects data at harvest time from markets which are closer to producers in the marketing chain.

A second way to evaluate existing price series is to collect prices in the same markets independently of the service responsible for providing such information. In 1986, SESA initiated a year long data collection experiment in the urban area of five prefectures to test the accuracy of the MINIPLAN urban retail price series. Results of this test are reported by Ngirumwami, who concludes, "...the differences between the two series are not generally large...". He states that the differences "Are probably due to methodologies which are not identical". Ngirumwami cites different enumerators and different days of data collection that could result in different observed prices.

Thus two different methods of evaluating the quality of the data reported in existing series yield the same conclusion: the methods used to collect prices in Rwanda are relatively accurate. Methodological questions are therefore of little relevance in this case. What is necessary for improved price data is some standardization along with improvements in the regularity and the frequency of the data collection. More rapid distribution of prices could reduce the need for other ministries and services to duplicate price data collection activities.

National Bank are collected twice a year.

Figure 3.7

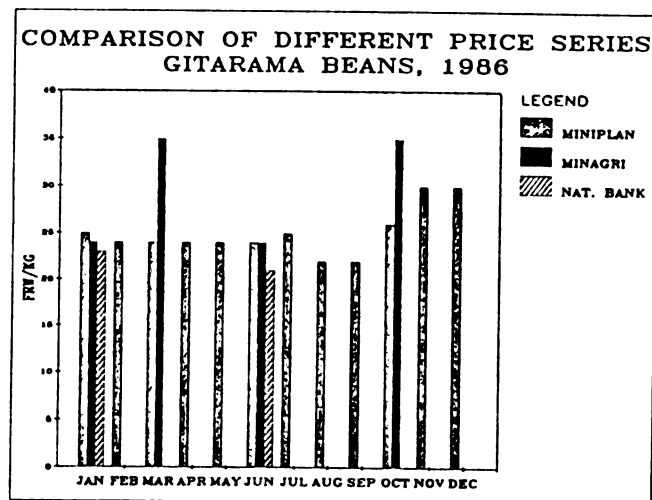


Figure 3.8

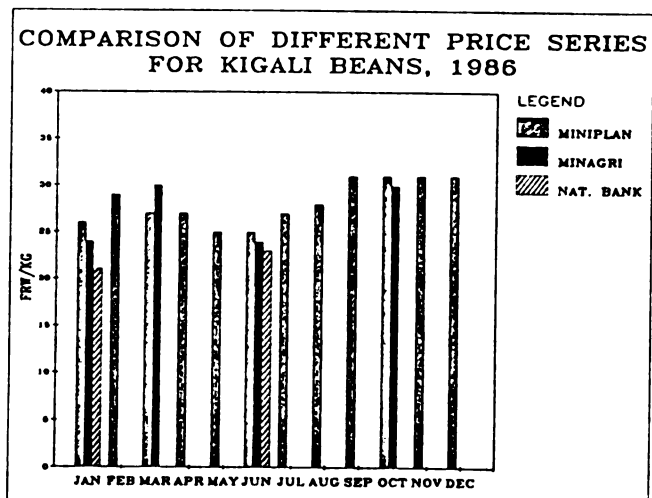
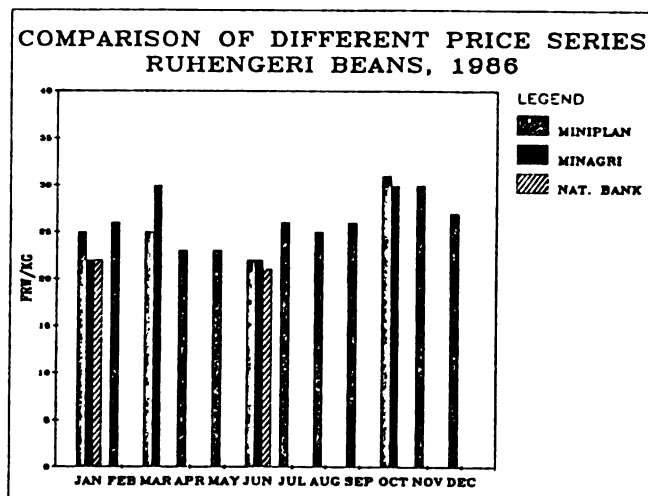


Figure 3.9



3.7 Grades and Standards

As markets develop, grades are usually established to enable all market participants to easily and reliably distinguish between different levels of quality in a product. Similarly, standards are used to measure different quantities of a product (i.e. a system of weights and measures such as the metric system). Once a universally accepted system of grades and standards is in place, market transactions of that product are facilitated. Buyers no longer need to visually inspect the product prior to a purchase agreement. Contracts for future delivery of a specific quantity and grade of product can be drawn up with less risk of misunderstanding between buyer and seller.

In Rwanda for beans and sorghum, there appears to be little need for a system of grades to inform consumers of the level of product quality. Most consumers buy in very small lots, and in face to face transactions with sellers. When consumers buy in small lots (such as a kilogram), they can visually inspect the product to determine the level of quality. If the quality does not meet their specifications, there are usually alternative suppliers in the market. Bylenga et al. have suggested that OPROVIA experiment with grades in its retail operations. OPROVIA could conduct a low cost experiment with retail grading to test consumer reaction to grades before any further action is taken.

As one moves up the system from the producer or the consumer to wholesaler-wholesaler transactions, the volumes involved may preclude inspection at the time of transaction. This is particularly true in the case of OPROVIA, Army, World Food Program, or school transactions, where volumes purchased may exceed one ton. Here it becomes difficult

for each party vying for a contract to deliver for inspection the quantity desired without guarantee of purchase.

To help remedy the above situation, OPROVIA has studied the feasibility of a system of grades for large grain transactions. In order to study the practicability of grades, OPROVIA's researchers developed a grading system for beans and sorghum. OPROVIA's grades are based on three criteria: moisture content, percentage of broken grains, and percentage of inedible material mixed in with the commodity. The grades and the feasibility of implementing them are discussed in Bylenga, Clarke, and Kayumba. The authors found that "...producer deliveries to OPROVIA warehouses were too numerous for sampling and testing according to the proposed grades to take place..". They also found that "Warehouse buying campaigns could...be made more orderly so that existing visual and sensorial methods inspection can be properly employed...". With respect to purchases from cooperatives and merchants they state "The proposed grades, including the objective system of sampling and testing, could be adapted to warehouse buying procedures...".

It appears there is potential for good payoff to continue OPROVIA efforts to experiment with grades in its buying operations or selling operations. When OPROVIA has implemented and refined its own system, thought can be given to the feasibility of expanding the system. The major criterion for feasibility would be that grades reduce transactions costs. If OPROVIA's system is easy to understand and useful, the system may be adopted by other market participants with little government prodding. If a national grading system ever becomes

used frequently in market transactions, price data collection systems should begin to incorporate information on grades.

Standards can facilitate consumer price comparisons in Rwanda. Rwanda has adopted the metric system. Informal observations indicate that the weight of a "kilogram" of beans or sorghum appears to vary from seller to seller and from market to market. Stricter enforcement of a system of weights and measures would improve consumers' capacity to seek the best bargain. If merchants and farmers begin to conform more closely to the metric system, price data collection could also be simplified.

3.8 Evaluating Price Policy

A. The 1986 case

As discussed in Section 1.5, the Government of Rwanda changed its pricing policy in January 1986. Prices of beans and sorghum had been under an "indicative" pricing system. Under the indicative prices the government suggested prices that it deemed to be fair to all market participants. Merchants and OPROVIA were free to operate at prices differing from the indicative prices if they chose. The purpose of the indicative prices was to provide a reference point for bargaining. It was felt that the reference point would make it difficult for merchants to secure economic profits due to asymmetric information.

In 1986, the government moved to a fixed farm level floor sales price. Merchants were thus required to pay the minimum prices set by the government in their buying operations. One object of the farm level floor price was to increase farm level incomes by assuring

farmers higher prices for their products. A second object was to stimulate an increase in overall farm output. The Government employed a combination of three methods to influence market prices: moral, legal, and physical.

The moral method of the policy differed little from the old "indicative" pricing scheme--using its political apparatus to plead for respect of official prices.

The legal method of implementation consisted of shutting down or threatening to shut down merchants who did not respect official prices.

The physical method of the new policy was implemented through OPROVIA. OPROVIA was asked by the government to conform to the new 35 FRW/kg dry bean and 22 FRW/kg sorghum prices in its buying operations. The government told OPROVIA to make its purchases, to the extent possible, directly from farmers and cooperatives at the minimum prices instead of its usual merchant suppliers. The government also promised to buy OPROVIA stocks at prices which would allow them to make a profit or at least cover costs. OPROVIA duly bought selected quantities of beans and sorghum from producers and cooperatives at the official prices.

All of the above policy measures were put into effect while the SESA/MSU bean and sorghum farm level transactions survey was in the field. It is therefore possible to study the relationship between government policies and prices received by farmers for beans and sorghum. Figure 3.10 displays average farm level sorghum purchasing and selling prices by month from November 1985 to June 1987. Average farmer sorghum selling prices rose above the 22 Frw/kg official floor

price during only four of the eighteen months after the January 1986 policy change. The April-May 1986 and the May 1987 price peaks are probably not results of OPROVIA actions. These peaks are probably typical seasonal price movements. The seasonal price analysis in Section 3.1 shows that prices typically swing upward in April and May in two of the three prefectures analyzed. This is completely consistent with the fact that the years' biggest sorghum harvest comes in June (see Annex II) and it costs to store a commodity. Fundamentals of supply and demand indicate that prices will be at their highest just before harvest. Thus the government's new sorghum policy fell short of its goal of a 22 Frw/kg selling price for during most of the time and for most of the sales.

Figure 3.10

**Average National Monthly Rural
Farm Level Sorghum Buying and
Selling Prices in Rwanda
November 1985 - June 1987**

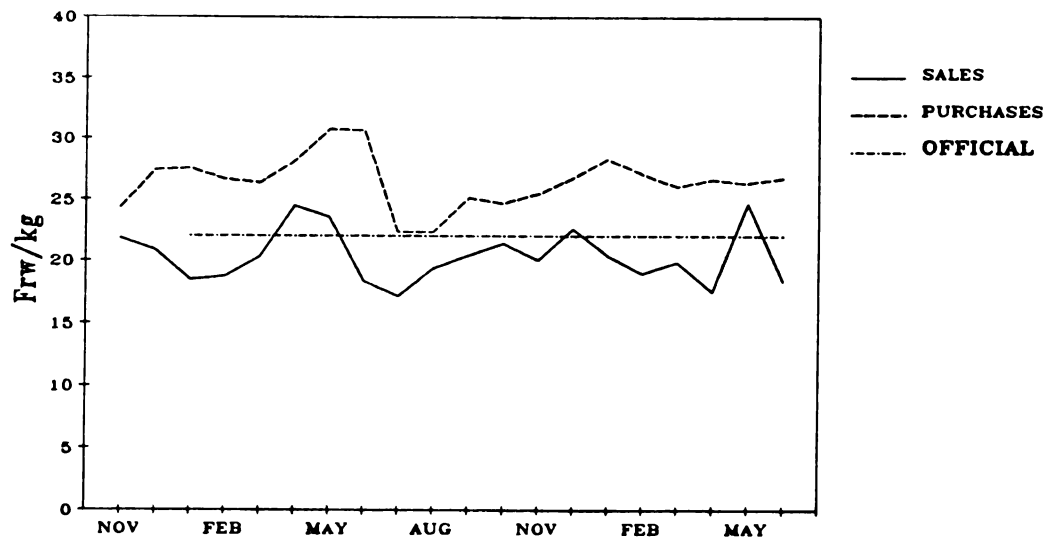


Figure 3.11

**Average National Monthly Rural
Farm Level Dry Bean Buying and
Selling Prices in Rwanda
November 1985 - December 1986**

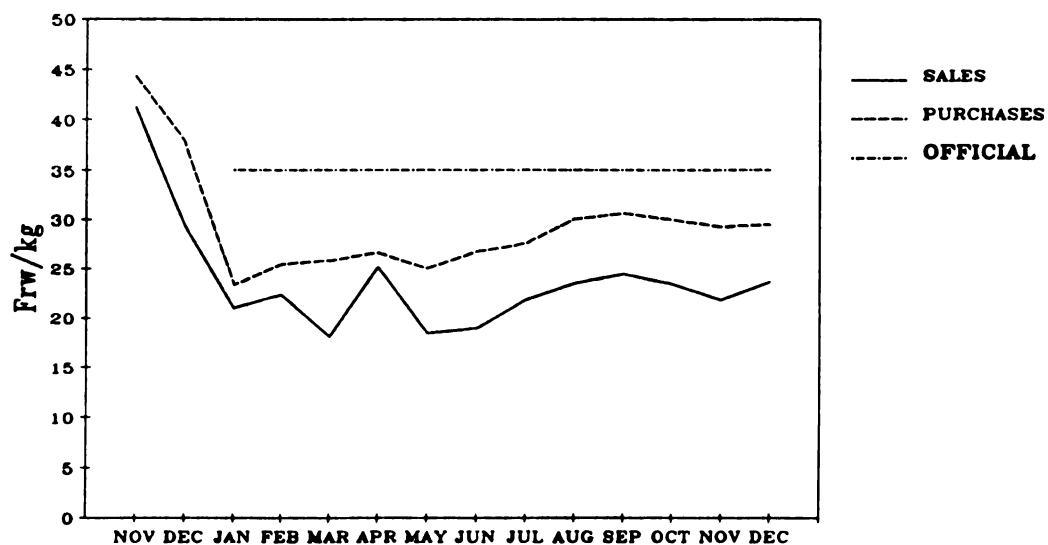


Figure 3.11 shows that prices received by farmers for beans were consistently below the official target price. Not once during the survey did farm level dry bean prices meet the official minimum after the January 1986 policy implementation date. It is however probable that the OPROVIA buying campaign did affect prices. The April peak in dry bean sales prices is associated with the timing of OPROVIA's purchases from farmers and cooperatives. All of the nearly 3000 tons of dry beans OPROVIA bought from farmers and cooperatives in 1986 were purchased in April. Despite OPROVIA's heroic buying effort at official prices, market prices appear to have been pushed up by only about 5 Frw/kg from the 20 Frw/kg mark, and then only for one month. OPROVIA's effect on the bean market appears to have been greater than its effect on the sorghum market. The 2900 tons of sorghum OPROVIA bought from producers and cooperatives in July and August 1986 do not appear to have influenced the price movements recorded in Figure 3.10.

Average prices received by farmers for dry beans and sorghum are presented in Annex II. Any price increases associated with OPROVIA's 1986 buying campaign appear to have been well distributed geographically; eight of the ten prefectures show a peak in prices received by farmers for dry beans in April. The two prefectures (Butare and Byumba) which don't show a peak in prices received by farmers in April experienced a peak in May. Prices paid to farmers for sorghum do not show a significant peak in any of the prefectures during the OPROVIA sorghum buying campaign.

Urban retail prices reported by MINIPLAN tend to confirm the above findings. Of seven prefectures reporting urban retail sorghum prices

during the OPROVIA sorghum buying campaign, prices dropped or showed no change in six. Retail sorghum prices were generally above 22 Frw/kg in 1986. Of eight prefectures reporting urban retail dry bean prices during the April-May OPROVIA bean buying campaign, four showed price increases. In April and May prices are normally flat.

B. Potential for Long Run Success of Fixed Price Schemes

If the 1986 experience can be used to gauge quantities purchased and price differentials needed for a 5 Frw/kg price increase, OPROVIA will find it difficult to increase prices paid to farmers. If it were to consistently offer a price well above market levels, OPROVIA would be inundated with local and foreign supplies. Given present and foreseeable resources, OPROVIA could not manage or dispose of the volumes necessary to sustain large, continuous price increases. A continuation of such a policy would be a large drain on the government budget since OPROVIA would either have to store large quantities of beans and sorghum indefinitely, or sell at a loss. It has chosen the latter option with the sorghum it acquired in 1986¹¹.

C. Potential Ramifications of OPROVIA Price Supports

Unfortunately, the potential effects of OPROVIA actions in price fixing schemes go beyond a drain of government resources. Data presented in Chapter II shows that Rwanda is a net importer of beans and sorghum. Chapter IV (below) shows that there are more farms which buy beans and sorghum than farms which sell beans and sorghum. Most of

¹¹Kayumba

the locally grown beans and sorghum put on the market in Rwanda comes from a small minority of farmers. In the short run, a farm level bean and sorghum price increase would benefit only a small proportion of the total rural population, while hurting the majority of farmers--and the evidence indicates that households that buy beans and sorghum are the poorest households. The rural poor would have considerable difficulty expanding bean output to reduce purchases, let alone realize positive sales.

What would happen if the government were successful at increasing prices paid to farmers? A few large farms in some areas of Rwanda might be able to respond to the price increase. Yet, a large increase in aggregate output is unlikely in the near future given the constraints presented in Chapter II, and that there are no technologies available to alleviate those constraints. If all farm level prices were increased by the same amount, then the cropping mix would likely not change.

If the price for one commodity were increased more than others, then any increased production of the crop would most likely be offset by reduced production of other crops. In other words, farmers might plant fewer sweet potatoes in order to plant more sorghum. Farmers would then need more sweet potatoes, which might have to be brought in from neighboring countries. Analysis in Chapter IV shows that it is quite rational for many farmers to specialize in tubers rather than beans or sorghum. Application of policy instruments to change the crop mix towards more beans and sorghum may in fact result in decreased food security.

If Rwandan producers did not change their product mix, neighboring countries and a small minority of Rwandan farmers would be benefactors of the increased prices. Arable land in Zaire and Uganda is much more plentiful than in Rwanda. Higher prices in Rwanda might stimulate farmers in these border countries to increase acreage planted, bringing more beans and sorghum to Rwanda. Greater availability of imported beans and sorghum would put downward pressure on prices in Rwanda, exacerbating the problem of implementing a higher than market level floor price.

Attempts to stem the flow of beans and sorghum from neighboring countries would be difficult, if not unworkable, and unwise. Unworkable because of the permeable nature of the border. Unwise because stopping bean and sorghum imports would drastically cut food availability in Rwanda. Tightening border controls would also probably disrupt the flow of goods and services in the other direction, decreasing rural incomes in Rwanda. (This is explored in more detail in Chapter IV).

The attractive buying price offered by OPROVIA also invites corruption at several levels in the system. Increased corruption might also be the result of the legal arm of the government's new price policy. Passing laws which make it difficult for merchants to practice their trade will encourage them to break the law, as they did in 1986. The law then becomes an avenue by which officials can extort bribes and favors from merchants.

In summary, the 1986 experience has shown that government supported prices (at above market levels) are costly and difficult, if not

infeasible, in the long run. Unfortunately, attempts to increase prices paid to farmers are likely to have several negative effects on the rural economy. The majority of farmers are net buyers of beans and sorghum, so they would have to pay more for their food. Farmers in neighboring countries or traders would likely capture a large percentage of the benefits associated with increased bean and sorghum prices. The private sector, which currently operates with reasonable efficiency, could be disrupted. Restricting imports would curtail food availability in the country, and probably decrease rural incomes. Incentives for corruption in government could easily increase.

3.9 Chapter Summary

This chapter illustrates how price data can improve understanding of the market and the incidence of policies on producers and consumers.

All four commodities included in an analysis of urban price seasonality based on MINIPLAN data show at least mild seasonality. Sorghum's price seasonality in Ruhengeri appears to be the reverse of the other two prefectures studied. This is consistent with a reversal in the seasonality of production in that prefecture. Dry bean exhibit more pronounced seasonality than the other three crops studied. An analysis of probable returns to storage shows that storage is very risky for all four crops. Historical average returns to bean storage are higher than the other three crops. This is due to the very high bean prices recorded in 1984.

Several tests of market integration indicate that markets generally appear to be well integrated. At the urban level for three

prefectures, the following rank ordering of market integration was obtained: beans, potatoes, sorghum, bananas. In tests of market integration at the rural level for ten prefectures beans appear better integrated than sorghum. Rural markets appear to react more to the rest of Rwanda as a whole than to price changes in a particular market. Accounting for seasonal changes in the direction of product flow also improves models of market integration. Thin markets, product specific characteristics, high transport costs, high assembly costs and spatial production patterns hamper market integration in Rwanda. The behavior of marketing margins appears to be consistent with likely storage, transport and assembly costs.

Tests of market efficiency depend on price data. The probable direction of commodity flows, the timing and duration of shortages, and the spatial distribution of shortages can be inferred from price data. Comparison of various price series available in Rwanda and an independent verification show that collection methods in Rwanda are reasonably accurate. MINIPLAN and the BNR currently collect the country's best price series. Increasing the data collection budgets of these two services could be a cost effective means of improving understanding of the marketing system.

OPROVIA is currently experimenting with a new system of grades for beans and sorghum within its operations. It appears that a continuation of this experiment could be beneficial. Study of the feasibility of a national system of grades, however, should not be undertaken until OPROVIA has a successful program within its own operations. Grades may eventually reduce the cost and risk associated

with long distance transactions. Price data collection methods will need to be updated to take grades into account if a national system of grades ever comes into use in the marketplace.

Standard weights and measures appear to be under utilized in the marketing system, especially at the retail level. Increased use of standard weights and measures can facilitate consumer and producer transactions. Standard weights and measures could also make price data collection easier.

OPROVIA purchases of beans and sorghum at official prices in 1986 do not appear to have had any of the intended lasting effects on farm level prices. The goals of increasing production and improving farm income were not met. High official prices (compared to existing market prices) could have significant negative effects on the national budget, the marketing system, national and household food security as well as the rural economy.

CHAPTER IV

CHRONIC FOOD INSECURITY ISSUES

Chronic food insecurity arises when, under normal climatic and economic conditions, a person, region or nation is unable to obtain sufficient food to maintain good health. Its ramifications are far reaching. At best, chronic food insecurity leads to low worker productivity, psychological trauma and reduced resistance to disease. In more severe situations, it can produce irreversible stunted physical and mental child development, and ultimately death. The link between chronic food security and productivity is obvious. A downward spiral is possible. The chronically food insecure may produce less, leading to greater food insecurity.

This chapter examines the available evidence on the extent of chronic food insecurity in Rwanda. The chapter is laid out as follows. First, food production and consumption trends and relationships are discussed. This provides an idea of what the food situation has been in Rwanda and where it may be headed. Next, characteristics of families that may be chronically food insecure are presented. Understanding who is at risk in terms of chronic food insecurity can help target policy. An examination of means by which farmers attempt to overcome obstacles to chronic food security follows. Understanding how farmers cope with chronic food insecurity can help government reinforce farmer initiatives. A discussion of national strategies and constraints to food security precedes the chapter summary.

4.1 Production and Consumption Trends and Relationships

A. Introduction

An understanding of production and consumption trends and relationships is important in reducing the number of underfed people. Agricultural policy needs to be evaluated in light of production and consumption data to determine probable effects of policy initiatives.

Production and consumption trend data is useful in determining whether aggregate food output per capita can be expected to increase or decrease. This type of information can be used to plan food import or export strategies. Trend, however, is only an indicator of probable future performance. Plans should be flexible to deal with extremely good or bad years, or reversals of trend.

The relationships between production and consumption variables can provide insights into the food system. Understanding why some farms have high output while others have low output can help design programs to stimulate both types of producers. Characterization of chronically insecure groups with production and consumption variables can lead to better targeted and more appropriate programs.

B. Sources of Data on Production and Consumption Trends and Relationships in Rwanda.

Production and consumption data for Rwanda are not very complete. The first consumption survey in Rwanda was done in 1953 (Close). This survey was very qualitative in nature, and drew upon a very restricted sample. Close's major finding was that the composition of the family diet was quite dependent on seasonality of production. Close's publication does not include any breakdowns by household category.

Leurquin (1960) collected detailed consumption information on 1,210 households in Ruanda-Urundi (mostly in what is now known as the Central Plateau region). He estimated average caloric intake at about 2300 Kcal/cap/day, with 27% of calories coming from sweet potatoes, 23% from beans, and 14% from sorghum.

Table 4.1 shows how value of crop production was distributed in Leurquin's sample (no equivalent kilocalorie breakdown was published). The vast majority of the sample lies in a relatively narrow range, with only a few families producing substantially more than average.

Table 4.1
Distribution of the Value of Food Crop Production
Ruanda-Urundi 1956 Agricultural Year
(Adapted from Leurquin, 1960)

Value of Production ¹	Number of Households	Percentage of Sample
<1000	14	1
1000- 2000	116	10
2000- 3000	223	18
3000- 4000	278	23
4000- 5000	226	19
5000- 6000	132	11
6000- 7000	91	7
7000- 8000	51	4
8000- 9000	31	2
9000-10000	17	1
10000-11000	11	1
11000-16000	17	1

Leurquin's cash income data show a similar distribution; 71% of households had less than 2500 colonial francs revenue in 1956. At the

¹In colonial francs.

same time, a small percentage of households were making two to four times that amount. Unfortunately, Leurquin doesn't present any tables which combine cash and crop income.

Vis et al. (1975) studied food consumption in ten communes (seven prefectures) of Rwanda. The study found that average adult energy needs ranged from 1931 to 2192 Kcal/cap/day. Average energy consumption in their sample was "...around 80 per cent of the optimum quantities defined by the FAO (1957)", or approximately 1711 Kcal per adult-equivalent per day². Vis et al. do not present any of their data by consumption category, so it is impossible to determine how total kilocalories were distributed within their sample.

The problem with all the consumption studies listed to this point is that large parts of Rwanda are not represented in the study samples. To correct this problem, a national (260 household) budget and consumption survey was fielded in 1983 by MINIPLAN with French technical assistance. In 1986 USAID joined France and Rwanda in financing preparation and analysis of the 1983 data. According to Minot and Niyibizi, data from this survey show that on average Rwandans consume 2,444 Kcal per adult-equivalent per day. Major calorie sources are: 32% from beans, 17% from sweet potatoes, 12% from manioc, and 10% from sorghum.

²In 1973 FAO and WHO adjusted the estimated minimum energy requirement levels. Vis et al. report that the 1973 estimated minimum energy requirements are 0.41 to 8.6% lower than the 1957 estimated minimum energy requirements in Rwanda. Vis et al. use "adult-equivalents" in their reporting, a system which yields higher values than "per capita" reporting, because children and older persons are counted as less than one in "per adult-equivalent" averages, making the denominator smaller.

Table 4.2 shows real income distribution from the MINIPLAN survey³ to be consistent with value of production distribution in the Leurquin study two decades earlier. The low and high ends of the distribution in the MINIPLAN study appear to be more attenuated than in Leurquin's findings. The longer "tail" at the high end of the spectrum can be explained by MINIPLAN's inclusion of cash income in its distribution. The longer "tail" at the low end of the scale may indicate that the percentage of families facing chronic food insecurity increased in the years between the two studies.

Data in Table 4.2 indicate that family income is positively correlated to land holdings. The modal 30001 - 40000 income group has less than a quarter of the land holdings of the richest group, yet the richest group's family size is less than twice as large. Income is necessary for food acquisition, so land shortage is clearly an important factor in food insecurity in Rwanda.

³For MINIPLAN, real income includes revenue from agriculture (including food crops consumed on farm), crafts, services, commerce, salaries, sale of goods, and rents.

Table 4.2
Frequency Distribution of Rural Households
by Level of Real Income⁴
(1983)

Net Real Income Class (Frw/yr. /household)	% of Households	Cum. % of Households	Ave. Size of Household	Ave. Farm Size (ha.)
1 - 10000	.8	.8	1.0	.13
10001 - 20000	3.6	4.5	2.1	.57
20001 - 30000	9.1	13.6	3.2	.57
30001 - 40000	16.7	30.3	4.3	.84
40001 - 50000	16.2	46.5	3.9	1.08
50001 - 60000	13.4	59.9	5.5	1.26
60001 - 70000	9.3	69.2	5.5	1.35
70001 - 80000	7.4	76.7	5.8	1.49
80001 - 90000	6.8	83.5	6.4	1.64
90001 - 100000	3.3	86.8	6.7	1.69
100001 - 150000	10.3	97.1	6.2	2.03
150001 - 200000	2.1	99.2	7.8	3.18
> 200000	.8	100.0	8.1	3.80
Total	100.0		4.9	1.28

Source: Personal communication, Nicholas Minot, National Budget and Consumption Survey, MINIPLAN.

To summarize the data on consumption, there are three available studies. Two of the studies (Leurquin and MINIPLAN) show approximately the same average kilocalorie consumption while the third (Vis et al.) found very different kilocalorie consumption. Comparison of distribution of food production from Leurquin and distribution of income from MINIPLAN indicates that some groups may be less food secure in the 1980s

⁴For MINIPLAN, real income includes revenue from agriculture (including food crops consumed on farm), crafts, services, commerce, salaries, sale of goods, and rents.

than they were in the 1950s. But Leurquin and MINIPLAN arrive at fundamentally different levels of consumption for the various crops. Official estimates show only small changes in Rwandan per capita crop production over the last thirty years. It is improbable that these differences are due exclusively to real changes in consumption patterns. Some differences may arise from Leurquin's non-representative sample or from the Ministry of Plan's smaller sample. The Rwandan diet varies considerably from month to month, so the timing of observations may play a role in generating opposing results. Whatever the reason for the incongruities, meaningful analysis of consumption trend data is difficult.

Some difficulties also arise in MINAGRI's historical production data series, which is at least partially based on consumption data. To quote Prefol and Delepierre:

"Recall that the procedure used by the authors of the '*Comptes Economiques*' was the following: the integral adoption of the systematic household **consumption perspective** of the INRS nutritional survey⁵, starting from the principle that what is consumed is necessarily produced."

The data presented in Chapter II show that Rwanda is importing beans and sorghum. Production data for these two commodities based on consumption data must be biased upward. These biases may be small however, since a combination of measures are used by MINAGRI in production estimates. Mudacumura et al. describe the MINAGRI method of developing production estimates:

"... the extension agent...collects information on surface area planted and crop production. Almost all of the extension

⁵i.e. Vis et al.

agents make their estimates of production and surface area by eye...

...some extension agents, knowing the number of households in their area, make extrapolations to obtain sector-level estimates...

...in synthesizing the data for the commune, the Commune Agronomes adjust the figures from the extension agents based on prior years' estimates, taking into consideration climatic conditions during the season.

...The last step is the synthesis of all the reports issued from the prefectures. This onerous task is accomplished through adjustments taking into account prior years' estimates and known regional crop yields. Since the establishment of the Agricultural Survey and Statistics Service [SESA], the person in charge of the final synthesis depends on the estimates from that service to better adjust the figures..."

A second source of data on production are the estimates from SESA.

These estimates are based on direct measurement of production from over 1000 households. The system has been in place for three complete years, which is short for trend analysis of a static agricultural system.

C. Consumption Relationships

The MINIPLAN consumption survey indicates that farmers who produce a large bean and/or sorghum surpluses tend to have a higher monetary value of consumption⁶ than farmers who do not produce a surplus. A few farms that do not produce large surpluses have a relatively high value of consumption, and most of their income comes from non-agricultural activities. Farms that rely on agriculture for over half their income, and that do not produce a surplus of beans and/or sorghum make up a

⁶MINIPLAN defines "value of consumption" as cash expenditure on goods destined for own use plus probable acquisition cost of food consumed from own production plus the value of goods received through gifts or barter.

large percentage of households, and tend to have the lowest value of consumption. These relationships are illustrated in Tables 4.3 through 4.6, which were derived from MINIPLAN's 1983 consumption survey.

Table 4.3
Value of Consumption of Rural Households
by Quantity of Sorghum Produced and Importance of
Agriculture in Revenue Generating Activities

Importance of Agriculture in Household Revenue						
Quantity of Sorghum Produced (Kg/fam./yr)	Less than 50%			More than 50%		
	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)
0 Kg	4.1	17,014	.62	17.3	12,873	1.07
1-100 Kg	9.0	11,368	.66	25.6	11,607	1.18
101-200 Kg	4.9	17,550	.83	14.7	11,766	1.22
>200 Kg	1.9	16,878	2.00	22.6	14,170	1.83
Total	19.9	14,576	.82	80.1	12,632	1.34

Source: Personal communication, Nicholas Minot, National Budget and Consumption Survey, MINIPLAN. Note: MINIPLAN defines "value of consumption" as cash expenditure on goods destined for own use plus probable acquisition cost of food consumed from own production plus the value of goods received through gifts or barter.

Table 4.4
Value of Consumption of Rural Households
by Gross Quantity of Sorghum Sold and Importance of
Agriculture in Revenue Generating Activities

Importance of Agriculture in Household Revenue						
Quantity of Sorghum Sold (Kg/fam./yr)	Less than 50%			More than 50%		
	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)
0 Kg	16.9	14,770	.80	55.3	12,510	1.20
1-100 Kg	2.6	13,745	1.03	15.4	12,607	1.43
>100 Kg	.4	11,691	.27	9.4	13,388	2.04
Total	19.9	14,576	.82	80.1	12,632	1.34

Source: Personal communication, Nicholas Minot, National Budget and Consumption Survey, MINIPLAN. Note: MINIPLAN defines "value of consumption" as cash expenditure on goods destined for own use plus probable acquisition cost of food consumed from own production plus the value of goods received through gifts or barter.

Table 4.5

Value of Consumption of Rural Households by Quantity of Beans
Produced and Importance of Agriculture in Revenue Generating Activities

Importance of Agriculture in Household Revenue						
Quantity of Beans Produced (Kg/fam./yr)	Less than 50%			More than 50%		
	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)
0 Kg	.8	13,495	.28	1.9	9,823	.80
1-100 Kg	8.3	12,348	.33	18.0	12,068	.85
101-200 Kg	2.3	12,239	.98	19.9	11,665	1.26
201-300 Kg	3.8	16,431	.90	18.0	12,231	1.27
>300 Kg	4.9	18,166	1.59	22.2	14,522	1.93
Total	19.9	14,576	.82	80.1	12,632	1.34

Source: Personal communication, Nicholas Minot, National Budget and Consumption Survey, MINIPLAN. Note: MINIPLAN defines "value of consumption" as cash expenditure on goods destined for own use plus probable acquisition cost of food consumed from own production plus the value of goods received through gifts or barter.

Table 4.6

Value of Consumption of Rural Households by Gross Quantity of Beans Sold and Importance of Agriculture in Revenue Generating Activities

Importance of Agriculture in Revenue						
Gross Quantity of Beans Sold (Kg/fam./yr)	Less than 50%			More than 50%		
	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)	% of Families	Value (Frw) of Consump. per capita	Ave. Farm Size (Ha.)
0 Kg	15.0	14,691	.64	49.6	11,914	1.23
1-100 Kg	3.8	12,846	1.61	25.9	13,297	1.48
>100 Kg	1.1	18,807	.57	4.5	16,801	1.86
Total	19.9	14,756	.82	80.1	12,632	1.34

Source: Personal communication, Nicholas Minot, National Budget and Consumption Survey, MINIPLAN. Note: MINIPLAN defines "value of consumption" as cash expenditure on goods destined for own use plus probable acquisition cost of food consumed from own production plus the value of goods received through gifts or barter.

Table 4.3 shows that households which get more than 50% of their income from agriculture are in the minority (less than 20% of the sample). Families with high non-farm income have smaller average land holdings and larger average monetary values consumed than families that rely on agriculture for over half their income. Table 4.3 indicates that producers who harvest moderate quantities of sorghum and rely heavily on agriculture for their income consume less than other groups. This pattern is shown even more clearly in Table 4.4. Over half of the sample sold no sorghum and obtained more than 50% of their income from agriculture. Families in this "no sales, more than 50% of income from agriculture" category are the poorest group⁷.

Families growing little sorghum, relying heavily on cropping income but selling no sorghum can be characterized as low income and probably chronically food insecure. Families in this category appear to have neither the crop production necessary for subsistence nor sufficient non-farm income to make up production shortfalls through market purchases.

The above story is repeated for beans in Tables 4.5 and 4.6. Non-farmers and part time farmers are generally better off than their farming counterparts, and bean sellers are generally wealthier than those who do not sell beans.

The evidence here is substantiated by SESA/MSU transactions data (discussed in Section 4.2). A policy to increase incomes of poor

⁷The 0.4% of households in the sample which sold more than 100 kg of sorghum and obtained over half of income from non-agricultural activities represents only one household and can therefore be ignored as a probable outlier.

farmers through bean and sorghum price increases cannot be effective when the poorest farmers sell very few beans and sorghum, and have severe constraints to expanding output.

D. Production Trends and Relationships

Two recent studies have examined trends in the MINAGRI production data. Kampayana looked at trends in bean and sorghum production from 1974 to 1984, and found that production in most prefectures (except Cyangugu, Gisenyi, and Kibuye) had increased throughout the period, most probably due to "...the increase in surface area, and not other elements".

Meach examined changes in productivity in agriculture using the MINAGRI data from 1978 and 1982. He converted all crops to banana equivalents using prices, and then totalled banana equivalents across all crops as a proxy for total production. He found that for Rwanda, both output per active agricultural worker and output per hectare planted had increased between 1978 and 1982. Meach's findings on labor productivity may be somewhat misleading because, lacking estimates of labor applied in production, he uses the rural population between the ages of 15 and 64 as his proxy for number of active workers. Thus while average output per worker appears to have increased, average output per unit of labor applied may have increased, decreased, or stayed the same, depending on the levels of underemployment in the agricultural sector for the two years.

On the other hand, if the MINAGRI production and surface area estimates Meach uses are accurate, yields may be rising. Explanations for increased yields could be intensification in techniques of

cultivation (see Section 4.3), or a shift from crops which give a low monetary value per hectare to higher priced crops. (Meach used monetary value to aggregate across crops.)

Figure 4.1, based on MINAGRI and USDA data, shows that bean and sorghum production appears to have kept pace with population growth until about 1981. From 1979 through 1986, sorghum production appears to have been outstripped by population growth, while per capita bean output rose.

Rwanda's ability to feed itself may have decreased over the past few years. Official statistics show decreasing per capita kilocalorie production despite overall production increases. Per capita kilocalorie production from the 8 major crops is presented in Figure 4.2⁸. Growth trend in kilocalorie production appears to have exceeded population growth from 1973 until 1981. From 1981 to 1986, kilocalorie production appears to have dropped considerably. Data in Chapter V indicate that less dependence on beans and sorghum in favor of other crops appears to be a farmer strategy to improve caloric output.

Unless Rwanda can make up for the production shortfall with food imports chronic food insecurity may increase sharply. Non-cropping activities may be one way farmers can earn money to pay for food imported from neighboring countries.

Variability in bean, sorghum, and kilocalorie production appears to have increased since 1983. This is probably related to MINAGRI's use of SESA's annual physical crop measurement in developing recent

⁸USDA population estimate and MINAGRI production data. The 8 major crops are: beans, sorghum, maize, bananas, sweet potatoes, potatoes, manioc, and peas.

official estimates. MINAGRI's traditional system may have underestimated short term production fluctuations prior to 1983.

Figure 4.1

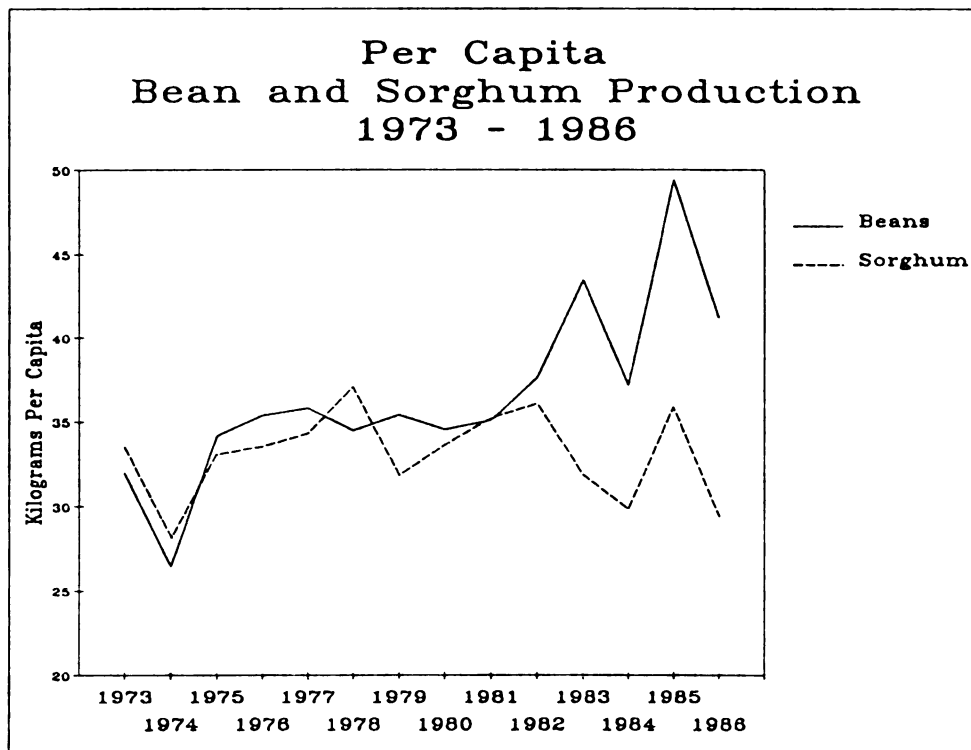
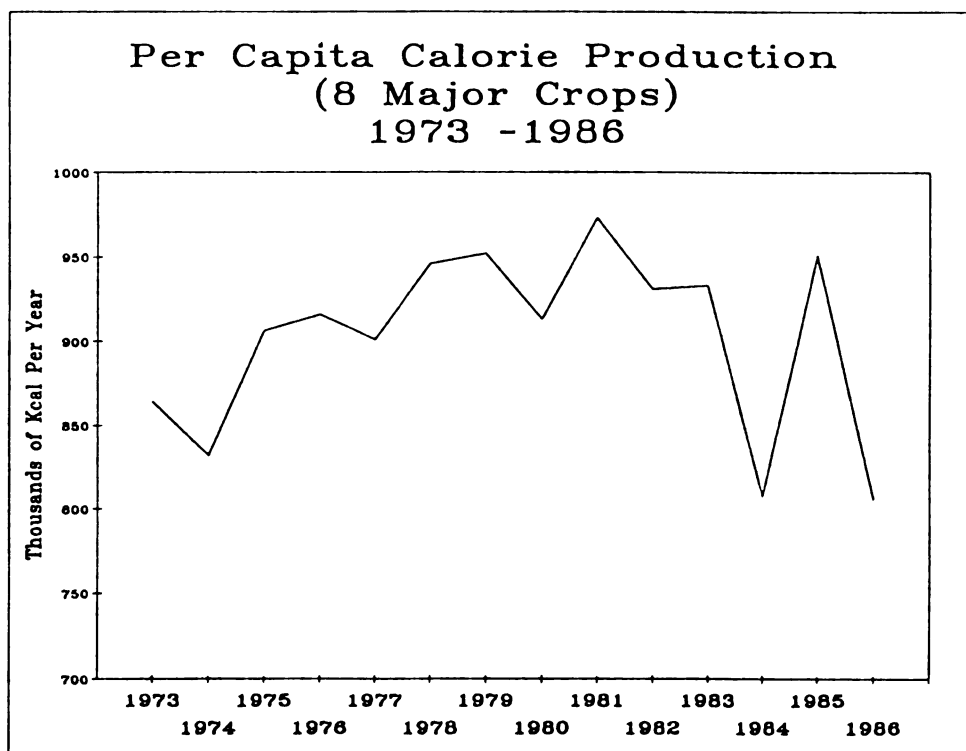


Figure 4.2



The data series from SESA's national production survey is not long enough to make any judgments on long term trends in Rwandan agriculture. Data for the entire agricultural year are currently available for only three years: 1984, 1986, and 1987. During two of these years, 1984 and 1987, rainfall patterns were unfavorable, making it even more difficult to get a fix on overall trends using this data.

E. Factors Related to Household Production

Understanding of determinants of household production can be improved by testing whether output is correlated with other household characteristics. Understanding of the determinants of production can help policy makers formulate plans to reduce chronic food insecurity in Rwanda. Data from several SESA surveys was used to construct simple models of household per capita bean, sorghum, and kilocalorie production. The models were estimated using ordinary least squares regression analysis.

The conclusions discussed in the following paragraphs are drawn from the multiple regression analysis summarized in Tables 4.7 through 4.12. Dependent variables were constructed based on SESA bean, sorghum, and total kilocalorie production data. The continuous variables in the four tables were taken from SESA production and household inventory surveys. In the bean and sorghum production models, kilocalorie production of other crops was included as an independent variable. The square root of kilocalorie production provided a better fit than the unsquared variable in all models estimated, indicating a curvilinear relationship between kilocalorie output and production of beans and sorghum.

In the models by geographical zone, sorghum production was modelled only for those farms that harvested sorghum during the 1986 agricultural year. Dummy variables were constructed from the SESA/MSU Farmer IV survey. Farmers mentioning an item (i.e. labor) as a primary or secondary constraint, revenue, or expense were assigned the value of 1, while the others were assigned a value of 0. Similarly, in "whole country" regressions, the intercept was allowed to shift by zone through the use of dummy variables for zone.

To facilitate reading of Tables 4.7 through 4.11, only the signs on of variables statistically significant at $\geq 90\%$ are reported here. Readers wishing more detail are referred to Annex II, where additional information from the individual regressions is presented. A regression on the decision of the family to grow or not to grow sorghum is included in Annex II.

Table 4.7
Summary of Models of Sorghum Production Per Person by Zone

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Households in the sample which grow sorghum:					
1) Number	69	88	183	201	262
2) Percentage	42%	53%	73%	91%	95%
Adjusted R-square	.59	.34	.21	.19	.35
Continuous Variables:					
Square root of kcal production excluding sorg. and beer bananas	+	+	+	+	+
Farm area per person				+	
Small ruminants/person					+
Cows per person			+		-
Ave. time (min) to bean/sorghum market	-				
Expense dummies:					
Labor	+	+		+	+
Clothing			+		
Seed, field rent, or tools			+		
Food					-
Constraint dummies:					
Drought					+
Labor					-
Revenue dummies:					
Field work			-		-
Non-farm					
Beer-making					

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$. Notes: 1) Households not growing sorghum excluded. 2) Dummies for incidental expenses, industrial crop revenue, and food sales revenue were not significant at $\geq 90\%$ for any of the five regions.

Table 4.8
Summary of Models of Bean Production Per Person by Zone

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample Size	165	165	250	220	276
Percentage of sample growing beans	92%	100%	100%	100%	100%
Adjusted R-square	.44	.44	.38	.57	.61
Continuous Variables:					
Square root of kcal production per person excluding beans		+	+	+	+
Farm area per person	+	+			+
Small ruminants per person		+			+
Cows per person	-	-			
Ave. time (min) to bean/sorghum market	-		-		
Expense dummies:					
Labor	+	+		+	
Clothing	-			+	
Seed, field rent, or tools	-			+	
Food		-			
Incidentals	-			+	
Constraint dummies:					
Drought					
Labor				+	-
Revenue dummies					
Field work					
Non-farm			-	+	
Beer-making			-		
Coffee/tea				-	
Food Sales					+

Codes:+=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$ Note: The regression for the Northwest region includes households which do not grow beans.

Table 4.9
Summary of Models of Kilocalorie Production Per Person by Zone

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Adjusted R-square	.53	.36	.37	.34	.54
Continuous Variables:					
Actives per person		+		+	+
Share of tubers and bananas in kcal prod.		-	-	-	-
Farm area per person	+	+	+	+	+
Small ruminants/person	+		+		+
Cows per person				+	
Ave. time (min) to bean/sorghum market	+			-	
Expense dummies:					
Labor	+				
Seed, field rent, or tools			+		
Constraint dummy:					
Drought					+
Revenue dummies:					
Field work		-			
Beer-making		+	+		+
Food Sales	+		+		+

Codes: +=significant (at $\geq 90\%$) positive relationship, -
=significant (at $\geq 90\%$) negative relationship, blank=not
significant at $\geq 90\%$. Notes: 1) Dummies for labor expenses, food
expenses, labor constraint, and non-farm revenue were not
significant at $\geq 90\%$ in any of the five regions. 2) SESA defines
an "active" as a person between the ages of 15 and 64.

Table 4.10
Summary of Whole Sample Bean, Sorghum, and Kilocalorie Production
Per Person Models

	Dependent Variable		
	Bean Prod. per Person	Sorghum Prod. per Person	Kcal Prod. per Person
Adjusted R-square	.51	.26	.48
Continuous Variables:			
Actives per person	+	+	+
Square Root of Kcal Production Excluding			
A) Beans	+	nr	nr
B) Sorg. and Beer Bananas	nr	+	nr
Share of Tubers and Bananas in Kcal Prod.	nr	nr	-
Farm Area Per Person	+		+
Small Ruminants/person	+	+	+
Cows per person	-		
Ave. time (min) to bean/sorghum market	-	-	
Expense Dummies:			
Food	-		
Labor	+	+	+
Seed, field rent, or tools			+
Constraint Dummies:			
Soil Fertility	-		
Land	+		
Drought		+	
Labor	-		
Revenue Dummies:			
Beer making			+
Food Sales		+	+
Coffee/tea			+
Zone Dummies:			
Northwest	-	-	-
Southwest	-	-	-
Northcentral	-	-	-
Southcentral	-	-	-

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$, nr=not regressed for theoretical reasons.

Table 4.11
Summary of Kilocalorie (1000s) Production Per Centiare Regressions

	Geographical Zone					Whole Country
	North-west	South-west	North-central	South-central	East	
Sample size	165	165	250	220	276	1076
Adjusted R-square	.36	.36	.53	.49	.38	.33
Continuous Variables:						
Actives per person	+			+		+
Share of potatoes in kcal prod.	+		+			+
Share of sweet potatoes in kcal prod.		-	-	-	-	-
Share of manioc in kcal prod.			-			
Persons per centiare	+	+	+	+	+	+
Small ruminants per centiare	+				+	+
Cows per centiare	-	+	+			
Ave. time (min) to bean/sorghum market	+			-		
Expense dummies:						
Seed, field rent, or tools						+
Clothing			-	-		
Constraint dummy:						
Drought	-		-			
Land	-			+	+	
Soil Fert.					-	
Revenue dummies:						
Beer-making			+		+	+
Food Sales			+	+		
Industrial crops		-	+	+		

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$. Notes: 1) Dummies for labor expenses, food expenses, labor constraint, and non-farm revenue were not significant at $\geq 90\%$ in any of the five regions. 2) SESA defines an "active" as a person between the ages of 15 and 64. 3) A joint test of dummy intercept shifter variables for zone in the whole country regression showed them to be insignificant at $\geq 90\%$.

Output Per Person.- Per capita bean and sorghum production of farm households is strongly correlated with household productivity in other crops. The more calories the household produces in other crops, the more the household tends to produce in beans and sorghum.

An important debate in Rwanda is whether prices can be used as a means of increasing specialization. Some analysts hypothesize that increased prices will create incentives for farmers who are producing many different crops to specialize in those crops for which their cost of production is lowest. They will then be able to afford the higher prices they face as consumers.

The results shown in prior sections and the above models results, call this logic into question. Per capita bean and sorghum output is contingent on productivity of farm resources, many of which are fixed for the near future. Many Rwandan families are on farms that do not have enough physical resources for adequate production, and are net food buyers. The only way increased food prices can help net buyers is by increasing returns to labor. A better way to increase returns to labor is by searching for ways to increase labor productivity, not simply output price. Improved cropping techniques or development of non-cropping employment are ways labor productivity could be increased.

Aside from per capita calorie production, the hiring of labor also appears to be an important indicator of high per capita household sorghum and bean production. If the household uses outside labor to manage its physical endowment, resource access per household member is probably quite high. It is important to maintain an effective labor market in Rwanda, both to provide employment opportunities for those with insufficient or

infertile land, and to increase total agricultural output by making labor resources available to those few farms with abundant land.

Total farm size per person is also positively related to bean production per capita, while for sorghum this relationship is not as strong. Soil fertility or climate may be more important in determining per capita sorghum output than it is in determining per capita bean output.

Other factors correlated with high bean and sorghum production appear to be specific to individual geographic zones, a natural result of the diversity of resource endowments (temperature, surface area, soil fertility, labor) between regions. Researchers and food policy makers could improve the potential for strengthening the rural economy by taking this diversity into closer consideration in the future.

Per capita kilocalorie production is strongly related to farm size in each of the five agro-ecological zones in Rwanda. Research on land saving strategies is probably appropriate in each of the five zones.

Animal husbandry (especially small ruminant production) appears to be positively related to kilocalorie output per person in most zones. More intense animal husbandry may be both a cause and effect of higher per capita kilocalorie production. The presence of animals on the farm can help improve soil quality over time. At the same time, the poorest farms may not be able to support both their human occupants and intense animal husbandry.

In four of the five zones, total per capita kilocalorie output decreases as the percentage of kilocalorie output comprised of tubers and bananas increases. This may be a result of reduced fallow and little

rotation as poor farms rely more and more on these crops to obtain sufficient calories.

The ratio of "actives" (persons 15 to 64 years old) to household members is not significantly related (at $\geq 90\%$) to caloric output per person in two of the five zones. This may be an indication that these two zones (Northwest and Northcentral) have more surplus labor than other zones.

The zonal dummies in all three production per person regressions have negative coefficients. This means that *ceterus paribus* the East produces more beans, sorghum, and kilocalories per person than the other four zones.

Comparison of the national model results in Table 4.10 with the those by zone in Tables 4.7 through 4.9 illustrates the need for disaggregated information in analyses of Rwandan agriculture. The larger sample size in the national models had little effect on the overall fit of the model compared to the fit of the zonal equations. Further, aggregation into a national model masks certain relationships specific to the agro-ecological conditions of each zone. For example, Table 4.8 shows a felt labor constraint to be associated with higher per capita bean production in the South-central zone, but lower per capita bean production in the East. This is logical given higher population densities in the South-central zone: farmers that have a labor constraint probably have adequate land and fertility. In the national model the labor constraint variable is not significant. In short, modeling by geographic zone appears to provide better insights into the factors correlated with bean, sorghum, and kilocalorie production than do national models.

Output Per Unit Land Area.- Results of regressions on output per unit land area (centiares) are presented in Table 4.11. While there are significant differences between the six equations, some there are also some important commonalities. The share of output in sweet potatoes is negatively related to aggregate yield in four of the five zonal equations, and in the "whole country" equation. At first glance, this is a puzzling result, because sweet potatoes yield more calories per hectare than other crops. Families planting a high proportion of sweet potatoes may have low soil fertility due to short or non-existent fallow times and little crop rotation. Sweet potatoes may not increase aggregate yield enough to compensate for the low soil fertility.

Livestock is generally positively related to aggregate caloric yield. Fallow fields and the availability of manure are probably the key explanatory factors in this relationship.

Across all six equations, the number of persons per centiare is positively related to the caloric output per centiare. The magnitude of the coefficient on the "persons per centiare" variable in these equations is the marginal caloric output the family could harvest given one extra person. These coefficients, expressed in terms of kilocalories per day, are reported in Table 4.12. The FAO estimate for minimum caloric intake for maintenance of good health in Rwanda is 2100 kcal/day. Table 4.12 clearly indicates that the marginal caloric productivity of extra labor is not sufficient for the physical maintenance of that labor.

The data in Table 4.12 confirm similar findings by MINIPLAN listed in Table 4.13. Table 4.13 shows that as the number of persons

per hectare increases, total value added per hectare increases, but value added per person decreases. The general conclusion from Tables 4.12 and 4.13 is that given current technology, agricultural production in Rwanda exhibits diminishing returns to labor. Farmers may be intensifying their use of their abundant input, labor, but this strategy, while perhaps their best current option, is likely to make them poorer. All this underscores the need to find better cropping technologies that are well adapted to Rwanda, and better non-cropping income earning strategies for rural Rwandans.

Table 4.12
Marginal Increase in Average Family Caloric
Production Associated with an Additional Family Member

Area	Additional Output (kcal/day)	Significance of T-test
Northwest	471	>99.99%
Southwest	843	>99.99%
North-central	920	>99.99%
South-central	830	>99.99%
East	580	>99.99%
Rwanda	578	>99.99%

Table 4.13
Value Added in Agriculture
by Classes of Farm Surface Area

Farm Size Class (hectares)	Ave. Size of Household (persons)	Ave. Persons per Hectare	Value Added in Agriculture		
			Per Household	Per Person	Per Hectare
0.0-0.37	3.6	17.5	21,632	6,544	104,731
0.38-0.65	4.6	9.6	27,599	6,901	56,631
0.66-1.07	4.8	5.9	32,065	7,434	39,634
1.08-1.90	5.6	3.9	39,157	7,652	26,584
1.91+	6.2	2.1	52,653	8,987	17,126

Source: MINIPLAN (1988).

4.2 Characteristics of Groups Which May be Vulnerable to Chronic Food Insecurity

This section uses tabular and regression analysis to identify groups which may not be able to acquire enough food for minimum health needs. Ideally, this analysis should consider anthropomorphic, consumption, and income data. Since these data sets are not available for the national SESA sample, proxies relating to bean and sorghum transactions are developed.

This section shows the following about beans and sorghum in Rwanda. For both beans and sorghum, a small percentage of Rwandan households are large net sellers. The large net sellers account for the vast majority of net sales for both crops. Net sellers tend to have larger farms and higher per capita kilocalorie production than net buyers. The majority of farm families are net bean and sorghum buyers. Net buyers appear to have access to fewer productive resources than net sellers. Specialization in bean production to buy sorghum and vice

versa appears to be negligible. Net sellers of beans tend to be net sellers of sorghum. Over half of the rural families in Rwanda are net buyers of both crops.

A. Sorghum

Based on data from the SESA/MSU Farmer I survey, Table 4.14 highlights several characteristics of sorghum marketing in Rwanda according to household type. Household categories were established by level of net household transactions in dry sorghum grain, germinated sorghum, and sorghum flour. Sorghum beer sellers are treated separately because they depend on selling sorghum beer for income, which sets them apart from other types of households. Net household transaction categories were established as follows. First, each household's non-commercial transactions were summed for the months November 1985 to October 1986. Total purchases or total sales were divided into categories by "natural" breaks in the distribution.

Note first in Table 4.14 that sorghum beer sellers account for a significant part of the sorghum trade, both in buying and selling sorghum. Farms that sold both sorghum beer and sorghum grain (net) accounted for only 4.5% of all rural households (19% of sorghum sellers), and 20% of rural net sales.

Farms selling sorghum beer which were net buyers of sorghum grain accounted for 65% of net purchases in 1986. This group, which is only 13% of the universe of rural households (20% of net buyers) bought a net quantity of sorghum larger than estimated rural net imports. The data do not permit estimation of the proportion of sorghum purchases going to marketed sorghum beer. Nonetheless, results in Table 4.14

imply that much of the sorghum purchased in rural Rwanda goes to families processing beer for income.

If sorghum imports essentially go into sorghum beer production to supplement family income, then a policy of increased sorghum grain prices must be carefully examined. Haggblade with Minot found that during 1983 (a typical production year), 23 million liters of sorghum beer and 169 million liters of banana wine were exported from the rural areas of Rwanda. If sorghum prices rose, local sorghum beer and banana wine⁹ prices would also rise. Consumers would buy less sorghum beer and banana wine, which would result in a loss of income for processors.

Regardless of the effects on brewers, increased sorghum prices would make those who buy sorghum as a low cost food staple worse off.

⁹Sorghum is an ingredient in banana wine.

Table 4.14
Total Net Sales (Gifts Excluded) of Dry Sorghum Grain,
Germinated Sorghum, and Sorghum Flour
by Household Net Transaction Category
Nov. '85 - Oct. '86
(Negative Numbers Indicate Purchases)

Household Net Transaction Category:	% of Farms	No. of Farms	Net Tons Sold By Category	% of Sales	Ave. Area Per Farm (ha)
Net Sorghum Sellers:					
Households That Sold Sorghum and Beer	4.5%	49409	5507	19.9%	1.6
Households that Sold Sorghum, but No Beer:					
>60 Kg Sold	6.2%	68476	19473	70.2%	1.9
30-59 Kg Sold	3.4%	36916	1497	5.4%	1.4
<30 Kg Sold	9.4%	103399	1234	4.4%	1.1
 No Net Sorg. Transactions	9.0%	99035			1.0
Net Sorghum Buyers:					
Households that Bought Sorghum and Sold No Beer:					
<30 Kg Bought	34.5%	378334	-4892	-7.5%	0.9
30-59 Kg Bought	10.4%	113743	-4966	-7.6%	1.2
>60 Kg Bought	9.2%	101264	-12895	-19.7%	1.4
Households that Bought Sorghum and Sold Beer	13.4%	146515	-42710	-65.2%	1.4
Total	100.0%	1097091			1.2

Note: 0.6% of the households sold beer, but had no net sorghum transactions. To simplify the table, these households were lumped with households that did not sell beer, and who had no net sorghum transactions.

Table 4.15 shows some of the internal consistency in the transactions data. Those who bought the most sorghum either processed sorghum for sale as beer, or produced very little sorghum on farm. Families that had net sorghum purchases of over 60 kg obtained 77% of the sorghum they used through purchases and gifts. Families that bought 30-59 kg of sorghum (net) in 1986 obtained roughly half their sorghum through transfers. Clearly these two groups would also be hard hit by sorghum price increases.

At the other end of the spectrum, those who sold sorghum from their own production harvested relatively large quantities of sorghum. Only one group, those who sold more than 60 kg (net) of sorghum, sold or gave away a large proportion (49%) of their sorghum harvest. This group represents only 6.2% of rural farm families.

Tables 4.14 and 4.15 also indicate the relative well being of families in different transaction categories. Table 4.14 shows the average farm size of those who sold the most sorghum is higher than any other group. Table 4.15 shows this group producing more kilocalories (from the 8 major crops) on an annual per capita basis than any other group. Clearly this category of households is unlikely to experience chronic food insecurity. Without exception, net sorghum grain seller groups produce more calories per capita than net sorghum grain buyer groups.

Table 4.15
Total of Per Capita Dry Grain Sorghum Grain,
Germinated Sorghum, and Sorghum Flour Availability
by Net Transaction Category of Household
Nov. '85 - Oct. '86

Household Net Transaction Category:	% of Farms	Kg of Sorghum Produced	Kg of Sorghum Trans- ferred	Kg of Sorghum Avail- able	Kcal/cap/day Produced (8 Major Crops)
Net Sorghum Sellers:					
Households that Sold Sorg. and Beer	4.5%	102	24	78	3320
Households that Sold Sorghum, but No Beer:					
>60 Kg Sold	6.2%	113	55	58	3855
30-59 Kg Sold	3.4%	74	11	63	2830
<30 Kg Sold	9.4%	40	3	37	2422
No Net Sorghum Transactions:	9.0%	21	-0	21	2025
Net Sorghum Buyers:					
Households that Bought Sorghum and Sold No Beer:					
<30 Kg Bought	34.5%	12	-4	16	1737
30-59 Kg Bought	10.4%	12	-10	22	2112
>60 Kg Bought	9.2%	8	-27	35	2140
Households that Bought Sorghum and Sold Beer	13.4%	32	-54	86	2274
Rwanda	100.0%	44	-7	37	2216

Note: transfers include sales, gifts given, gifts received, and purchases. Seed is considered as a part of sorghum availability. Less than 1% of households sold beer and had no net transactions in sorghum. To simplify the table, these households were lumped with households that did not sell sorghum beer, and had no net transactions.

Households producing the fewest kilocalories per capita are those with the smallest surface area to cultivate: families that bought less than 30 kg (net) and those that neither bought nor sold (net). These two categories also had the lowest on farm sorghum availability of any of the groups. This indicates either: A) They have little interest in sorghum and/or sorghum products; or B) They are too poor to be able to afford to purchase sorghum to augment their diets. In either case, a farm level sorghum price increase is not likely to improve their situation. Yet together they constitute over 42% of rural households.

The use to which Rwandan households in the rural areas intend to put sorghum (see Table 4.16) they have purchased varies considerably between transaction categories. Most striking is the group that sold beer and were net buyers of sorghum. They intended to manufacture beer or wine out of 89% of the sorghum they purchased. For the rural population as a whole, 59% of all sorghum purchases (roughly 50,000 tons) are for alcoholic beverage production.

Table 4.16
Intended Use of Sorghum Purchased by Rwandan Farmers

Household Net Transaction Category:	Intended Use at Time of Purchase					
	Consump- tion	Resale	Seed /cons	Beer/ wine	Other	Total
Net Sorghum Sellers:						
Households that Sold Sorghum and Beer	9%	67%	2%	21%	1%	100%
Households that Sold Sorghum, but No Beer:						
>60 Kg Sold	33%	60%	0%	5%	0%	100%
30-59 Kg Sold	30%	1%	1%	65%	3%	100%
>30 Kg Sold	44%	45%	3%	7%	1%	100%
No Net Sorg. Trans.	1%	99%	0%	0%	0%	100%
Net Sorghum Buyers:						
Households that Bought Sorghum and Sold No Beer:						
<30 Kg Bought	53%	30%	3%	14%	2%	100%
30-59 Kg Bought	60%	3%	1%	34%	2%	100%
>60 Kg Bought	38%	23%	1%	38%	0%	100%
Households that Bought Sorghum and Sold Beer	8%	2%	0%	89%	1%	100%
Rwanda	23%	16%	1%	59%	1%	100%

Notes: This table includes dry grain sorghum, germinated sorghum, and sorghum flour. Households with no net transactions in sorghum that sold sorghum beer are lumped with households that sold no beer and which had no net sorghum transactions.

Families purchasing small net quantities of sorghum annually (less than 60 kg) are more likely to use purchased sorghum in direct consumption than for beer brewing. These small net purchasers may rely on cabarets for sorghum beer, or they may be too poor to afford even the modest luxury of sorghum beer. These households are also much less involved in reselling sorghum than households that are large net sellers of sorghum.

A high percentage of large net sellers of sorghum are engaged in reselling activities. Large net sellers probably have better developed contacts with outlets for excess production than other groups of farmers. They may be capturing economies of scale in marketing their own production by performing assembly functions to boost volume.

Table 4.16 shows very little activity in purchasing sorghum for seed. This indicates that farmers may be leery of new varieties of sorghum. It is difficult to distinguish one variety of sorghum from another by the appearance of the seed in Rwanda. Reluctance to acquire seed through the market may be an adaptation to asymmetric market information on seed characteristics. Also, much of the sorghum on the market may not be well adapted to the particular micro-climate in which the farmer intends to plant.

Table 4.16 shows all groups (even large net sellers of sorghum) bought some sorghum for direct consumption purposes. This finding is explored further in Table 4.17.

The proportion of families engaging in both non-commercial buying and non-commercial selling is given in Table 4.17. The purpose of this table is to investigate the common belief that farmers are forced to

sell at harvest time at a low price, only to buy back later at a high price. (See for example Clement.) Table 4.17 shows that during the 1986 agricultural year, only 26% of rural households bought and sold sorghum.

Thus a maximum of one quarter of rural households engage in the practice of selling and repurchasing at a later date. The percentage of households that sell at harvest for a low price because they need cash and buy back later at a higher price because they need the food is probably much lower than 26%. Listed below are other situations which might cause a farmer to buy and sell the same product within a year:

- 1) A bad season followed by a good season (the family needs to buy just before good harvest, then has more than enough).
- 2) The family opts to sell old poor quality sorghum, and replace it with higher quality (purchased) sorghum.
- 3) Grain was sold, but the family bought a new or improved variety of sorghum seed for the upcoming season. Table 4.16 indicates that some of the very large net sellers are purchasing seed.
- 4) The family miscalculated their sorghum needs for the year. Unexpected births, marriages or deaths might require quantities of sorghum for ceremonial purposes.
- 5) The farm family harvested and sold off-season sorghum when prices were high, and then purchased sorghum after the main harvest when prices were low.
- 6) The family did not want to risk losing its sorghum harvest during storage.

Seasonal analysis in Chapter III showed that seasonal prices changes in sorghum are moderate in most years. Thus when the family sells and then buys, what is lost is due mostly to transactions costs.

Table 4.17

Sorghum Market Activities: Percentage of Families With
No Transactions, Purchases Only, Both Purchases and Sales,
and Sales Only

Nov. 1985 through Oct. 1986

(Buying for Resale and Sales from Purchases Not Included)

Household Net Transaction Category:	Percentage of Households:				Total
	No Transac- tions	Bought Only	Bought and Sold	Sold Only	
Net Sorghum Sellers:					
Households that Sold Sorghum and Beer			49	51	100
Households that Sold Sorghum, But No Beer					
>60 Kg Sold			47	53	100
30-59 Kg Sold			61	39	100
<30 Kg Sold			54	46	100
No Net Trans.	96		4		100
Net Sorghum Buyers:					
Households that Bought Sorghum, and Sold No Beer					
<30 Kg Bought		83	17		100
30-59 Kg Bought		81	19		100
>60 Kg Bought		87	13		100
Households that Bought Sorghum and Sold Beer		66	34		100
Rwanda	9	54	26	11	100

Note: table includes dry sorghum grain, germinated sorghum, and sorghum flour. Sorghum beer sellers with no net transactions are combined with families that didn't sell beer and which had no net sorghum transactions.

The following facts derived from Table 4.18 shed more light on the importance of buying followed by selling of sorghum. Over half the sorghum sold in Rwanda is sold by families that buy and sell sorghum. Only 27% of the dry grain purchased is purchased by families that buy and sell sorghum (19,361 tons/71,490 tons). Purchases of dry grain by net sellers equal only 11% of total sales by net sellers. Sales of dry grain by net buyers are a mere 4% of total purchases by net buyers (2,507 tons/67,950 tons).

Further, purchases of dry grain by net sellers who bought and sold make up a volume equal to 22% of these families' gross sales (3,499 tons/15,491 tons). Sales of dry grain by net buyers who bought and sold constitute 16% of these families gross purchases (2,507 tons/15839 tons).

A conclusion from the preceding two paragraphs is that total purchases and sales by families that engage in both buying and selling activities are large relative to national volumes transacted. A second conclusion is that the impact of having bought and sold is probably minimal at the household level. From discussion of Table 4.17 we know that fewer than 26% of farm families are forced to sell sorghum at a low price at harvest and then repurchase after prices rise. In sum, only a few families sell then buy at a higher price, and the effect on them appears to be minimal. Discussion in Chapter III indicates that price movements appear to reflect real transfer costs. It is safe to say that few sorghum merchants are extracting unfair profits from farmers who sell then must buy back at a later date. Indeed, it seems more likely that most households who buy and sell benefit from the

marketing system. The market provides both a source and an outlet for sorghum, and it can meet family needs even when family circumstances change.

Table 4.18
Gross Non-commercial Sorghum Transactions
by Household Net Transactions Category
Nov. 1985 - Oct. 1986
(Metric Tons)

Household Net Transaction Category	Families That Bought and Sold Sorghum (26%)		All Families	
	Purchases	Sales	Purchases	Sales
Net Sorghum Sellers	3499	15491	3499	31209
No Net Sorghum Transactions	23	23	23	23
Net Sorghum Buyers	15839	2507	67950	2507
RWANDA	19361	18022	71490	33740

B. Beans

Data in Tables 4.19 and 4.20 provide insights about categories of households supplying and demanding marketed dry beans. One major finding is that 82% of net dry bean sales come from only 7% of farm households. On the purchasing side, 31% of households make 76% of the net dry bean purchases. As with sorghum, average size of land holding is larger for households with large net dry bean sales. Land is a reasonably good proxy for wealth in Rwanda, which means that poorer farmers tend to buy beans while wealthier farmers sell beans.

Contrary to the case of sorghum, farms with no net transactions have larger average land holdings than farms that are net buyers of dry beans. Beans are probably much more of a nutritional necessity than sorghum. When a farm can't grow enough food, the household may elect to forgo sorghum and sorghum beer, but not protein rich beans.

Table 4.19
Net Sales of Dry Beans by Household Net Transaction Category
Nov. '85 - Oct. '86
(Negative Numbers Indicate Purchases)

Household Net Transaction Category	Number of H.H.	% of H.H.	Net Tons Sold by Class	% of Sales	Ave. Farm Size (ha)
>60 Kg Sold	72224	7%	13977	82%	2.0
30-59 Kg Sold	39913	4%	1738	10%	1.6
<30 Kg Sold	123471	11%	1399	8%	1.6
No Net Transactions	51499	5%			1.4
<30 Kg Bought	265475	24%	-4295	-8%	1.0
30-59 Kg Bought	202991	18%	-8847	-16%	1.0
>60 Kg Bought	341518	31%	-41379	-76%	1.1
Total	1097091	100%			

Table 4.20
Per Capita Availability Of Dry Beans
by Household Net Transaction Category
Nov. '85 - Oct. '86

Household Net Transaction Category	% of H.H.	Kg Beans Produced Per Capita	Kg Beans Transferred Per Capita	Kg Beans Available Per Capita	Total Kcal/cap Produced
>60 Kg Sold	7%	136	48	88	4658
30-59 Kg Sold	4%	83	13	70	3442
<30 Kg Sold	11%	73	5	68	3072
No Net Transactions	5%	49	0	49	2600
<30 Kg Bought	24%	34	-5	39	1966
30-59 Kg Bought	18%	30	-11	40	1773
>60 Kg Bought	31%	24	-24	48	1781
Total	100%				

Notes: transfers include purchases, sales, gifts given and gifts received. Availability includes seed and storage losses. Total per capita kcal production is based on the eight major crops included in SESA's production survey.

Table 4.20 shows per capita bean availability by household net bean transaction category. The three categories of households that are net purchasers of beans have less household per capita beans and total calorie production (from the 8 major crops) than the other categories. Households that bought more than sixty kilos (net) of dry beans per capita during the year acquired only half of their bean supply from their own production. An increase in bean prices would hurt this group (31% of rural households) much more than the population at large. Each 1 Frw/kg price increase would decrease their average family income by 121 Francs, if they were to buy the same quantity of beans as in 1986. If they held spending at 1986 levels by reducing purchases, a 1 Frw/kg price increase would lower average family daily food availability by 33 Kcal for this group.

Overall, 73% of rural households are net buyers of beans while only 22% are net sellers. Thus a price increase in beans is likely to hurt 73% of farm families and help only 22% of farm families in the short run. Better cropping technologies would be needed before more farmers could benefit in the long run.

Since the 73% of farm families that buy beans also produce the least kilocalories per person per year, augmenting farm level bean prices is likely to reduce the incomes of those least capable of producing adequate food.

Table 4.21 shows that every transaction category had some households who both purchased and sold dry beans, with 37% of farm families buying and selling for non-commercial purposes. Buying and selling by the same family is apparently more widespread for beans than

for sorghum. Yet Table 4.22 shows that the relative quantities of beans bought by net sellers and sold by net buyers are relatively minor. Purchases by net seller families that bought and sold were only 22% of their gross sales (2,378 tons/10,730 tons), and sales by net buyer families were only 19% of their gross purchases (3,429 tons/17,188 tons).

The reasons previously discussed for sorghum purchasing and selling are also valid here. The continuous nature of the bean harvest may result in another type of buying and selling behavior: farmers with an "off-season" harvest may sell while prices are high, and buy during the main harvest after prices drop.

The data for both beans and sorghum do not support the belief that farmers sell at low prices to buy back later at higher prices. For these commodities, the market cannot be seen as generally increasing chronic food insecurity.

Table 4.21
Dry Bean Marketing Activities: Percentage of Households With
No Transactions, Purchases Only, Both Purchases and Sales,
and Sales Only by Household Net Transaction Category
(Commercial Transactions Excluded)
Nov. 1985 through Oct. 1986

Household Net Transaction Category	Percentage of Households:				Total
	No Trans- actions	Bought Only	Bought and Sold	Sold Only	
>60 Kg Sold			54	46	100
30-59 Kg Sold			34	66	100
<30 Kg Sold			56	44	100
No Net Transactions	86		14		100
<30 Kg Bought		61	39		100
30-59 Kg Bought		60	40		100
>60 Kg Bought		74	26		100
Rwanda	4	49	37	10	100

Table 4.22
Gross Non-commercial Dry Bean Transactions
by Household Net Transactions Category
Nov. 1985 - Oct. 1986
(Metric Tons)

Household Net Transaction Category	Families That Bought and Sold Dry Beans (37%)		All Families	
	Purchases	Sales	Purchases	Sales
Net Dry Bean Sellers	2378	10730	2378	19460
No Net Dry Bean Trans.	109	109	109	109
Net Dry Bean Buyers	17188	3429	57988	3429
RWANDA	19674	14269	60475	22999

C. Limited Exchange of Beans for Sorghum and Vice Versa

One might argue that households made worse off by bean price increases are probably surplus in other crops. Thus a net purchaser of beans might be a net seller of sorghum and end up with no net gain or loss when prices of both commodities are increased. Indications are that this is not the case for beans and sorghum in Rwanda.

Table 4.23
Transaction Position of Farm Households in Beans and Sorghum
Gifts Excluded.
(Percentage of Households)

Household Net Transaction Position in Dry Beans	Household Net Transaction Position in Sorghum (Percentage of Households)		
	Net Buyers	Net Sellers	No Net Transactions
Net Buyers	54.5%	12.6%	6.7%
Net Sellers	10.3%	9.7%	1.6%
No Net Transactions	2.7%	1.2%	0.7%

Table 4.23 shows that over half of the farm families in Rwanda are net buyers of beans and net buyers of sorghum. These families would be hit doubly hard if both bean and sorghum prices were increased. Further, less than 10% are net sellers of both beans and sorghum. Thus the idea that increased prices will allow farmers to earn more on one crop in order to enable them to spend more on another crop is probably incorrect with respect to beans and sorghum.

Hypothetical transfer effects of a one franc price increase in beans and sorghum given 1986 supply and demand are shown in Table 4.24.

Only those groups (12.5% of the rural households) that do not buy either crop would benefit in such a situation. The 9.7% of households that are net sellers of both crops stand to benefit substantially more than other groups. Over 85% of households would have net losses in such a situation, with the 54.5% of rural households buying both crops bearing the highest losses. Net losses would be lower for those families buying one crop and selling the other.

Households currently unable to produce sufficient beans for their own use are not likely to produce enough sorghum for own use. It is also likely that these families are among the poorest in Rwanda and prone to be chronically food insecure. Increased prices must clearly exacerbate their dilemma either by reducing their disposable income or the amount of food they buy. This is certainly true in the short run, and perhaps true in the long run as well, given constraints faced by Rwandan agriculture and the lack of improved production techniques.

Table 4.24
Net Transfer Effects of a One Frw/kg Increase in Bean
and Sorghum Prices by Household Net Transaction Position
Gifts Excluded
(Frw per Person)

Household Net Transaction Position in Dry Beans	Household Net Transaction Position in Sorghum		
	Net Buyers	Net Sellers	No Net Transactions
Net Buyers	-30	-3	-13
Net Sellers	-6	58	4
No Net Transactions	-20	6	0

Note: estimates assume 1986 quantities.

Average prices received by farmers were 12 Frw/kg below target levels for beans and 2 Frw/kg below target levels for sorghum. Hypothetical annual transfer effects of increasing bean and sorghum prices from 1986 market levels to 1986 target levels (assuming quantities transacted remain unchanged) are shown in Table 4.25. MINIPLAN has estimated average value of consumption per capita at about 13,000 Frw (see Table 4.3). Since most net buyers are likely poorer than average, the negative effects illustrated in Table 4.25 on net buyers of increasing prices to target prices could be significant. This is particularly true for net bean buyers, who would face substantially higher prices.

Table 4.25
Net Transfer Effects of Increases in Bean and Sorghum
Prices to 1986 Target Levels
by Household Net Transaction Position
Gifts Excluded
(Frw per Person)

Household Net Transaction Position in Dry Beans	Household Net Transaction Position in Sorghum		
	Net Buyers	Net Sellers	No Net Transactions
Net Buyers	-192	-136	-160
Net Sellers	59	337	55
No Net Transactions	-39	13	0

Note: estimates assume 1986 quantities.

D. Household Characteristics Related to Net Transactions Position

Household marketing position is related to a host of variables which are quite specific by region. To systematically examine these factors, regression models were developed as follows. Purchases and sales were modelled separately as these activities and the factors associated with them should be quite different. For the dependent variables, net transactions positions were established by summing farmer transactions over the 1986 agricultural year. Independent regression variables were developed as described in an earlier section of this chapter on kilocalorie production models. Tables 4.26 through 4.29 summarize results of regressions on farmer net purchases and sales of beans and sorghum. Specifics of each regression are included in Annex II.

In general, net transaction models did not perform as well as the kilocalorie production models. This can be traced in part to the reduced degrees of freedom resulting from the division of the sample into net buyers and net sellers. Crop rotation considerations, total farm income, and the farm's suitability for bean and sorghum production are missing variables which may account for a high proportion of the unexplained variation.

Nonetheless, regression model results indicate that ability to produce surpluses and the degree of reliance on the market for food is associated with different variables by region. This is another indication that solutions to Rwanda's chronic food insecurity problems may vary substantially between regions.

Table 4.26
Summary of Bean Sales Per Person Models

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Net Bean Sellers	21	34	35	68	133
Adjusted R-square	n/a	.56	n/a	.34	.14
Continuous Variables:					
Share of bananas and tubers in prod.				-	-
Farm area per person				+	+
Small ruminants/person		+			

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$, n/a=none of the variables were significant at $\geq 90\%$. Notes: 1) None of the dummies for expenses, constraints, or revenue were significant at $\geq 90\%$ in any of the five regions. Continuous variables for average time to market, cows per person, and actives per person were not significant at $\geq 90\%$ in any of the five regions. 2) The dependent variable includes gifts given.

Table 4.27
Summary of Bean Purchases Per Person Models

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Net Bean Buyers	144	131	215	151	143
Adjusted R-square	.12	.16	.06	.12	.08
Continuous Variables:					
Actives per person		+	+	+	
Share of bananas and tubers in production	+			+	
Farm area per person	-	+			+
Small ruminants/person			+		
Cows per person				-	
Expense dummies:					
Labor			-		
Incidentals					+
Constraint dummy:					
Labor	+				

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$.

Notes: 1) Dummies for expenses, constraints, revenues which appear in other regression tables but not here were not significant at $\geq 90\%$ in any of the five regions. Average time to market was not significant at $\geq 90\%$ in any of the five regions. 2) SESA defines an "active" as a person between the ages of 15 and 64. 3) The dependent variable includes gifts received.

Table 4.28
Summary of Sorghum Sales Per Person Models

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Net Sorghum Sellers	16	9	55	55	157
Adjusted R-square	n/a	n/a	n/a	.36	.22
Continuous Variables:					
Share of bananas and tubers in production				-	-
Farm area per person				+	
Small ruminants/person					+
Expense dummies:					
Seed, field rent, or tools				+	
Clothing					-
Constraint dummy:					
Soil Fertility					-
Revenue dummy:					
Field work				-	

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$, n/a=none of the variables were significant at $\geq 90\%$. Notes: 1) Dummies for expenses, constraints, revenue included in other regressions were not significant at $\geq 90\%$ in any of the five regions. The continuous variables "actives per person", average time to market and cows per person were not significant at $\geq 90\%$ in any of the five regions. 2) SESA defines an "active" as a person between the ages of 15 and 64. 3) The dependent variable includes gifts given.

Table 4.29
Summary of Sorghum Purchases Per Person Models

	Geographical Zone				
	North- west	South- west	North- central	South- central	East
Sample size	165	165	250	220	276
Net Sorghum Buyers	149	156	194	163	119
Adjusted R-square	.30	.12	.17	.05	.04
Continuous Variables:					
Actives per person		+			
Share of bananas and tubers in production			-		
Farm area per person	+	+			
Small ruminants/person	+		+	+	
Cows per person		+			
Ave. time (min) to bean/sorghum market	-		+		
Expense dummy:					
Food	+				-
Constraint dummies:					
Drought			+		
Land	-				
Labor			+		-
Revenue dummies:					
Food Sales	+				
Industrial Crop				+	

Codes: +=significant (at $\geq 90\%$) positive relationship, -=significant (at $\geq 90\%$) negative relationship, blank=not significant at $\geq 90\%$.

Notes: 1) Dummies for expenses, constraints, revenues are not included in the table if they were not significant at $\geq 90\%$ in any of the five regions. 2) SESA defines an "active" as a person between the ages of 15 and 64.3) The dependent variable includes gifts received.

4.3 Farmer Production Strategies and Constraints

A. Constraints: Transactions Survey Compared with a Single Visit Farmer Opinion Survey

In July 1986, a single visit farmer opinion survey¹⁰ was fielded on SESA's entire national sample. One question asked farmers which constraint they found to be the greatest barrier to increasing their total production. Table 2.3 (in Chapter II) presents responses to this question by Prefecture. Tables 4.30 and 4.31 list farmers' responses to the same question by the net transaction categories established in Section 2 of this chapter.

Sorghum beer sellers and farms selling over thirty kilos of sorghum grain listed drought as their biggest production constraint much more often than other farms. Increased specialization in sorghum in dry areas may result from sorghum's ability to withstand drought conditions.

Farms with no net sorghum transactions and those buying less than thirty kilos of sorghum most frequently listed lack of land as their biggest production constraint. This is logical because (recall Table 4.14) these farms have the lowest average surface areas of all the groups.

¹⁰The general characteristics of the survey (called the Farmer IV survey) are given in Chapter I, Section 6.

Table 4.30
Biggest Production Constraint
by Household Net Sorghum Transaction Category

Principal Constraint	Household Net Transaction Category									
	Net Grain Sellers				No Net Transactions	Net Grain Buyers				Rwanda
	Sold Beer	>60 kg	30-59 kg	<30 kg		<30 kg	30-59 kg	>60 kg	Sold Beer	
Fertilizer										
/Soil Fert.	29.5%	18.5%	23.7%	25.5%	36.9%	32.5%	25.3%	34.7%	36.1%	30.8%
Surface Area	16.4%	12.3%	15.7%	22.8%	27.0%	37.9%	34.8%	27.1%	23.6%	28.9%
Labor	16.6%	19.3%	21.0%	26.4%	22.4%	11.0%	19.8%	10.2%	10.4%	15.3%
Drought	24.0%	40.3%	23.2%	15.9%	7.6%	11.6%	10.9%	16.5%	21.5%	16.2%
Too										
Much Rain	8.5%	2.2%	8.5%	4.9%	5.1%	2.8%	5.0%	8.4%	7.6%	5.0%
Seed		.5%	5.6%			1.5%				.7%
Lack of										
Pesticides								.9%		.1%
Low										
Food Prices	1.3%	6.9%					1.0%			.6%
Other	3.6%		2.2%	4.5%	1.0%	2.7%	3.1%	2.3%	.8%	2.3%
No Response						.1%				.0%

Farms with net purchases of over 60 kilos and those selling beer and buying grain most often listed soil fertility as their biggest production constraint. This figure tends to confirm Tables 4.14 and 4.15, which showed these groups to have relatively large farms but with low caloric output.

These findings illustrate that rural households across Rwanda face very different production constraints. Future agronomic research in productivity enhancements will want to carefully consider these differences in order to maximize the potential of developing appropriate technology.

As a sidelight, Tables 4.30 and 4.31 also show that the vast majority of farmers do not consider low agricultural commodity prices as the most limiting factor in increasing their production. This is consistent with the small percentage of output marketed.

Table 4.31
Biggest Production Constraint
by Household Net Bean Transaction Category

Principal Constraint	Net Household Bean Transaction Category							Total
	>60 Kg Sold	30-59 Kg Sold	<30 Kg Sold	No Net Transactions	<30 Kg Bought	30-59 Kg Bought	>60 Kg Bought	
Fertilizer								
/soil Fert.	16.2%	25.7%	27.5%	22.1%	28.2%	33.9%	37.2%	30.8%
Surface Area	17.8%	15.1%	18.6%	17.1%	37.9%	32.2%	29.3%	28.9%
Labor	29.4%	9.5%	24.1%	24.1%	14.0%	16.6%	8.7%	15.3%
Drought	27.5%	39.5%	16.6%	27.4%	12.4%	12.6%	14.3%	16.2%
Too								
Much Rain	3.9%	6.4%	8.7%	4.6%	3.0%	2.7%	6.8%	5.0%
Seed					1.0%		1.5%	.7%
Lack of								
Pesticides			.8%					.1%
Low								
Food Prices	4.4%	3.9%				.4%	.3%	.6%
Other	.9%		3.7%	4.0%	3.4%	1.7%	1.7%	2.3%
No Response				.7%				.0%

Production constraints for bean buyers and sellers (Table 4.31) conform to the general patterns exhibited for sorghum buyers and sellers. Sellers tend to be more hampered by drought and labor problems, while buyers are handicapped by lack of land and low soil fertility.

Responses to the production constraint question were also cross tabulated with household per capita kilocalorie production quartile (Table 4.32). The lowest kilocalorie producers listed a land constraint far more frequently than the other groups. The highest producers listed labor constraints much more frequently than other groups. Thus the relationships between net bean transactions position and constraints are similar to relationships between total kilocalorie production and production constraints.

While soil fertility is a problem for every group, the lowest and highest per capita kilocalorie producers listed soil fertility somewhat less often than the two middle groups. Low kilocalorie producers may tend to be located in the volcanic soils which are fertile but densely populated. Low kilocalorie producers may also practice labor intensive soil fertility maintenance practices. High kilocalorie producers may also be able to maintain soil fertility better because larger farms allow longer fallow periods.

Table 4.32
Biggest Production Constraint by Household
Per Capita Kcal Production Quartile

Constraint	Household Per Capita Kcal Production* Quartile				Rwanda
	Lowest	2nd	3rd	Highest	
Fertilizer/ Soil Fert.	24.7%	35.1%	33.7%	28.2%	30.8%
Land	49.5%	37.4%	26.7%	16.1%	28.9%
Labor	5.6%	9.8%	15.3%	23.2%	15.3%
Drought	14.7%	12.2%	13.7%	21.6%	16.2%
Too Much Rain	3.2%	4.7%	6.1%	5.2%	5.0%
Seed	1.8%		1.1%	.5%	.7%
Low Food Prices			.6%	1.3%	.6%
Pesticides				.3%	.1%
Other	.6%	.8%	2.8%	3.6%	2.3%
No Response				.1%	.0%

*Note: caloric production refers to the 8 major crops only.

Table 4.33
Biggest Production Constraint by
Farm Size Quartile

Constraint	Farm Size Quartile				Rwanda
	Smallest	2nd	3rd	Largest	
Fertilizer/ Soil Fert.	17.8%	32.2%	40.8%	32.6%	30.8%
Land	56.4%	34.2%	19.0%	5.6%	28.9%
Labor	13.1%	7.8%	14.0%	26.3%	15.3%
Drought	8.5%	12.8%	18.9%	24.6%	16.2%
Too Much Rain	1.9%	5.4%	5.8%	7.1%	5.0%
Seed	1.1%	1.3%		.5%	.7%
Low Food Prices	.3%	1.0%		1.2%	.6%
Pesticides				.3%	.1%
Other	.9%	5.4%	1.4%	1.6%	2.3%
No Response			.1%		.0%

Table 4.33 shows relationships between farmer constraints and the total area of land managed by the family (measured by SESA enumerators). In general, these relationships are quite similar to those discussed in conjunction with the preceding three tables.

The preceding four tables illustrate that constraints vary considerably between farm types. Table 2.3 (from Chapter II) shows that this variation is also found between regions. This indicates that there are at least two broad classes of farming systems problems to be solved--one for relatively larger farms in semi-arid, low population areas, and another for small farms in higher population, more intensively cultivated areas. Within each of these farm types is a host of subclasses, each with its own set of constraints and conditions. But the two types of farming systems provide a starting point for classification of agronomic research. A partial solution to Rwanda's chronic food insecurity problems lies in removing barriers to increased production for both farm types. The dichotomy in farm types is explored further in Section 3.C of this chapter.

B. Cropping Patterns

Stability of Production.- The use to which a farm family puts its resources is a function of many factors. Among these are soil types, weather, labor availability, farm surface area, non-farm employment opportunities, access to markets, and various types of risk. The concepts of chronic and transient food security represent two types of risk that are intertwined. Farmers may elect for a stable low level of output in favor of a risky but on average higher level of output

(increasing the potential for transient food insecurity). To quote Reutlinger (1987),

"The quest for stable streams of income and consumption was not invented by imaginative politicians. People want and need protection from instability. Failure to achieve stabilization in income and consumption may be life threatening for millions of people living at the margin of adequate food consumption. So it must not be taken lightly.

Stabilization is a costly undertaking whether performed privately or by the public sector. The options need to be carefully assessed."

To assess options for stabilization of food availability, we must first be aware how food supplies are currently stabilized, which is the focus of this section.

One approach to understanding how farm families stabilize their food availability is to examine seasonal cropping patterns and the mix of crops produced annually. It has long been known that Rwanda's climate is particularly favorable to year round cropping. To quote Leurquin (1963):

"Multiple rotations of crops, of fields, and above all sowing of different varieties of crop at intervals of a few days assure constant flow of provisions. Such methods are exploited very knowingly in a manner resembling horticulture rather than agriculture."

DeJaegher and Ngarambe undertook the first steps towards a comprehensive understanding of how farmers in Rwanda in the 1980s deal with risk by studying national monthly food production. In support of Leurquin, they found that

"...the maintenance of food availability during the year is more or less assured by a quasi-constant production. It should also be emphasized that the farmer's principal means of food storage is his field..."

This conclusion was based on analysis of the monthly production data summarized in Figure 4.3, which shows that at the national level,

most crops are harvested year round (with peaks and valleys), and that to a large extent, harvests are timed to be complementary; larger production of crops with flexible harvest times (tubers, bananas) tends to come when other crops such as beans and sorghum are less available.

Why this extension of harvest times of all crops, and complementarity of harvests between crops? The prolongation of harvest periods is probably due to a large dose of risk avoidance in the farmer's strategy. Since a majority of farms are smaller than 1.0 hectare, this may be the only strategy for surviving periodic food shortfalls. Another factor which could cause this behavior is farm labor considerations. To quote DeJaegher and Ngarambe:

"Farmers don't necessarily seed or plant during the period which would maximize yield; they prefer to distribute risk across time by extending the planting (seeding) period. A better distribution of farm tasks through time can improve the productivity of farm labor while avoiding as much as possible peak periods, fatigue, and underemployment. They [farmers] avoid as much as possible the "bottleneck" phenomena produced by seasonality."

Figure 4.4 provides additional insights into the Rwandan cropping system when compared with Figure 4.3. The data displayed in Figure 4.4 reflect the late rains for the first season of 1987 (1986 was a normal year). Farmers reacted to the late rains in 1987 by planting their beans later in the first season of 1987 than in the first season of 1986. Late planting had two effects: 1) The bean harvest was delayed, so that more beans were harvested in February than in January, and 2) Overall for the year, less beans were harvested. Yet these effects are not observed for most of the other crops. Most of the decrease in calories produced between the first seasons of the two years is attributable to lower bean production.

Figure 4.3

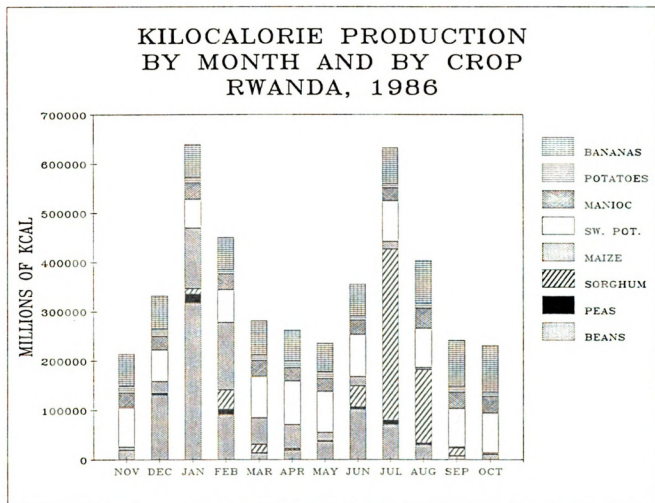
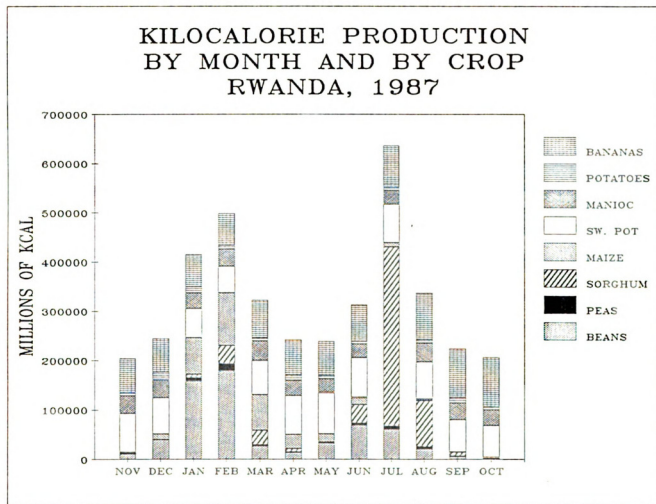


Figure 4.4



How does this compare with other years when the rains failed?

DeJaegher and Ngarambe found that the second (drought) season 1984 bean production was significantly lower than the second (normal) season 1986 bean production. The only other crop included in their study with significantly lower production in 1984 than in 1986 was sweet potatoes, and this was attributed to a caterpillar infestation¹¹, not because of insufficient precipitation for plant maturation.

Thus beans appear to be much more sensitive to unfavorable weather patterns than most of the other important crops in Rwanda. Since of all the factors which determine yield in Rwanda, weather exhibits the most year to year variability, beans are probably the riskiest major foodcrop in the country. One would therefore expect farmers least able to bear risk (the chronically food insecure) to plant less beans than farmers who produce a regular food surplus.

Table 4.34 provides evidence to support the hypothesis that bean buyers may be planting less beans in order to minimize their exposure to drought conditions. Net buyers devote a much larger proportion of their productive resources to the production of sweet potatoes and potatoes than do the net sellers. Table 4.35 paints a similar picture for sorghum, with net sorghum buyers generally more dependent on tubers than net sorghum sellers.

¹¹DeJaegher and Ngarambe hypothesize that caterpillar breeding may have been encouraged by the low rainfall that year, so rain could have had an indirect effect on production.

Table 4.34
Average Proportion of Kilocalories from Each Crop by Household
Net Dry Bean Transactions Category, 1986

Household Net Transactions Category	Proportion of Per Capita Kilocalorie Production in:							
	Beans	Peas	Sorghum	Maize	Sweet Pot.	Manioc	Potatoes	Bananas
>60 Kg Sold	.27	.01	.24	.06	.10	.08	.01	.22
30-59 Kg Sold	.24	.02	.15	.10	.14	.06	.01	.27
<30 Kg Sold	.23	.01	.15	.08	.23	.10	.01	.19
No Net Trans.	.21	.02	.11	.13	.18	.08	.01	.27
<30 Kg Bought	.20	.02	.10	.13	.27	.08	.03	.18
30-59 Kg Bought	.19	.01	.10	.12	.28	.10	.04	.16
>60 Kg Bought	.18	.01	.11	.08	.30	.09	.05	.18
Rwanda	.20	.01	.12	.10	.26	.09	.03	.19

Note: averages computed from household level per capita values.

Table 4.35
Average Proportion of Kilocalories from Each Crop by Household
Net Sorghum Transactions Category, 1986

Household Net Transactions Category	Proportion of Per Capita Kilocalorie Production in:							
	Beans	Peas	Sorghum	Maize	Sweet Pot.	Manioc	Potatoes	Bananas
Net Sorghum Sellers:								
Households that Sold Sorghum and Beer	.22	.01	.30	.04	.16	.09	.01	.17
Households that Sold Sorghum, But No Beer								
>60 Kg Sold	.22	.01	.29	.08	.11	.08	.01	.22
30-59 Kg Sold	.21	.01	.23	.07	.19	.09	.03	.17
<30 Kg Sold	.22	.01	.16	.07	.27	.09	.01	.19
No Transactions	.21	.01	.11	.08	.28	.08	.02	.21
Net Sorghum Buyers								
Households that Bought Sorghum and Sold No Beer								
<30 Kg Bought	.20	.01	.07	.10	.30	.10	.03	.19
30-59 Kg Bought	.18	.01	.06	.13	.22	.09	.07	.25
>60 Kg Bought	.19	.02	.04	.17	.22	.07	.05	.23
Households that Bought Sorghum and Sold Beer	.19	.03	.15	.11	.31	.07	.04	.10
Rwanda	.20	.01	.12	.10	.26	.09	.03	.19

Note: averages computed from household level per capita values.

Table 4.36
Average Proportion of Kilocalories from Each Crop by Household
Per Capita Kcal Production Quartile, 1986

Kcal Production Quartile	Proportion of Per Capita Kilocalorie Production in:							
	Beans Peas	Sorghum Maize	Sweet Pot.	Manioc	Potatoes	Bananas		
Lowest	.22	.01	.07	.15	.29	.08	.05	.14
2nd	.20	.01	.08	.09	.31	.10	.03	.17
3rd	.20	.01	.13	.07	.28	.09	.02	.20
Highest	.20	.01	.15	.12	.19	.08	.03	.21
Rwanda	.20	.01	.12	.10	.26	.09	.03	.19

Note: averages computed from household level per capita values.

When the proportion of each crop in total kilocalorie production is displayed by production quartile as in Table 4.36, a slightly different picture emerges. The proportion of beans in production is nearly constant. The importance of sorghum and bananas in output is higher in the higher kilocalorie production quartiles. The percentage of calories produced in sweet potatoes and potatoes is lower in the higher kilocalorie production quartiles. In effect, the lowest categories of producers appear to have traded alcoholic beverages (sorghum beer and banana wine) for calories. Sorghum and bananas provide more calories when consumed directly than when consumed as beverages. Sorghum and bananas therefore act as a kind of farm level buffer stock, being consumed directly when times are tough. In favoring tubers over bananas and sorghum, the low kilocalorie producers appear to have reduced their transient food security for decreased chronic food insecurity.

In addition to providing protection against drought conditions, sweet potatoes provide a much more consistent flow of food for the household across months than do beans and sorghum because they can be stored in the ground. Calorie deficit households need to minimize the variability of their harvest from month to month, so they plant more of those crops which buffer them from seasonal food shortfalls. Tables 4.37 and 4.38 illustrate how dependence on tubers translates into lower monthly variation of caloric production for net buyers of beans and sorghum compared to net sellers.

Table 4.37
Variability in Month-to-Month
Caloric Production (Total of 8 Crops)
by Household Net Dry Bean Transaction Category,
1986

Household Net Transaction Category	Standard Deviation (Kcal x 1000)	Relative Standard Deviation
>60 Kg Sold	675.08	1.02
30-59 Kg Sold	548.50	.89
<30 Kg Sold	349.22	.81
No Net Trans.	331.56	.83
<30 Kg Bought	217.02	.78
30-59 Kg Bought	193.53	.75
>60 Kg Bought	211.34	.71
Rwanda	273.38	.78

Note: Relative standard deviation calculated by dividing the standard deviation of monthly production by average monthly production.

Table 4.38
 Variability in Month-to-Month
 Caloric Production (8 Major Crops)
 by Household Net Sorghum Transaction Category,
 1986

Household Net Transaction Category	Standard Deviation (Kcal x 1000)	Relative Standard Deviation
Net Sorghum Sellers		
Sold Sorghum and Beer	613.22	1.05
Households that Sold Sorghum, But No Beer		
>60 Kg Sold	643.67	1.04
30-59 Kg Sold	324.69	.87
<30 Kg Sold	258.10	.75
No Transactions	172.36	.73
Net Sorghum Buyers		
Households that Bought Sorghum and Sold No Beer		
<30 Kg Bought	170.14	.69
30-59 Kg Bought	229.65	.69
>60 Kg Bought	275.21	.79
Households that Bought Sorghum, Sold Beer	351.09	.88
Rwanda	273.38	.78

Note: Relative standard deviation calculated
 by dividing the standard deviation of monthly
 production by average monthly production.

Table 4.39 demonstrates that low kilocalorie production households have lower variability in month-to-month caloric production. The mean relative standard deviation for the lowest kilocalorie production quartile is higher than for the second and third quartiles. This is because the lowest production quartile produces so little that a small absolute change in monthly food production is large relative to total production. The unstandardized standard deviation of the lowest production quartile is quite a bit lower than for the other groups. The finding that bean and sorghum buyers reduce fluctuations in food availability through year round harvest strategies can thus be generalized to low production groups.

Table 4.40 illustrates how the level of dependence on sweet potatoes and potatoes is related to intra-annual variability in food production. Relative variability in monthly kilocalorie production is substantially lower in farms that are highly dependent on potatoes and sweet potatoes than where these crops are less important. Clearly an advantage of shifting to the root crops is improved month-to-month food security.

Table 4.39
 Variability in Month-to-Month
 Caloric Production (8 Major Crops) by Calorie
 Production Quartiles (8 Major Crops)

Kcal Production Quartile (8 Major Crops)	Standard Deviation (Kcal x 1000)	Relative Standard Deviation
Lowest	94.93	.78
2nd	152.11	.69
3rd	224.16	.71
Highest	473.16	.89
Rwanda	273.38	.78

Note: Relative standard deviation calculated by dividing the standard deviation of monthly production by average monthly production.

Table 4.40
 Variability in Month-to-Month Caloric Production
 (8 Major Crops) by
 Percentage of Caloric Output
 Devoted to Sweet Potatoes and Potatoes

Importance of Sweet Potatoes and Potatoes	Percentage of Households	Standard Deviation (Kcal x 1000)	Relative Standard Deviation
<10%	13.3%	521.63	.98
10-15%	11.6%	424.36	.91
15-20%	11.0%	317.29	.89
20-25%	10.5%	232.89	.78
25-30%	9.7%	230.67	.76
30-35%	10.5%	173.79	.76
35-40%	8.0%	208.29	.74
40-45%	7.2%	144.07	.58
45-50%	5.7%	183.28	.61
≥50%	12.5%	138.96	.57
Rwanda	100.0%	273.38	.78

Note: Relative standard deviation calculated by dividing the standard deviation of monthly production by average monthly production.

Nutrient Output.- Thus far two advantages of increased reliance on tubers by food insecure households have been identified: drought resistance and stability of month-to-month production. A third advantage is that tubers produce more kilocalories per hectare per year than other crops. Table 4.41 provides estimates of average kilocalorie production per year per hectare of major crops in Rwanda. Tubers consistently produce more kilocalories per unit land area per year than all other crops.

Banana kilocalorie production per unit land area is lower than other crops, but this is a result of calorie loss upon transformation of bananas into beer. Roughly 70% of bananas produced are beer bananas. SESA (1985) estimates that a kilo of beer bananas provide only 17% of the calories that a human obtains from a kilo of cooking bananas because calories are lost in the brewing process.

When beer bananas are cooked and eaten directly they provide the same nutrition as cooking bananas. Similarly, cooking bananas can be made into beer. This property renders bananas extremely valuable to household food security. When food is plentiful, bananas can be transformed into a high value product (beer) and sold to supplement family income for purchases of food and sundries. Bananas are therefore a source of employment. When household food production is insufficient and/or food prices in the market are high, bananas can be converted into food. The percentage of bananas going into beer probably changes from year to year with changes in local availability of food, and has not been documented. Table 4.41 reports potential

caloric output for bananas (i.e. caloric output if all bananas produced were eaten directly).

Table 4.41 also shows that the value of output from acreage planted to beans and sorghum is lower than for other crops, while staples appear competitive in terms of value of output.

Table 4.41
Caloric Output Per Hectare Per Year
and Value of Output Per Hectare Per Year
Various Crops

Crop	Vegetative Cycle (Months)	Yield (Kg/ha)	Kcal/kg	Kcal/ha/year (thousands)	Frw/ha/year (thousands)
Beans	3.5	797	3,050	8,334	60
Sorghum	6.0	1,141	3,925	8,957	46
Maize	4.0	1,187	3,325	11,840	85
Manioc	12.0	11,342	1,023	11,602	159
Potatoes	4.0	6,782	574	11,679	142
Bananas	8.0	9,462	802	11,383	142
Sw. Potatoes	6.0	7,058	1,081	15,259	85
Peas	5.0	652	3,129	4,896	53

Notes: Vegetative cycle from FAO (1986a), yields are 1979-1986 averages calculated from national production and surface area estimates as published in MINAGRI annual reports. Kcal/kg conversion factors from MINAGRI (1985). Conversions of kg/ha/yr to Frw/ha/yr use average prices reported by the BNR for 1986.

Thus tubers are advantageous to farmers with limited productive capacity based on their resistance to drought, flexibility of harvest time, and output per land unit. Bananas have dual role as a source of calories and/or employment. Encouraging farmers to shift out of tubers and bananas into beans and sorghum would reduce the ability of these families to produce enough food energy for their own needs.

Table 4.42 shows annualized nutrient output per hectare of four crops. When these nutritional factors other than calories are taken into account, sorghum compares unfavorably with other crops. With the exception of fat, sorghum provides less of every nutrient listed on a per hectare per year basis than the other three crops. Sweet potatoes outperform bananas in providing a balanced diet, providing more of every nutrient listed on an annual per hectare basis. The movement of the lower kilocalorie producing households away from sorghum and bananas to sweet potatoes appears to hold no dire consequences in terms of a balanced diet. On the contrary the effects appear to be positive both in terms of calories and other essential nutrients.

Table 4.42 indicates that beans provide the most protein per hectare per year. If families are forced to cut bean production for increased calorie production, the long run nutritional consequences could be severe. Trade with neighboring countries to make up for chronic production shortfalls is likely to continue to be an important source of food security in proteins. This assumes that Rwandan households will continue to be able to generate the income necessary to pay for these imports.

Table 4.42
Nutrient Output Per Hectare Per Year
Various Crops

Nutrient	Kg/ha/year			
	Beans	Sorghum Meal	Sweet Potatoes	Bananas
Protein	512	198	268	184
Fat	38	75	70	14
Carbohydrate	1541	1522	4023	3449
Fiber	118	46	169	142
Ash	104	43	99	99
Sodium			2	
Potassium	33	9	36	
Magnesium	5	2	1	
Calcium	3		4	

Note: Grams of nutrient per 100 grams edible portion taken from Vis et al. converted to kg/ha/year using vegetative cycle and yield data presented in Table 4.41.

Kilocalorie Production and Farm Size Projections.- A complete examination of chronic food security issues must include projections of per capita food production over the next ten to twenty years. Because future events are difficult to predict, a scenario approach has been adopted. Each scenario is based on current and potential future land use patterns, population growth, and yields.

Prefol and Delepierre estimate that the maximum surface area available for agriculture in the long run is 1,385,367 hectares. Minagri (1985) estimates total area farmed in Rwanda at 1,349,923. Since the limits of farm extension into previously unclaimed areas have essentially been reached, the following scenarios concentrate on hypothetical changes in farm cropping patterns and yields. Four

scenarios for future total per capita kilocalorie production from the 8 major crops are explored:

1. Current Use and Yields. The crop mix and yields are assumed to stay at 1986 levels. Population is assumed to grow at the rate projected by Urban and Rose.
2. No Legumes or Sorghum. All beans, peas, and sorghum are assumed to have been put into the higher kilocalorie yielding sweet potatoes. There may be severe agronomic constraints on switching these crops to sweet potatoes. They have not been explored. All else is assumed as in scenario 1.
3. Less Fallow and Pasture. Minagri (1985) estimates fallow fields at 106,135 hectares and (pure) pasture at 113,781. This scenario assumes farmers convert these areas into crop land at the rate of 10% per year, without experiencing decreased yields. All else is assumed as in scenario 1.
4. Improved Yields. This scenario assumes that no legumes or sorghum are grown, that fallow and pasture lands are put into crops as in scenario 3, and that yields of the remaining crops increase at the rate of 5% per year starting in 1990. All else is assumed as in scenario 1.

Projections based on the above four scenarios are presented in Figure 4.5¹². Scenario 1, "Current Use and Yields", shows per capita energy production falling below the FAO minimum levels for maintenance of good health (2100 kcal/capita/day) before 1990. Scenario 2, "No Legumes or Sorghum", is slightly more optimistic: production would be sufficient to meet the needs of the rural population until about the mid 1990s. Scenario 3, "Less Fallow and Pasture", gives the same conclusion as Scenario 2, but arrives at that point by a different route. Under scenario 2, there would be rural calorie surpluses until the early 1990s which could be sold and/or traded for the lost bean, pea, and sorghum production. Scenario 3 shows no rural caloric

¹²Since the four scenarios cover only the eight major crops, total kilocalorie production projections are under estimated by approximately 6%.

surplus. Scenario 4, "Improved Yields", is the most optimistic, but is also probably the most unrealistic of the four scenarios. The yield increases that scenario 4 incorporates will be difficult to attain. Scenario 4 shows improved yields and increased crop land combining to produce an increase in rural per capita production until 1996. Once all pasture and fallow land are converted to crops (after 1996), improved yields alone are not sufficient to sustain increases in rural kilocalorie production per capita.

These simple models illustrate that the chronic food insecurity problem will likely get worse for Rwanda as a whole. Research to improve yields is urgently needed, but can only provide a partial solution for the chronic food insecurity problems of the 1990s and beyond. A 5% per year increase over a long period of time is extremely optimistic. There are almost no examples in Rwanda or elsewhere of sustained yield increases of that magnitude. Means must be found to increase Rwanda's income generating capabilities, so that it can afford to import food from the more land rich neighboring countries.

The above projections consider aggregate production only; some farms already produce less calories than are necessary to maintain good health. The ability to produce enough food on a farm is related to farm size. Figure 4.6 shows that in the 1986 agricultural year, farms with less than 1 hectare were unable to produce adequate food energy from the eight major crops.

Figure 4.5

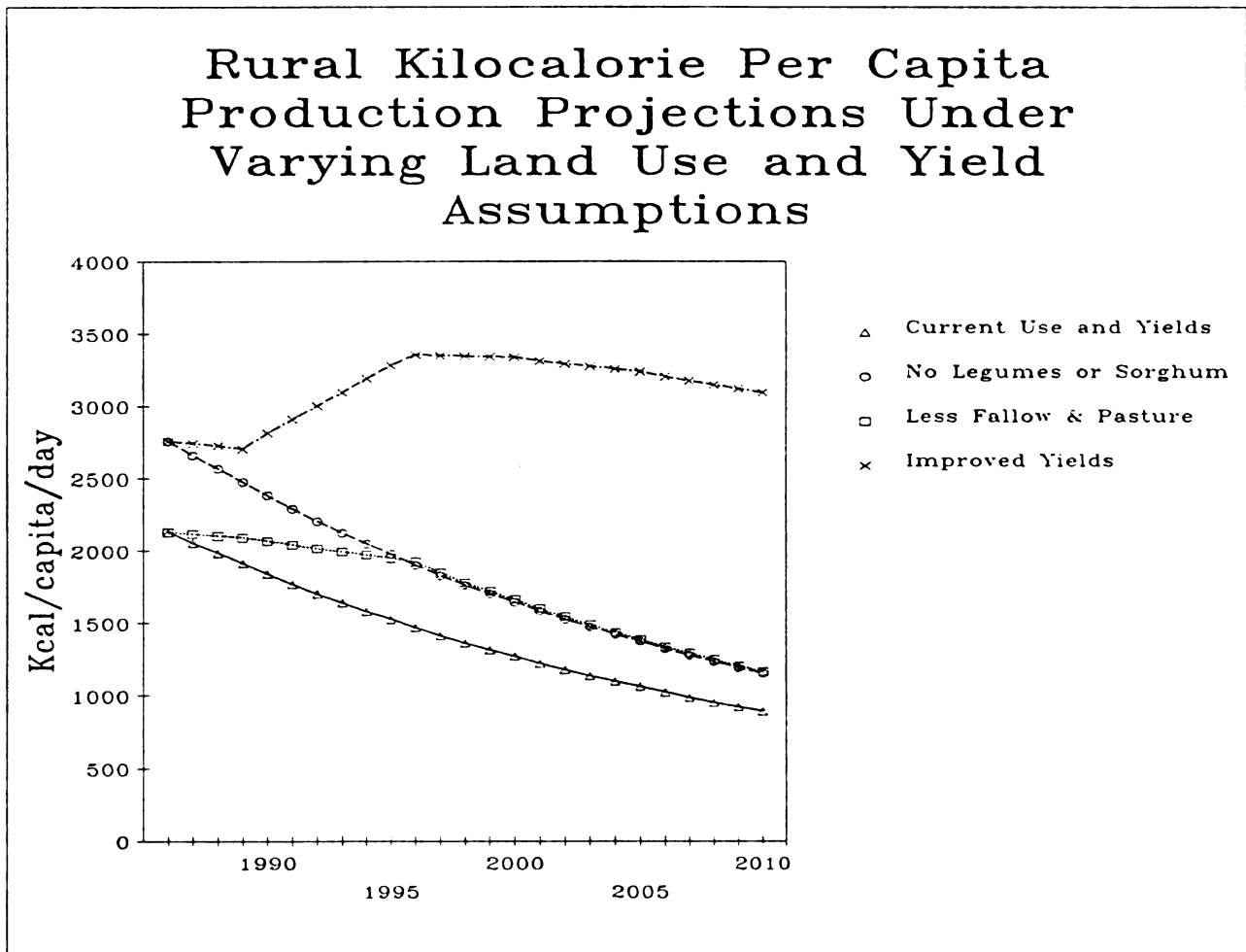


Figure 4.7 shows what may happen to average farm size in Rwanda under three scenarios. In all three scenarios, rural population is assumed to increase at the rate of general population growth projected by Urban and Rose¹³. Under the first scenario, "No Migration", average farm size will fall below 1.0 hectare by 1991. In the second scenario, 20,000 families per year are assumed to leave farming¹⁴. With this level of (physical or economic) migration, average farm size stays above the critical 1.0 hectare mark until 1998. When off-farm migration is assumed to be 35,000 families per year, farm size increases. Clearly, one means of maintaining a viable farm population is by encouraging growth of employment opportunities in other sectors. If farm size were to increase, scale economies might allow a shift to more capital intensive means of farming, increasing labor productivity and yields.

¹³They project a population growth rate varying between 3.6% and 4.1% per year over the relevant period.

¹⁴Note that physical displacement to urban areas would not be necessary. Only a shift from cropping to non-cropping activities.

Figure 4.6

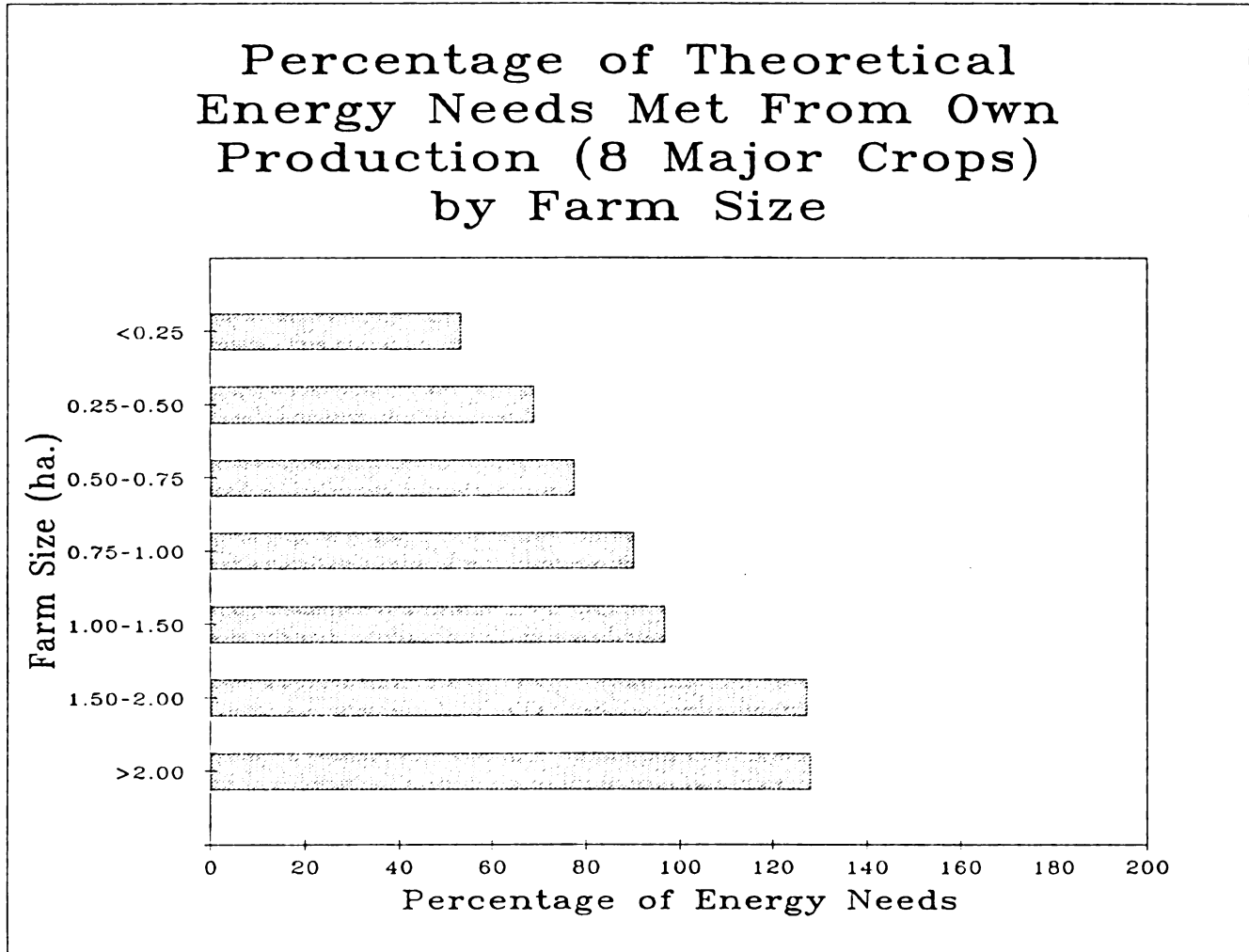
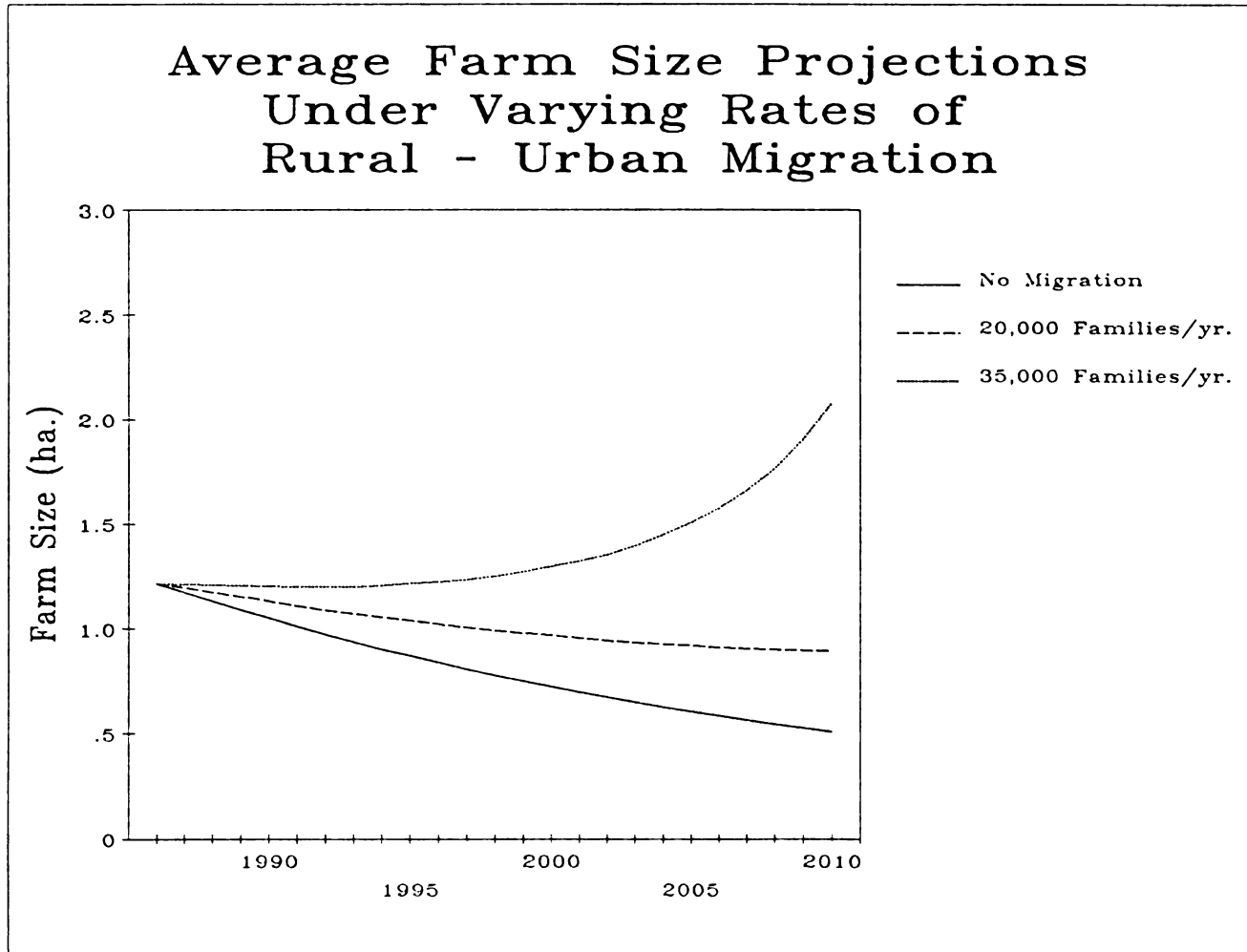


Figure 4.7



C. Technologies

This section of the report differs from all others in its methodology and focus. The author and other researchers personally visited fifteen farms in order to collect detailed data on farmer technologies. The fifteen farm sample was chosen from SESA's main sample frame. The farms were chosen so that the sample was evenly divided between net bean buyers, net bean sellers, and farms with few net transactions. The reason for dividing the sample along according to transaction class was to determine if technological differences exist between these groups.

A detailed description of the results of this case study research is presented in Annex VII. Both Annex VII and the remainder of this section are quoted almost verbatim¹⁵ from the summary and conclusions of a SESA working paper entitled: "Relationships Between Bean Marketings and Bean Production Techniques: A Study of Fifteen Farms in the Prefecture of Kigali", by Scott Loveridge with Krista C. Dessert.

Net bean purchasers appear to devote either a very large or very small proportion of their fields to beans. Not surprisingly, the land constraint appears to be greater for net bean purchasers and families with few transactions than for net bean sellers. Tubers appear to be beans' major competitor for family land.

Net bean buyers in the sample were more likely to plant beans in the same field in successive seasons than other types of farms, who

¹⁵Slight changes have been made in style and wording to accommodate the dissertation format. In one instance, interpretation of the data has been changed based on new information and further reflection.

rotated their bean fields. Two out of five net bean buyers leave bean debris in the field. The practice of burying uncomposted bean plant debris combined with no crop rotation may provide a source of inoculum for plant diseases.

All but one farmer (a net bean buyer) said they had changed their soil fertility maintenance methods over the past five years by the recent adoption of anti-erosion ditches and composting.

It appears that the tendency over the last five years is towards a larger surface being planted in beans, with 87% of the farms in the sample reporting the same or a larger surface area in planted in beans as compared to five years ago. Only 40% of farmers indicated they harvest the same or a larger quantity of beans in comparison to five years ago. This may be an indication that bean yields have declined over the last five years.

Next to drought, soil fertility was the most frequently mentioned bean production constraint, with this response coming in greater proportions from self-sufficient and seller farmers than from buyer farms. Conversely, lack of land was seen to be a problem more frequently by farms buying beans than by net sellers or self-sufficient farms.

Nine of the fifteen farms reported no bean storage losses. More farms which buy or which are self-sufficient in beans reported losses than did farms which sell beans. All farmers who reported storage losses said these losses were caused by insects. Chemicals are the most popular bean storage treatment regardless of transaction class. Only farms that buy beans reported using cow urine and pili-pili as a seed

treatment, and only bean sellers used kaolin. The most common storage container for both food and seed stock in the families interviewed is a basket lined with manure.

Roughly half of all farmers interviewed remove primary leaves from the maturing bean plant, but only one of the five families which sell beans engages in this practice. Net bean sellers may lack sufficient labor to perform this prophylactic task.

Bean buyers and self-sufficient farmers were roughly evenly divided between those who place the seed in the ground, and those who broadcast, while all of the bean sellers practiced the broadcasting method at least some of the time. Placing the seed in the ground is probably more efficient in terms of seed use. Buyers may be substituting labor for seed.

All of the net bean sellers use the number of pods on the plant and degree of black marks in seed selection, while only 40% of the net buyers and none of the self-sufficient farms use these criteria in seed selection.

What conclusions can be drawn from this exercise? First, the division of farms into net transaction categories is a useful tool in studying farmers' bean production practices.

Second, researchers and extension agents could increase their effectiveness by taking net transactions position into account in establishing target groups. Research based on "progressive farmers" chosen on the basis of inappropriate criteria may prove maladapted to more typical farmers whose basic strategies differ from the "progressive farmer". For example, suppose research were to be

directed towards farmers with largest land holdings in the area on the grounds that these farmers would be most open to experimentation. A labor intensive variety such as climbing beans might prove unacceptable to these types of farms (labor constraint), while the majority of farmers might find such an innovation profitable (land constraint). Such a research design might lead to recommendations biased towards large farms.

Third, additional research to identify differences in constraints and in cropping techniques between farmers would be worthwhile. This could involve expanding the research to a sample large enough to allow statistically valid conclusions to be drawn.

Fourth, when asked directly, farmers indicate that tubers are main competitors with beans for farm resources. Net bean buyers demonstrate more labor intensive agronomic practices. This serves to substantiate evidence collected more indirectly at the national level.

In summary, intensive interviews of fifteen farms showed major differences in farms' production methods by transaction class. Net buyers appear to face considerable obstacles in their quest for an adequate food supply. They are confronting these obstacles with a variety of methods to increase production. But indications are that they may be losing ground.

D. Specialization and Exchange. Off Farm Employment, Access to Markets

Farmers' sources of income and the items on which they spend their income give insights into the survival strategies of different types of farms. Two questions exploring farmer income and expense were included in the SESA/MSU Farmer IV national survey. The income and expense questions were single visit retrospective, and open ended. Farmers were simply asked their largest source of revenue and expense. Results from the Farmer IV survey were then cross-tabulated with net transactions and production information from the same farms. Tables 4.43 through 4.48 display the results. Percentages in the cells represent percentage of households, not percentage of expense or revenue.

Sorghum.- Tables 4.43 and 4.44 list results for sorghum. Under expenses, food was most frequently mentioned as the number one expense item by families in all transactions classes. Large net sorghum sellers mentioned food as the largest expense item much less frequently than other categories of farm families. Families with no net transactions and families which bought less than 30 kilos of sorghum mentioned food as their largest expense much more frequently than other classes of farms. These findings tend to confirm the earlier hypothesis that families with few transactions appear to be the worst off in terms of their ability to produce adequate food.

Beer sellers and those who sold over 60 kilos of sorghum are more likely to list labor as their most important expense item than other groups. This is consistent with their position of having larger than average farm surface areas. Since beer and wine making is an oft used

means of paying farm labor in some areas, beer and wine making as a direct revenue generating activity may have grown out of an initial need to pay labor for field work.

There are some surprises on the revenue side of the income question. Less than half of the households which sell sorghum beer listed selling beverages as their principal revenue generating activity. These households have the largest farms, and can therefore engage in a large variety of income generating activities. Note that the second most frequently mentioned number one source of revenue on these farms was sale of foodstuffs.

Over one third of households in each category which did not sell sorghum beer listed selling beverages as their principal source of income. This is not an anomaly, since selling beverages includes selling of banana wine as well as sorghum beer.

Farms identified as probably being the poorest (no net transactions and less than 30 kilos bought) rely heavily on industrial crops (primarily coffee), labor, and beer for their income. Thus some of Rwanda's poorest families may have provided money to the government via lower than world market export parity coffee prices only to have some of these resources be used in 1986 to increase the price they pay for sorghum (and beans).

Table 4.43
Largest Source of Revenue
by Household Net Sorghum Transaction Category

Source of Revenue	Household Net Sorghum Transaction Category									Rwanda
	Sold Sorgh. and Beer	Sold Sorghum, but No Beer			No Transac-tions	Bought Sorghum and Sold No Beer			Bought Sorghum and Sold Beer	
		>60 Kg Sold	30-59 Kg Sold	<30 Kg Sold		<30 Kg Bought	30-59 Kg Bought	>60 Kg Bought		
		Percentage of Households								
Alcoholic Beverages	46.0%	38.8%	40.3%	46.6%	24.7%	36.3%	37.2%	33.5%	31.1%	36.1%
Sale of Foodcrops	31.2%	43.4%	25.0%	16.5%	11.7%	9.2%	18.5%	16.8%	22.3%	17.2%
Industrial Crop	2.1%	10.9%	8.8%	13.5%	24.5%	20.5%	17.7%	16.6%	13.1%	16.7%
Field Hand	3.7%	2.2%	6.1%	11.3%	13.6%	18.2%	12.6%	13.2%	6.8%	12.5%
Work at a Project				2.4%	3.9%	2.0%	1.7%	1.5%	4.0%	2.1%
Salary				.8%	6.1%	2.8%	2.6%	2.5%	5.6%	2.8%
Sale of Livestock	1.1%	.8%	6.0%	1.1%	2.9%	1.3%		3.7%	2.4%	1.8%
Artisanry	6.5%	2.6%	8.3%	1.6%	4.3%	3.3%	2.1%	3.5%	3.7%	3.4%
Commerce	2.2%	1.3%		1.3%	3.1%	1.7%	3.8%	7.9%	6.8%	3.2%
Gifts from Relatives					.8%	1.4%	.8%		.6%	.7%
Renting Fields	3.5%				1.0%		2.3%		.7%	.6%
Other	3.5%		5.6%	3.9%	2.5%	2.1%	.7%	.9%	2.0%	2.1%
No Response				1.1%	.9%	1.1%			1.0%	.7%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest source of income, not the percentage of income.

Table 4.44
Largest Expenditure by Household Net Sorghum Transaction Category

Expense	Household Net Sorghum Transaction Category								Rwanda	
	Sold Sorgh. and Beer	Sold Sorghum, but No Beer			No Transac- tions	Bought Sorghum and Sold No Beer			Bought Sorghum Sold Beer	
		>60 Kg Sold	30-59 Kg Sold	<30 Kg Sold		<30 Kg Bought	30-59 Kg Bought	>60 Kg Bought		
Percentage of Households										
Food	28.6%	32.0%	51.0%	52.0%	58.1%	64.1%	54.2%	48.4%	57.9%	55.1%
Clothing	21.6%	19.2%	21.6%	17.7%	6.4%	9.2%	15.2%	11.9%	12.6%	12.7%
Labor	11.5%	19.9%	1.7%	5.9%	8.5%	2.3%	3.7%	8.3%	10.3%	6.5%
Medicine	16.9%	11.7%	3.9%	5.6%	1.3%	5.3%	6.7%	6.5%	3.9%	5.9%
Taxes	3.5%		.9%	2.5%	1.0%	3.4%	2.7%	3.8%	1.7%	2.6%
School Fees	2.2%	2.9%	5.6%		2.4%	1.5%	3.0%	2.3%	3.4%	2.2%
Kerosene		7.7%		4.7%	7.6%	1.3%	1.5%	2.7%	1.9%	2.7%
Alc. Bev.	5.3%		3.5%	2.2%	1.2%	2.2%	1.2%	4.7%	1.7%	2.2%
Soap				.9%		2.2%	2.7%	2.8%		1.4%
Kitchen Ware	3.2%	2.5%	1.4%	1.8%	2.2%	2.3%	4.9%	1.9%	1.4%	2.4%
Renting Fields	4.2%		4.0%	1.4%	2.3%	.5%	3.3%	3.3%	2.8%	1.9%
Seed				3.0%	1.3%	1.6%		1.6%	.9%	1.2%
Tools	2.3%	.7%	3.9%		3.8%	2.2%	1.0%	1.1%	.8%	1.7%
Other	.7%	3.4%	2.4%	1.2%	3.0%	1.4%		.8%	.6%	1.4%
No Response				1.1%	1.0%	.3%				.3%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest expense, not the percentage of expenses.

Beans.- Tables 4.45 and 4.46 present farmers' responses to income and expense questions by net dry bean transaction category. The revenue results for dry beans are quite similar to those for sorghum. Net sellers depend on sales of alcoholic beverages and foodcrops for income to a larger extent than do net buyers. A larger percentage of net dry bean buyers depend on industrial crops and selling their labor for income than do net sellers.

Under expenses, a much higher proportion of dry bean buyers listed food as their number one expense item than did dry bean sellers. In sorghum, the difference between the percentage buyers and the percentage of sellers mentioning food as the biggest expense was not as great. Large sorghum purchasers may be buying for ceremonial purposes. They therefore may not consider the sorghum as a food expense. Large bean purchasers are probably buying because they can't produce enough food for themselves. They are therefore more likely to be chronically food insecure than large sorghum buyers.

Table 4.45
Largest Source of Revenue by Household Net Dry Bean Transaction Category

Source of Revenue	Household Net Dry Bean Transaction Category							Rwanda
	Net Dry Bean Sellers			No Net Transactions	Net Dry Bean Buyers			
	>60 Kg Sold	30-59 Kg Sold	<30 Kg Sold		<30 Kg Bought	30-59 Kg Bought	>60 Kg Bought	
Percentage of Households								
Alcoholic Beverages	37.2%	48.6%	50.1%	40.0%	35.2%	38.2%	28.2%	36.1%
Sales of Foodcrops	41.7%	35.2%	18.6%	20.4%	13.5%	16.1%	12.4%	17.2%
Industrial Crop	9.2%	10.7%	15.0%	15.0%	17.3%	16.9%	19.3%	16.7%
Field Hand	2.0%	1.9%	7.3%	5.9%	14.6%	11.1%	18.1%	12.5%
Work at a Project					3.3%	2.1%	3.0%	2.1%
Salary	5.5%		2.0%	1.9%	2.3%	2.1%	3.8%	2.8%
Sale of Livestock	.7%		3.2%	2.8%	.7%	2.6%	1.8%	1.8%
Artisanry	2.3%		1.0%	1.7%	3.5%	2.9%	5.4%	3.4%
Commerce	1.5%	3.7%	1.2%	3.1%	3.4%	3.3%	4.1%	3.2%
Gifts from Relatives			.6%	4.8%	1.3%	.7%		.7%
Renting Fields					.5%	1.4%	.6%	.6%
Other				1.9%	2.6%	2.6%	2.8%	2.1%
No Response			.9%	2.4%	1.6%		.3%	.7%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest source of income, not the percentage of income.

Table 4.46
Largest Expenditure by Household Net Bean Transaction Category

Expense	Household Net Dry Bean Transaction Category						Rwanda	
	Net Dry Bean Sellers			No Net Transactions	Net Dry Bean Buyers			
	>60 Kg Sold	30-59 Kg Sold	<30 Kg Sold		<30 Kg Bought	30-59 Kg Bought		>60 Kg Bought
	Percentage of Households							
Food	10.3%	41.2%	29.9%	34.7%	55.8%	60.3%	74.5%	55.1%
Clothing	22.2%	14.2%	19.6%	21.7%	11.2%	12.8%	7.7%	12.7%
Labor	35.2%	20.9%	11.1%	4.0%	3.5%	1.0%	3.1%	6.5%
Medicines	9.4%	5.2%	5.9%	13.0%	6.7%	4.7%	4.3%	5.9%
Taxes			1.1%		2.7%	3.9%	3.4%	2.6%
School Fees	3.7%	1.9%	4.0%	1.0%	2.8%	2.0%	1.1%	2.2%
Kerosene	6.8%	4.4%	4.0%	5.2%	4.1%	.7%	.9%	2.7%
Alcoholic Beverages	1.1%	6.8%	3.5%		3.2%	2.8%	.7%	2.2%
Soap	.9%	3.2%	4.4%		.7%	1.6%	.8%	1.4%
Kitchen Ware	4.5%	.9%	2.3%	11.8%	2.1%	2.0%	1.2%	2.4%
Renting Fields	1.5%		4.1%	1.7%	2.4%	1.8%	1.0%	1.9%
Seed			1.5%		2.5%	2.0%	.2%	1.2%
Tools	3.9%		4.2%	2.8%	1.1%	2.9%		1.7%
Other	.5%	1.3%	3.4%	1.9%	.9%	1.4%	1.0%	1.4%
No Response			.9%	2.3%	.4%			.3%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest expense, not the percentage of expense.

Kilocalories Per Capita.- Revenue and expenses were cross-tabulated by household per capita kilocalorie production quartile (Tables 4.47 and 4.48). Kilocalorie production quartiles were obtained using the method described discussion of determinants of production.

Results of cross-tabulating kilocalorie production with income and expense are consistent with the net transactions cross-tabulations. Alcoholic beverages are consistently the most frequently mentioned number one source of income. High kilocalorie producers tend to rely more on alcoholic beverages and foodcrops for income. Low kilocalorie producers tend to rely more on selling their labor (lowest quartile) or industrial crops (2nd quartile) for income.

On the expense side, food is consistently the most frequently mentioned number one expense. Low per capita production households are more likely to mention this expense than other groups. As production increases, the frequency that clothing is mentioned as the number one expense increases. Clearly increased food prices would hurt the lowest production households hardest.

Table 4.47
Largest Source of Revenue by Household Kilocalorie Production Quartile

Source of Revenue	Per Capita Kcal Production Quartile				Rwanda
	Lowest	2nd	3rd	Highest	
Percentage of Households					
Alcoholic Beverages	25.8%	36.3%	41.6%	40.9%	36.1%
Sales of Foodcrops	10.6%	16.6%	20.8%	20.8%	17.2%
Industrial Crop	12.6%	20.2%	16.9%	17.3%	16.7%
Field Hand	24.0%	15.4%	5.9%	4.6%	12.5%
Crafts	4.4%	1.8%	5.5%	2.1%	3.4%
Commerce	4.8%	1.1%	3.2%	3.6%	3.2%
Work at Project	5.1%	2.3%	1.1%		2.1%
Salary	2.4%	2.2%	2.1%	4.6%	2.8%
Sale of Livestock	2.4%	.7%	1.1%	2.8%	1.8%
Gifts from Relatives	2.3%	.6%			.7%
Renting Fields	.4%	.4%	.9%	.6%	.6%
Other	3.1%	1.9%	.9%	2.3%	2.1%
No Response	2.0%	.3%	.1%	.3%	.7%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest source of income, not the percentage of income.

Table 4.48
Largest Expenditure Category by Household Kilocalorie Production Quartile

Expense	Per Capita Kcal Production Quartile				Rwanda
	Lowest	2nd	3rd	Highest	
Percentage of Households					
Food	65.4%	65.0%	51.5%	38.2%	55.1%
Clothing	10.6%	9.9%	14.6%	15.5%	12.7%
Labor	.7%	4.9%	6.2%	14.2%	6.5%
Medicine	3.8%	3.7%	8.5%	7.6%	5.9%
Kerosene	2.4%	1.5%	3.0%	4.0%	2.7%
Taxes	1.2%	3.5%	1.6%	3.9%	2.6%
Kitchen Ware	2.7%	2.5%	2.1%	2.3%	2.4%
School Fees	1.5%	.8%	2.7%	3.8%	2.2%
Alcoholic Beverages	1.5%	1.4%	3.8%	2.1%	2.2%
Renting Fields	3.7%	1.7%	1.5%	.6%	1.9%
Tools	3.2%	.4%	.8%	2.2%	1.7%
Soap	.7%	.8%	.9%	3.1%	1.4%
Seed	.7%	1.9%	.8%	1.5%	1.2%
Other	.9%	1.6%	1.9%	.9%	1.4%
No Response	.8%	.4%			.3%

Note: the figure in each cell represents the percentage of households mentioning the item as their largest expense, not the percentage of expense.

4.4 National Strategies and Constraints

A. Food Aid

Food aid is minuscule in comparison to the total value of food staples consumed in Rwanda, accounting for, as shown in Figure 4.8, less than 3% of the value of food staples¹⁶ in 1986. Using SESA/MSU survey results on transactions, it is possible to estimate the value of informal bean and sorghum imports destined for rural consumption. Informal bean and sorghum imports are a larger proportion of the food basket than food aid. These informal imports make up over 5% of the value of basic food availability. Food aid imports in 1986 were not exceptionally low; on the contrary, Figure 4.9 shows that food aid imports in 1986 were higher than average for the 1980s. Since over 97% of the value of basic calorie sources comes from own production or trade, Rwanda can be characterized as largely self-reliant in food. Food aid has apparently not had much effect on consumer preferences. McClelland et al. found that if given the choice, both food aid recipients and non-recipients in all areas of the country most frequently chose beans over all other food items normally eaten.

¹⁶Note that this figure does not include types of food (milk, milk products, meat, coffee, tea, spices, oils, oil bearing plants, oilseeds, sugar, cocoa, manufactured foods) excluded from SESA's production estimates.

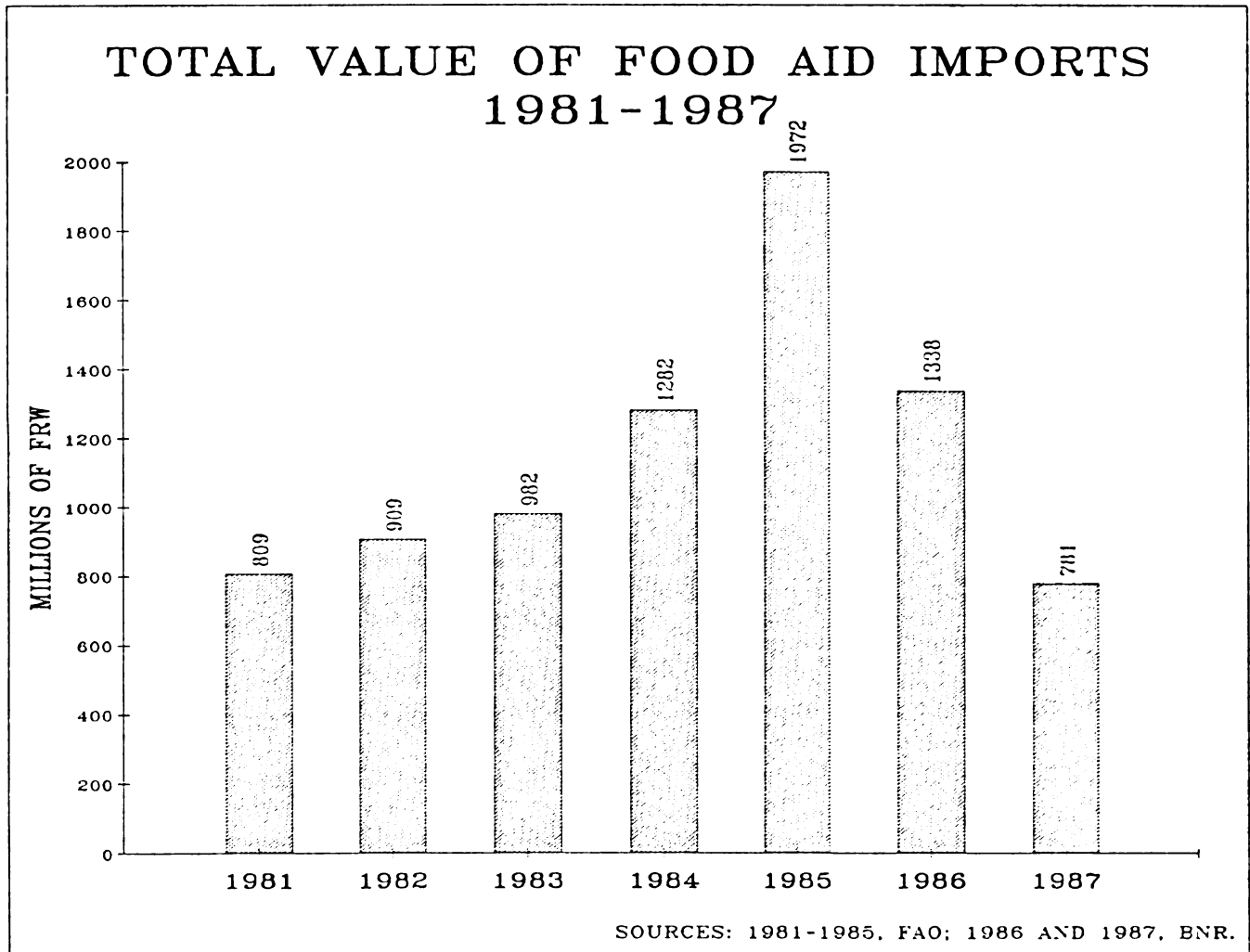
Figure 4.8

Value of Foodcrop Production,
Selected Imports and Food Aid,
1986 Calendar Year
(Millions of Frw)



Sources: BNR and SESA. Production is estimated by SESA, and includes only the eight major foodcrops. Bean and sorghum imports are net clandestine imports estimated by SESA. Prices used for valuation of farm production and clandestine imports are those reported by the BNR for 1986. Commercial food imports and food aid as reported by the BNR, not including seeds, fish, milk, milk by-products, honey, coffee, tea, spices, oilbearing plants, oilseeds, oils, sugar, cocoa, or preserves.

Figure 4.9



Much of the food aid in Rwanda is directed to refugee camps. Another portion goes to nutritional center maternal and child feeding programs food for-work-programs. The food distributed in refugee camps appears to be well targeted. There may be room for improvement in restricting food aid channelled through nutritional centers to the population at risk. To quote McClelland, Fleuret, and Pierre-Louis;

"CRS¹⁷...has made no effort to refine their approach or to employ criteria to isolate well nourished preschoolers from malnourished ones; this is at least partly because of their preventative orientation and their conceptualization of this entire population as an at-risk group. However...it seems reasonable to expect a refinement of the approach so that those at risk might be better targeted. CRS' own data show that areas of Cyangugu, Gikongoro, and Ruhengeri Prefectures experience comparatively high rates of malnutrition...A simple concentration of services in these areas would be likely...to reach more children who already are, or who are likely to become, malnourished than the present fairly even distribution of facilities throughout Rwanda."

The Adventist Development and Relief Agency (ADRA) has identified three prefectures as the most needy: Cyangugu, Gikongoro, and Kibuye. McClelland et al. criticize ADRA for not concentrating its food-for-work programs in these prefectures. The prefectures identified by CRS' child weight to age data and ADRA's informal observations correspond with the regions identified in Chapter II as large bean and sorghum importers. Hence local food production is insufficient in these areas by several different measures.

McClelland et al. also state that neither CRS nor ADRA has developed adequate means of differentiating between the chronically needy and other groups in relief programs.

¹⁷Catholic Relief Services, which runs many of the nutritional centers in Rwanda.

Thus food aid in Rwanda may be characterized as being barely significant in terms of total production. Food aid is not likely to have large negative effects on local incentives to grow and market food. Bezuneh et al. found that in Kenya, food for work may have positive effects on farm productivity. Changes in consumer preferences towards foods not grown in Rwanda have not been identified. At the same time, food aid may not be having the beneficial effect that is intended. Food aid is relatively poorly targeted, going to areas where production is relatively high, and to classes of people who do not appear to be food insecure.

B. Price Policy

Price policy in Rwanda has been treated extensively in Chapters II and III. It is mentioned here only to underline that price policy has historically been an important part of the GOR's strategy to increase production. The GOR believed that increasing prices received by farmers would increase total farm level production. This is not an unreasonable assumption if increased prices make it possible to use more of the factor of production that is limiting. Unfortunately the biggest obstacles to increased production in Rwanda are land area, soil fertility and lack of rain. Price policy is unlikely to remove these obstacles given the lack of tested technical packages to improve yields.

C. Trade and Specialization

Officially, Rwanda relies on exports of coffee, tea, and pyrethrum to European and North American markets as an important source of

foreign exchange. Tourism also plays a large role in earning foreign exchange for the country.

Evidence is beginning to mount that unofficial exports may also play an extremely important role in providing income and employment to Rwandans.

Several studies (Leurquin [1960], Gabriel, Gatera, Deschuytener) have found that livestock prices in Zaire, Uganda, and Burundi create incentives for Rwandan producers and merchants to export animals to these neighboring countries. Gatera estimated the total value of livestock exports from Rwanda to Zaire, Uganda, and Burundi at 305 million Rwandan francs in 1972. The consumer price index as reported by the BNR has gone from 104 in 1972 to 240 in 1986. If livestock exports and real prices have remained stable, then livestock exports go a long way towards paying for Rwanda's estimated 1.6 billion Frw bean and sorghum imports (recall Figure 4.8).

Banana wine and sorghum beer exports may also be generating a some income to pay for Rwanda's bean and sorghum imports. Haggblade with Minot found that 45% of banana wine and 10% of sorghum beer produced is exported from the rural areas. Urban areas account for less than 10% of the population in Rwanda. Since the urban population is much smaller than the rural population, a large percentage of rural exports of traditional alcoholic beverages (particularly banana wine) must be bought by neighboring countries.

There is also evidence that Rwanda uses its abundant labor to recondition used clothing brought in from Europe and North America.

Much of the used clothing imported into Rwanda appears to be destined for informal re-export to neighboring countries. Haggblade found that

"...a substantial proportion of Rwanda's used clothing imports are re-exported, almost always fraudulently, to Zaire, Uganda, Burundi, and Tanzania. Many of the traders interviewed speculated that as much as half of Rwanda's used clothing imports might ultimately be sold outside the country. By comparing 1983 consumption data with 1983 imports, and abstracting from stock changes, it has been possible to estimate roughly how much actually was re-exported, at least in that year. The results indicate that in 1983 well over half, and perhaps as much as two-thirds, of all used clothing imports were re-exported to neighboring countries."

Tin roofing materials and other manufactured items such as plastic containers are more readily available in Rwanda than they are in neighboring countries. Some of these manufactured items are entirely or partially produced in Rwanda; many are imported from elsewhere. Rwandans may benefit from providing the marketing services necessary to deliver these items to consumers in bordering areas.

In summary, official statistics indicate that trade links between Europe and North America are more important than trade with neighboring countries. This may be correct, but it is clear that official statistics seriously underestimate the level of trade between Rwanda and its neighbors. The population appears to be compensating for Rwanda's land shortage through the export of labor intensive goods such as stabled livestock, local brews, and reconditioned used clothing. Rwanda's permeable borders therefore contribute to the food security of the country by generating income and increasing the amount of food available through trade and specialization.

D. Promoting Productivity On and Off the Farm

The GOR's principal strategies in promoting on farm productivity have been to persuade farmers to preserve soil fertility through composting and anti-erosion trenches, and to seek better varieties through the auspices of the agronomic research service, ISAR. Until recently chemical fertilizer trials were limited in nature.

Results of various SESA surveys underscore the importance of the government's concern about soil fertility. Indications are that soil fertility in Rwanda is declining. The land pressure has reduced fallow times and brought more and more marginal areas into production. The question is, how should Rwanda attack its soil fertility problems? Chemical fertilizers are often mentioned as a potential solution to the fertility problem. The success of a fertilizer import program depends on the economy's ability to generate a large enough exportable (agricultural or non-agricultural) surplus to pay for fertilizer imports.

Getting chemical fertilizer to farmers on time is critical. In 1985, the Rwandan transportation network almost came to a standstill because civil strife in Uganda blocked fuel imports. Potential transport difficulties in importing fertilizers and exporting surpluses with distant trading partners must be accounted for in studying the feasibility of extensive use of chemical fertilizer.

Imported chemical fertilizer is a capital intensive means of increasing yields per hectare. Rwanda has very limited capital. Returns to capital investments in fertilizer need to be compared to returns to capital investments in other productive activities before a

broad program of fertilizer distribution can be considered. Extensive on farm research on the returns to chemical fertilizer is necessary, as is development of improved varieties. Extensive investment in varietal improvement is always a risk. The general experience is that solid research can improve productivity, especially responsiveness to fertilizer. But these types of research require a long lead time, and the results cannot be predicted in advance.

In sum, the fertilizer solution seems to be a long range option to be explored cautiously. Risks of supply disruptions and commodity price fluctuations must be balanced by significant yield improvement.

Are there any alternative solutions to the soil fertility problem? Rwanda has emphasised composting of livestock manure to allow returning this fertility to the fields. Rwanda has about 800,000 head of cattle, 2 million goats, 500,000 sheep, and 200,000 pigs, or about 3.5 million large and small ruminants. Rwanda also has six million people. Yet this obviously much larger source of composting material has been almost completely ignored by researchers and policy makers.

Rwanda is unique in Africa with respect to its population density and so must look beyond Africa for solutions to its soil fertility problem. Human waste is widely used as fertilizer in areas of Asia with similar population densities. Ways of tapping this resource while minimizing adverse health effects need much more attention. Only one project, PAK (Galliker), has experimented with alternative means of recycling human waste in Rwanda. PAK has had success in on-farm trials of waste collection techniques, but the soil fertility problem looms so large on Rwanda's horizon that a more focused effort appears warranted.

In terms of increasing off-farm or non-farm productivity, Rwanda can learn from its successes: beer, livestock, and used clothing. All three of these income and export generating activities rely on techniques requiring very little capital investment. They are all relatively labor intensive and provide goods and services demanded by rural Rwandans and neighboring countries.

Potential for increased production for export to Europe seems limited until Rwanda's links with seaports are improved. Exceptions to this rule are high value per kilo products like tea, and perhaps baskets, which may be economically air freighted. Rwanda's basket weavers are exceptionally talented. Baskets are easily transported and stored. Basket weaving is labor intensive. Materials for baskets are grown locally. In recent years Kenya has begun exporting substantial quantities of purses woven from locally available materials to Europe and North America. It may be possible for Rwanda to expand its exports of baskets as well.

4.5 Chapter Summary and Conclusions

Evidence presented in this chapter indicates that Rwanda's production is not keeping up with population growth. Chronic food insecurity may therefore be a growing problem in Rwanda. Cross-sectional data presented in the chapter indicate that a small percentage of households account for a large percentage of the marketed surplus in Rwanda, and that these household appear to be better off than the average Rwandan farmer. A majority of households are net buyers of both dry beans and sorghum. Available evidence indicates these households are poorer than net sellers.

The determinants of farmer marketing and production vary by agro-ecological zone. Bean and sorghum output and marketed surplus appear to be closely related to total productivity of farm resources. The household's ability to grow sufficient food decreases as farm size decreases. As total farm output drops, the percentage of sorghum and bananas in output mix appears to drop. This is a result of poorer farms opting for the more land efficient tubers in their crop mix. Tubers are also effective in stabilizing intra-annual food supplies. Small farms need access to income to purchase beans to supplement their protein intake.

Bean and sorghum imports are currently more important as a proportion of the total value of basic food availability than official food aid. Unofficial exports are therefore important in maintaining the food balance in Rwanda. Rwanda appears to pay for its informal bean and sorghum imports with a variety of informal exports. These include: alcoholic beverages, livestock, and reconditioned used clothing. Disruption of border trade by either side could result in reduced incomes and worsened chronic food insecurity in both countries.

Rwanda's exports reflect its high labor to land ratio: they are relatively labor intensive. Bean production in smaller farms also appears to be moving toward more labor using techniques as part of an effort by farmers to get the most from their limited land. The search for effective labor intensive means to produce food and earn income is an important priority for future research. Population trends and farmer constraints indicate that this need will only intensify in the future.

CHAPTER V

TRANSIENT FOOD INSECURITY ISSUES

Transient food security refers to the ability to obtain adequate nutrition in the face of short term supply shocks. This chapter starts with an historical discussion of the severity and frequency of food insecurity in Rwanda. Then alternatives for predicting supply shocks in Rwanda are explored. A discussion of farmer strategies for famine prevention and relief follows. Next, national policies to cope with temporary production shortfalls are examined.

5.1 Defining the Problem; How Big and How Often

A. Evidence from the Colonial Period

The timing and amount of rainfall are key factors affecting short term disruptions of food availability in Rwanda. To quote Leurquin (1963),

"...there are great differences in the rainfall between one year and another. The varying amounts of rainfall and its capricious character have caused much concern both to the African farmer and to the administration; in some years rains have been wanting at seed time; on other occasions, hail has destroyed the young maize plants, and on yet other occasions prolonged rains have caused the harvest to rot. This is the reason for many of the food crises that have occurred, against which both the traditional practices of the inhabitants and the administrative measures taken against famine have struggled, not always successfully."

One method of examining interannual variability in food supply was employed by Lugan, who used an interview technique combined with available historical evidence to identify thirteen famines (severe food shortages) or food crises in Rwanda (mild food shortages) from 1856 to

1944. Eleven of these were related to unfavorable rainfall patterns in Rwanda, most often drought. Of the thirteen famines or food crises, only three were generalized throughout all of Rwanda and one of these was brought on by war. The other two periods of generalized reduced food availability, the food shortage of 1856 and the famine of 1943-44, were due to drought.

If Lugan's data are accurate and if one can expect historical patterns to remain constant, then perturbations in food production can be expected, on average, once every seven years. In most cases, these perturbations are likely to be localized in nature or not very severe.

The capacity of the marketing system to transfer food from surplus to deficit areas has certainly improved since the time period covered by Lugan's study. Production of drought resistant crops such as manioc and sweet potatoes has increased since their introduction during the colonial period. These crops make farmers less susceptible to short-term food shortages. While Chapter IV showed that the chronic food security problem may be increasing, localized transient food crises are less of a problem now than before the development of modern infrastructure and techniques.

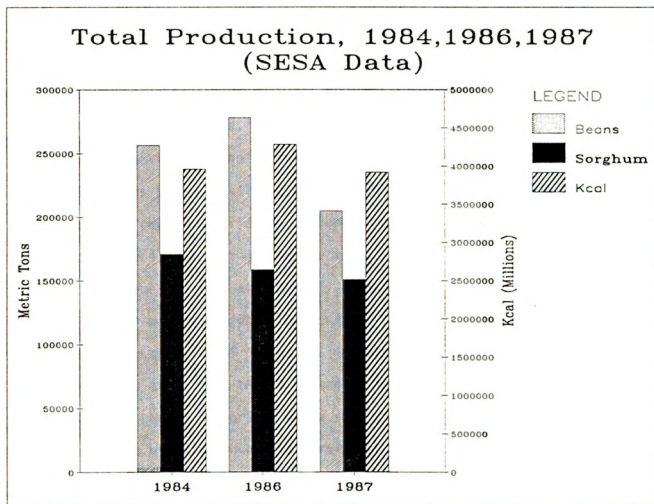
B. Production Patterns in the 1970s and 1980s

Another way to examine transient food insecurity in the past is through production data from SESA, which reveals that there has been some inter-annual variation in food production over the last few years. SESA's production estimates for 1984, 1986, and 1987¹ are shown in

¹1985, a normal year, is not presented because SESA collected data for the second season only.

Figure 5.1. Of the three years for which data is available, two, 1984 and 1987, have been characterized as poor years. The differences in total kilocalorie production between 1986 and the two "poor" years is quite small. Sorghum production trended downward slightly over the three years. Bean production fluctuated over the three years, being highest in 1986 and lowest in 1987.

Figure 5.1



Ideally, an historical analysis of food crises would include production data over a long time period. MINAGRI's historical production data is remarkably good considering the limited resources used to formulate the estimates. Nonetheless, MINAGRI's production data is better for trend analysis than for examining short term production fluctuations. Figures 4.1 and 4.2 (in Chapter IV) show that fluctuations in the official production data series increased when SESA figures became available starting in 1984. This indicates the official production series may underestimate production fluctuations prior to 1984. It is therefore better to search for other indications of differences in food availability between years.

Another way to approach the study of transient food security is through the analysis of prices as indicators of food availability. High prices are a sign that a commodity is scarce. If consumers have purchasing power, low prices are a sign that a commodity is abundant. Examination of price movements throughout the years can indicate when there may have been short term food shortages in Rwanda and in neighboring countries.

Based on SESA/MSU research, it is known that a large percentage of Rwanda's marketed beans and sorghum come from neighboring countries. Hence rainfall across Rwanda's borders will also affect local supplies and prices. Rwandan production also affects Rwandan demand for marketed food; in bad years people may need to buy more from the market than in good years. Market demand and supply of food in Rwanda may tend to shift in opposite directions, exaggerating price fluctuations. The same relationship may hold in neighboring countries.

Thus in years of reduced supply in Rwanda, foreign supplies probably become much more important. If foreign supply is also reduced by similar weather patterns, then opposing shifts in supply and demand could significantly increase regional price levels.

Because foreign supplies also influence local food availability in Rwanda, national production statistics are not enough to determine the frequency and duration of food shortfalls in recent years. Unfortunately, production statistics for the relevant production regions of Zaire and Uganda are not available, so another means of measuring the periodicity and duration of contractions of supplies must be relied upon. Prices in Rwanda are the best available indicator of food scarcity, because they reflect a number of relevant factors, including foreign and domestic supplies, and transport and storage costs. A drawback of using prices as a proxy for food availability is that farmer incomes may fall with reduced output so prices may not reflect the extent of reduced consumption. Food security involves both availability and access. Prices are only indicators of availability.

C. Historical Bean and Sorghum Price Movements

Purchased dry beans represent an estimated 23% of rural utilization, while purchased sorghum is about 36% of rural utilization (Tables 2.1 and 2.2). The 1986 transactions data show that at least half of the beans and sorghum purchased in rural markets are imported in good years. Hence bean and sorghum prices are a function of bean and sorghum availability in supplier nations, as well as supply and demand in Rwanda.

Figures 5.2 through 5.10 illustrate historical monthly urban bean and sorghum price movements in Rwanda. The agricultural year used by SESA, November through October of the following year, is retained in all the figures to facilitate comparison with production, purchase, sales, and price graphs elsewhere in this document. The nominal MINIPLAN price data were inflated to 1987 levels using the BNR's consumer price index. Annex II contains tables of the prices after inflation to 1987 price levels. The nominal data are from Mukezangango (1972 to 1986) and Zalla (1987). The bean data covers the period from 1972 to 1987. Bean data were not collected in Kigali in 1972-74, so Gikongoro data was substituted in those years². Sorghum prices from 1977 to 1987 are included, since MINIPLAN did not collect sorghum prices in any prefecture from 1974 to 1976. All sorghum prices presented are from Kigali.

To facilitate comparison of absolute price levels across years, Table 5.1 presents average real urban dry bean and sorghum prices over the reference period.

²Of the other prefectures, Gikongoro's price series is the most closely correlated with Kigali's. See for example Bylenga and Loveridge.

Table 5.1
Average Real Urban Bean and Sorghum Prices
(1987 Frw)

	Frw/kg	Frw/1000 kcal	Reference Period
Dry Beans	49.9	16.4	1972-87
Sorghum	34.6	8.8	1977-87

Notes: Averages are simple averages of MINIPLAN data inflated to 1987 levels using the BNR's consumer price index as reported in International Financial Statistics. Kilocalorie conversion factors are from SESA.

Beans.- When deflated with the the BNR's consumer price index, the Miniplan dry bean price data appear to trend downward (not shown in a figure). It is not clear why this has happened. Reduced regional transfer costs, civil unrest in Uganda in the 1980's, and expanded per capita production in Rwanda may all have contributed to the lower prices.

The typical monthly pattern of urban dry bean price movements is presented in Figure 5.2. Figure 5.2 is a mean of the years 1972, 1973, 1976-80, and 1983. These years show a similar intra-annual pattern: prices drop with the first harvest in December, rebound slightly until they are pushed down by the second harvest in May and June, and then increase steadily until the end of the (agricultural) year. Knowing the typical annual pattern of price changes can help policy makers look for exceptions that provide useful insights for transient food security problems and policies.

For example, comparison of within year Kigali bean price movements in 1984 and 1987 crop years with SESA bean production estimates for the same years provides an illustration of how foreign supplies may be influencing local prices (Figures 5.3 and 5.4). In 1984 real Kigali bean prices began to follow the typical pattern, but rose above 80 Frw/kg by November of 1984. This was a known drought year in Rwanda, and SESA production estimates were 256,504 metric tons for the agricultural year. In sharp contrast in 1987, when Rwandan bean production was 20% lower than in 1984 (204,946 metric tons), bean prices also followed the typical pattern, but remained below 60 Frw/kg during the period of typical high price months (Oct.-Nov.). The higher prices in 1984 may be due to a major reduction in the total regional supply. Rwandan production in 1987 was much lower than in 1984, but there was apparently no simultaneous supply reduction in nations exporting to Rwanda. The 1987 end-of-year price increases were significant, but still much lower than in previous years when region-wide shortages appear to have influenced the market.

Figure 5.2

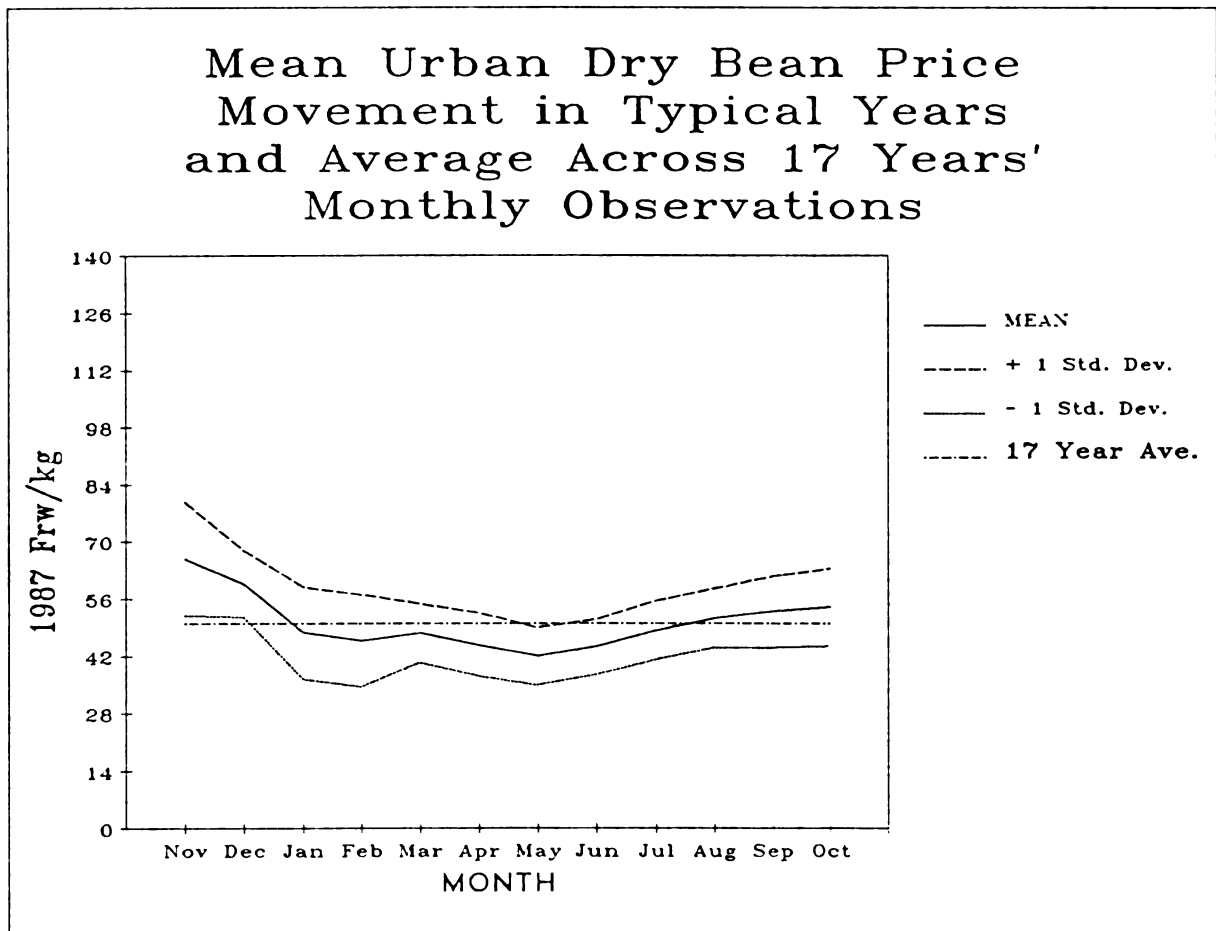


Figure 5.3

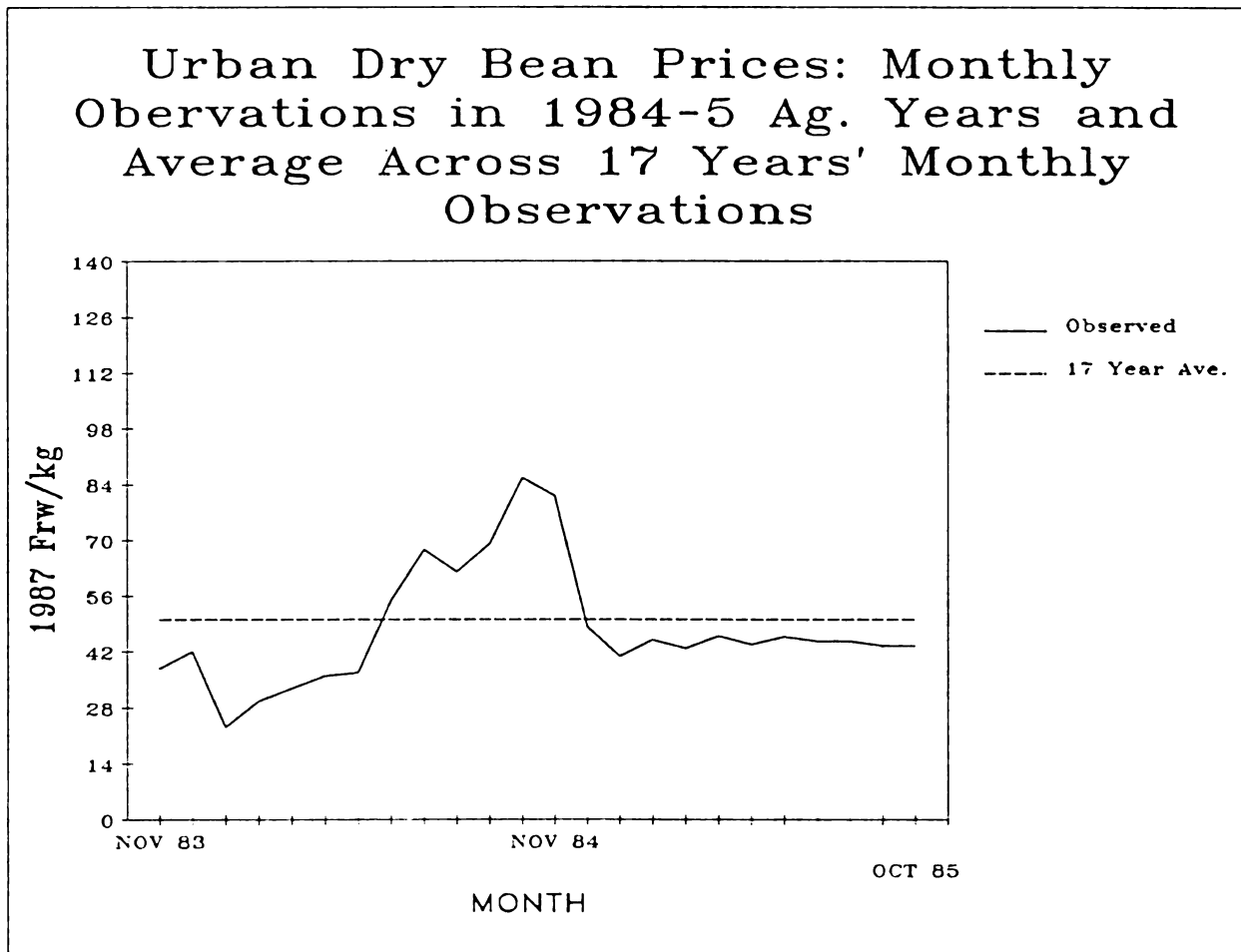
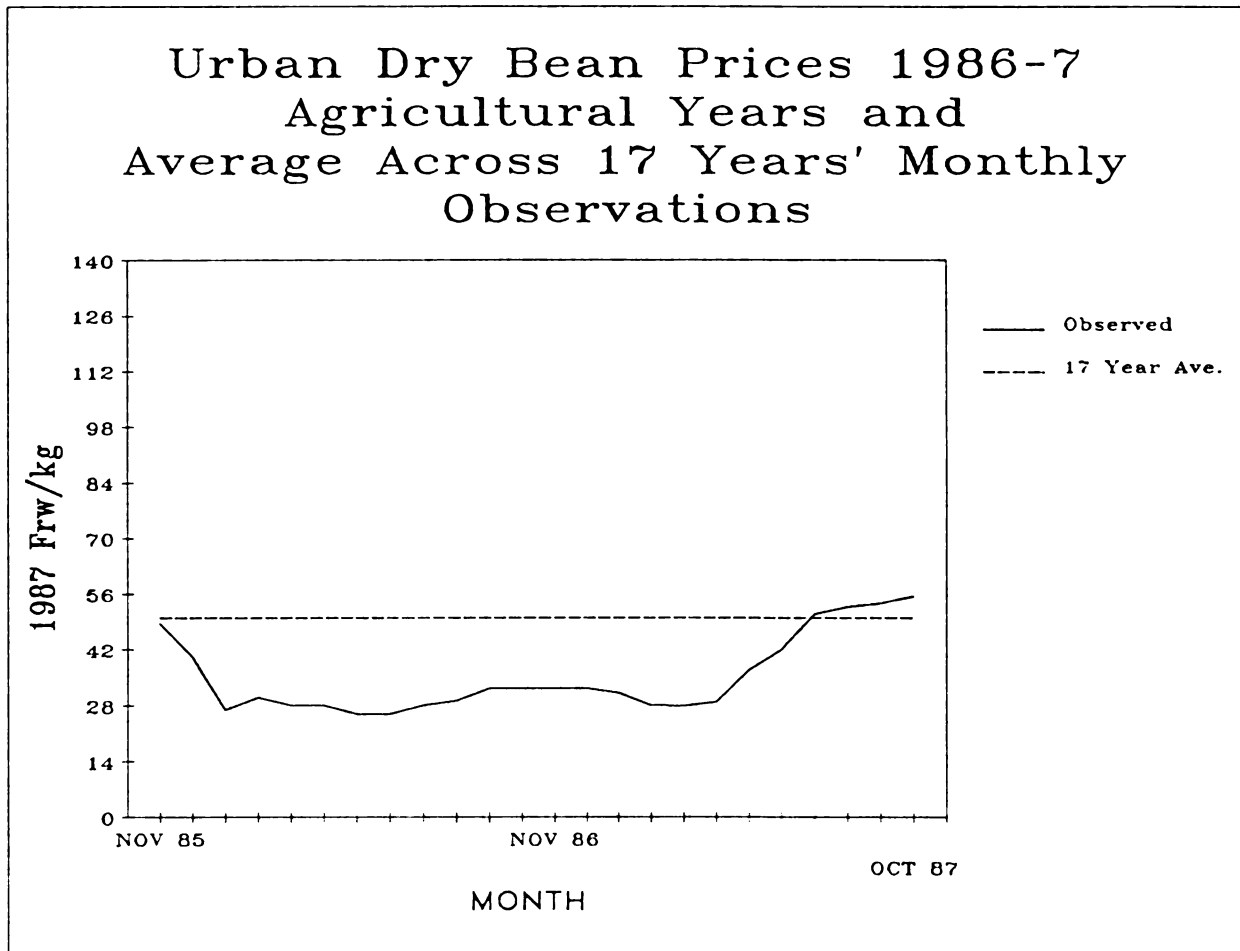
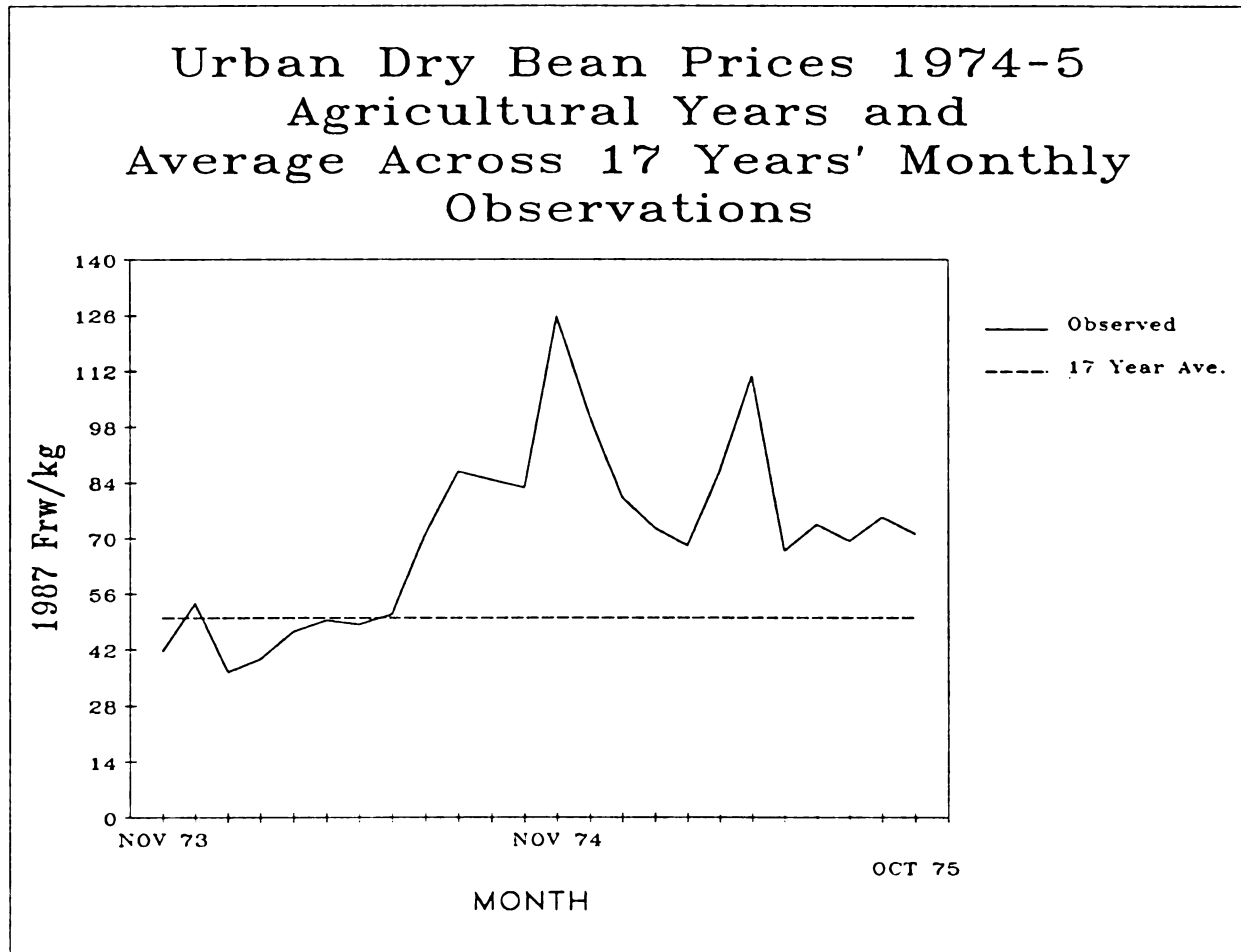


Figure 5.4



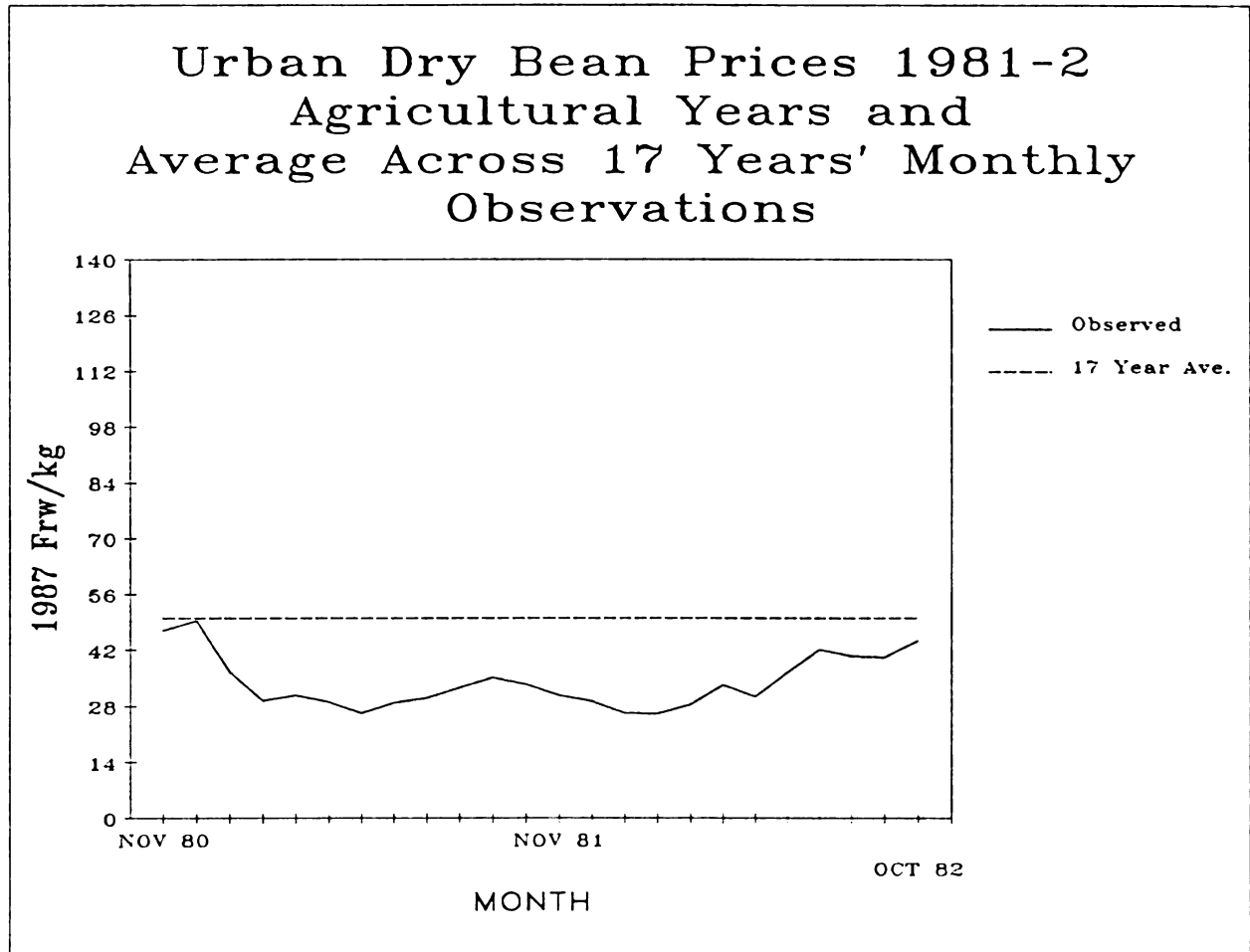
Another insight possible from a review of the price series is the determination of the frequency and duration of historical major price increases. (These are indicators of supply shortages.) Over the 17 year period covered by the bean data, there have been only two years of extraordinary price increases: 1974 and 1984. In 1984, the bean price increase was not as severe and did not persist nearly as long as in 1974. (Compare Figures 5.3 and 5.5.) In 1984, bean prices were abnormally high from June through November. In early 1985, bean prices dropped significantly, and stayed below the 17 year average for the rest of the year. In 1974, the bean price increase also started in June, but went much higher, and then stayed relatively high for the next eighteen months. Official MINAGRI bean production statistics indicate that 1974 was a bad production year in Rwanda, but that 1975 was a good year. Why then did prices stay high throughout an entire agricultural year? Again, it hypothesized that the answer is that exporting countries experienced below normal bean harvests in 1975 while Rwanda's was normal. From a transitory food security perspective, this set of events may result in serious and prolonged problems for Rwandan consumers who must purchase beans. Fortunately, this set of supply conditions is not frequent: over the seventeen year period of analysis it is found only once.

Figure 5.5



Consumers benefit from low prices, but net sellers do not, especially if they store product in anticipation of seasonal price increases. What does the price series reveal about the frequency and duration of low bean prices? Some four times over the 17 year period prices were unseasonably low. During 1981 and 1982 (Figure 5.6) and again during 1986 and 1987, bean prices stayed well below average between the months of July and October. The seasonality of bean production in the Northern Kivu Region of Zaire is the opposite of that in Rwanda; more beans are produced in the second season than in the first. It is therefore likely that an exceptionally large main bean harvest in May through July in Zaire affects Rwandan markets in the period June through October. Hence Rwandan prices stabilize at low levels. A normal harvest in Zaire may result in the typical seasonal price pattern shown in Figure 5.2, while a major harvest failure in Zaire, may push prices upward significantly towards the end of the year in Rwanda. (For example 1974 and to a lesser extent, 1984).

Figure 5.6

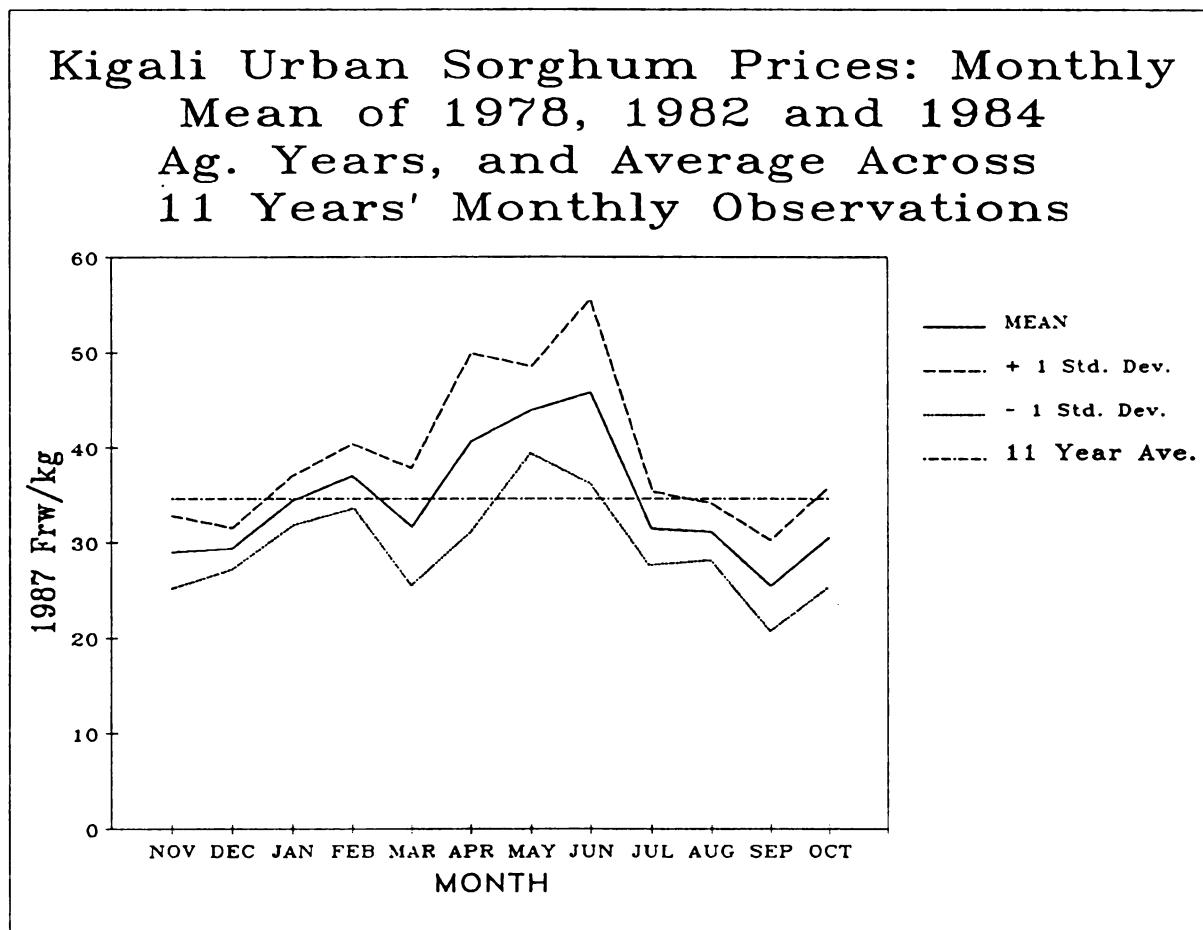


Sorghum. - For 1984, 1986, and 1987, the years for which SESA production estimates are available, overall price levels appear to be unrelated to total Rwandan sorghum production. SESA's estimates show sorghum production trending downward over the three years (Figure 5.1), and so are real prices (Figures 5.7 through 5.9). This indicates the likelihood foreign supplies also play an important role in determining local consumer prices for sorghum.

Intra-annual urban sorghum price movements in Rwanda are more complex than for beans; yet even with a shorter data series, at least three "typical" patterns of urban price movements are discernable.

One typical pattern is exhibited in 1978, 1982, and 1984 (Figure 5.7). In these years, sorghum prices are about average in November, but peak sharply in the middle of the year before dropping below average. MINAGRI data shows Rwanda's sorghum production to be below trend in 1984, but 1978 and 1982 were normal years. This pattern could arise from slightly below average January harvests in Rwanda and/or neighboring countries.

Figure 5.7



A second pattern emerges in the 1981, 1983, and 1986 data (Figure 5.8). Sorghum prices in these years are about average until around May, when there is a short, mild price peak that is ended with the onset of the main harvest. The 1987 sorghum price pattern (Figure 5.9) is similar except prices remained below average all year long. This is probably an indicator of good July and January harvests in Rwanda and in supplier nations.

In 1977, 1979, 1980, and 1985, (Figure 5.10) prices start out above the eleven year 35 Frw/kg average, then drop precipitously with the approach of the main July harvest. This may reflect a smaller than average January crop in Rwanda or elsewhere.

As with beans, it is hypothesized that these differences in intra-annual price movements reflect conditions in areas importing sorghum to Rwanda, because over 50% of the sorghum in rural markets is imported. High stable prices early in the agricultural year could mean a poor harvest in Rwanda or on the other side of the border. Low prices probably result from large harvests from within and outside the country.

Figure 5.8

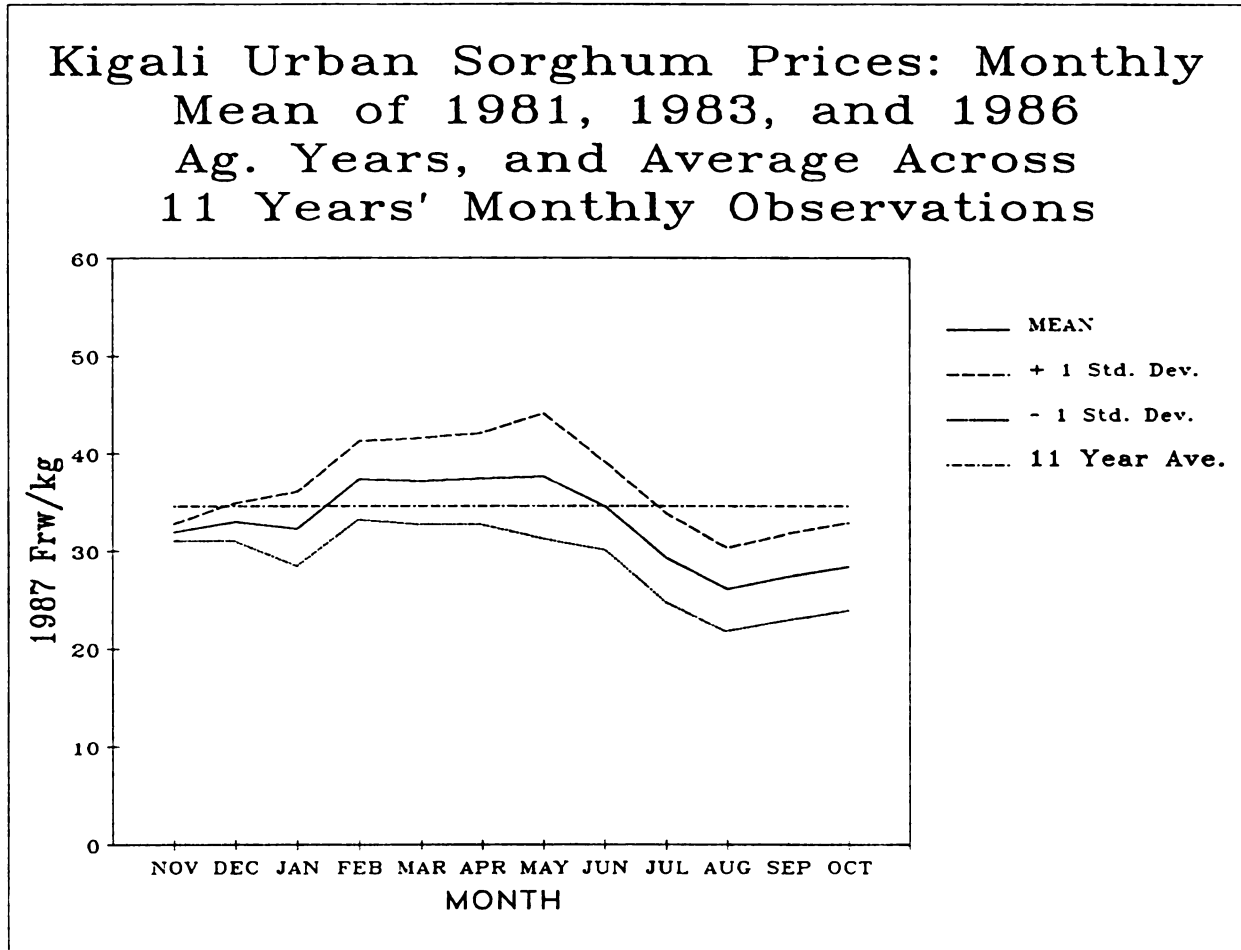


Figure 5.9

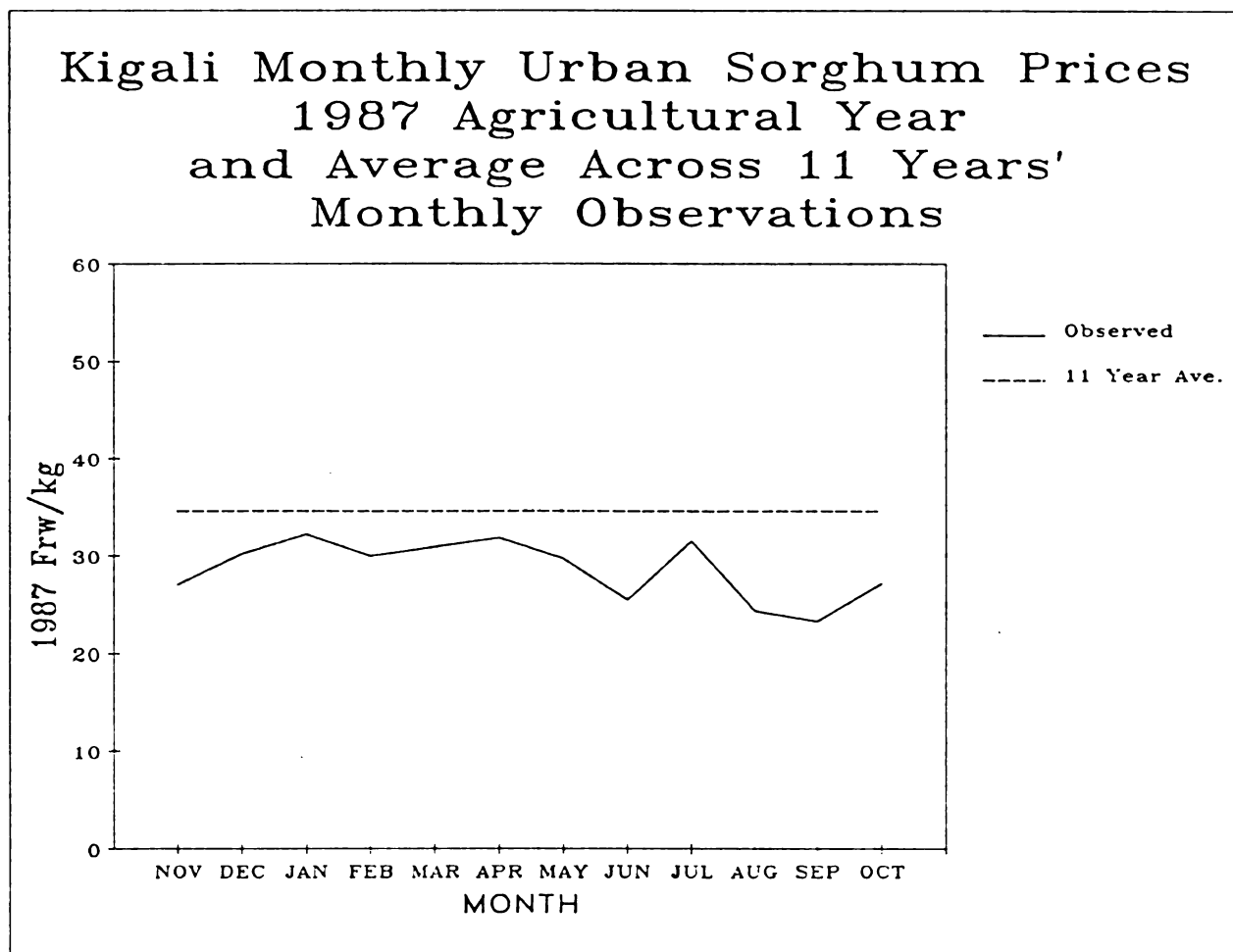
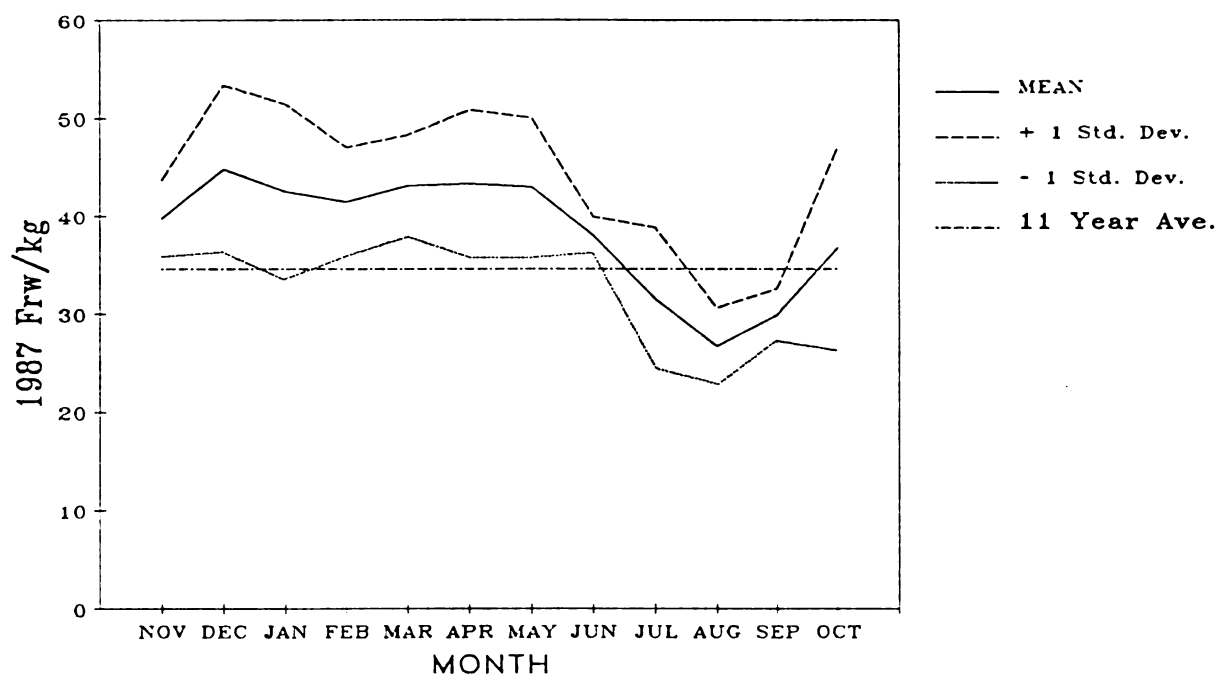


Figure 5.10

Kigali Urban Sorghum Prices: Monthly
Mean of 1977, 1979, 1980, and 1985
Ag. Years, and Average Across 11
Years' Monthly Observations



Less is known about the seasonality of sorghum production areas of neighboring countries supplying Rwandan markets. The variability of the seasonality of production in Rwanda are discussed in Chapter III. It may also be that supplier nations also have cyclical production patterns which vary from one region to another. Investigation of foreign production patterns could help develop a better understanding of reasons for price behavior in Rwanda. Policy makers need information on both national and foreign variations in production when formulating transient food security policy for the 1990s.

In general, sorghum prices do not exhibit the prolonged periods of high prices found in the bean data. This may be in part due the shorter price series which excludes 1974-75, the years when bean prices remained high for quite some time. Still, sorghum prices only rarely go more than 15 Frw/kg above their reference period average (see Annex II). A similar statement cannot be made for beans. On balance, sorghum therefore appears to be characterized by more price stability than beans.

Potential For Substitution to Lower Priced Commodities.- Having established that urban retail prices in Kigali are a useful and inexpensive indicator of general food availability in Rwanda, let us turn again to the principal questions of this section: how large and frequent are food shortfalls? What might be done about them? Can consumers shift purchases away from high price items to those more available, and maintain caloric intake?

Bean and sorghum prices provide indications that food shortfalls are infrequent, and that these rare perturbations are not generalized

to other commodities. Urban prices went significantly above average for both commodities in only one year between 1977 to 1987: 1984.

What shifts are feasible among marketed commodities to mitigate the effects of short term food price increases? Table 4.37 (Chapter IV) shows that sorghum provides less protein and other nutrients than beans, but Table 4.36 shows sorghum's kilocalorie content slightly above beans. In terms of transient food insecurity, kilocalories are generally the most critical nutrient. Long term consumption of sorghum instead of beans could create protein deficiency, but short term substitution would have minimal adverse health effects.

With the exception of 1984, over the period 1977-1987, consumers lacking adequate bean production and unable to pay high bean prices could have substituted sorghum, or vice versa. Even in 1984, sorghum prices peaked in June and were at or below average when bean prices went far above average in October and November. Table 5.2 shows the real cost of obtaining 1000 kilocalories from various foods by month in 1984. Real dry bean prices were only slightly above their 17 year average (16.4 1987 Frw/1000 kcal) when sorghum prices peaked in June. From July to December, sorghum was close to or below its 11 year average (8.8 1987 Frw/1000 kcal). Cost of calories from both crops remained substantially below costs of calories from other crops. Farmers may have been able to sell tubers and bananas to buy beans and sorghum, gaining calories. (MINAGRI data indicate sweet potato production was down in 1984, but manioc, banana, and irish potato production remained close to trend.) These data suggest that food was available to those with adequate purchasing power.

Table 5.2
Real Urban Kigali Cost of Calories
from Various Foods, 1984
(1987 Frw/1000 Kcal)

Food	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Beans	8	10	11	12	12	18	22	20	23	28	27	16
Sorghum	8	9	6	9	10	12	8	9	5	9	10	10
Potatoes	31	31	30	25	24	26	32	35	37	35	31	27
Bananas	29	25	26	26	22	23	20	21	20	26	35	43
Manioc	16	15	14	15	14	15	16	22	12	21	19	17

Sources: Prices from MINIPLAN. Kilocalorie conversion factors from SESA. Prices inflated to 1987 levels with the BNR's urban consumer price index as reported in International Financial Statistics.

In summary, severe transitory national food shortages are infrequent in Rwanda. Contingency plans for the event of an exceptionally poor harvest in Rwanda and/or its neighbors are necessary. But the major task of food policy is that of keeping up with the needs of a growing population--the chronic food insecurity problem.

The above analysis shows that prices in Rwanda are probably responsive to the underlying patterns of supply and demand in Rwanda and supplier nations. For a more complete understanding of the determinants of price in Rwanda, the hypotheses and concepts laid out above need to be verified in the long run. A continual information system which incorporates information about crop conditions in neighboring countries would greatly improve understanding of the relationships between food availability in these countries and Rwanda. The most cost effective means of accomplishing this task is probably

the collection of monthly price data in foreign markets in areas which export to Rwanda. A better understanding of inter-annual production levels and crop seasonality in Zaire and Uganda would also improve analysts capabilities to elucidate relationships which determine prices and food availability in Rwanda.

5.2 Techniques and Importance of Forecasting Need, Prices and Weather.

Forecasting of extreme changes in food production in Rwanda, Zaire, and Uganda is important because the government needs time to react to the problem. Decisions to import/not to import and to release/not to release stocks take time. If government does not begin to take action well before the peak of a food crisis, people may go hungry. Conversely, if government over-reacts to slightly unfavorable weather conditions, public resources will be wasted and normal food distribution channels may be disrupted. As much prior knowledge as possible of the extent and probable duration of any food crises is therefore critical to rational transient food security policy.

A range of methods are available for attempting to forecast harvests. These include farmer opinion surveys, aerial photography, and price-rainfall regression analysis.

A. Farmer Predictions of Crop Size in Rwanda

From 1985 through 1988, SESA attempted forecasts of the size of the harvest through national farmer surveys. Questions include farmers' estimates of harvest size and quantities of inputs used in planting. The method is still being refined. The method has several strong points. It is inexpensive (if the enumerators are already visiting

households to collect other information). It relies on direct observations by those who should know best. It provides good geographic coverage of the country and the minimal processing time allows timely distribution of estimates.

One disadvantage of the method is that individual farmers do not seem to be very adept at making accurate estimates on the size of their crop. However, individual farmer errors have offset each other in the aggregate as national estimates from this method have been close to results obtained later in the season by physical measurement³. A second disadvantage is that there is no way of knowing *a priori* whether farmers will over or under predict the size of their crops in exceptionally bad years. Econometric methods used to estimate total crop size based on individual farmer estimates in good years may provide coefficients that are not realistic in poor years.

Despite these disadvantages, methods using farmer predictions could be a cost effective way of establishing an early warning system. As long as SESA continues to collect yearly production data, the marginal cost of experimenting with this type of forecasting work is quite small. Rainfall, price, and/or windshield data from Rwanda and other countries in conjunction with farmer opinion data might be useful in improving the accuracy of predictions in the future.

B. Photographic Methods for Predicting Crop Size

Satellite and/or aerial photography to predict changes in agricultural output are in use in various parts of the world. These

³Personal communication, Yvan DeJaegher.

techniques are not well suited to Rwanda. The prevalence of intercropping in Rwanda demands a very high resolution photographic image before crops and crop mixtures can be determined. Even with a very high degree of resolution, crops such as beans planted under banana trees may be difficult to discern. High resolution pictures mean more photographs taken from a lower altitude. More photographs increase processing time, and more importantly, expense. This technique is very expensive even with high altitude photographs. Aerial or satellite photography may or may not be desirable for a one time calibration and verification of data collected by other methods. At current prices, it would be too expensive to sustain for crop forecasting purposes.

C. Using Price and Rainfall Information to Predict Crop Scarcity

Prices, as shown in section 1 of this chapter, are very important indicators of availability of food crops. This is particularly true in countries like Rwanda where consumers try to even out year to year variations in own production via the market. Monitoring for an uncharacteristic price rise early in the season may be the most effective form of early warning system possible in Rwanda. Prices in neighboring countries at critical times of the season could also be used for early warning purposes for beans and sorghum, and perhaps other commodities.

Rainfall is a central element in predicting the size of national production from one year to the next. But total rainfall is much less important in determining production of critical crops like beans than the timing of the rains. Fortunately, Rwanda's Meteorological Service

has had a good system for monthly rainfall data collection in place for quite a few years. This data is at present underutilized for predicting the size and distribution of food shortfalls. One reason that rainfall is often overlooked in formulating crop estimates is that the data necessary to complement the rainfall data are frequently not available.

To illustrate the potential uses of rainfall data in conjunction with other types of data, a model was developed which relates rainfall and MINIPLAN urban bean price data from three prefectures: Kigali, Gitarama, and Ruhengeri.

Regression analysis was used to determine possible relationships between rainfall patterns in critical planting months⁴ and peak prices. Recall from the seasonal analysis of the MINIPLAN price data that bean prices tend to peak in October, November, and December each year. Increased ability to forecast relative price levels in these months would allow the government to better anticipate food crises. The months in which rainfall is critical for bean production in Rwanda are September and October (1st season) and May and June (2nd season). The equations examined for each of the three prefectures took the following form:

⁴Thanks to Yvan DeJaegher for his advice in selecting critical planting months by prefecture.

$$\text{POND} = \alpha + \beta_1 \cdot \text{MAJU} + \beta_2 \cdot \text{SEPT}(-1) + \beta_3 \cdot \text{OCT}(-1) + e \quad (5.1)$$

Where: POND = Sum of MINIPLAN urban dry bean prices in October, November, and December
 α = Constant
 $\beta_1, \beta_2, \beta_3$ = Coefficients
MAJU = Sum of May and June rainfall (mm)
SEPT(-1) = September rainfall one year prior (mm)
OCT(-1) = October rainfall one year prior (mm)
e = Error term

The dependent variable in each of the regressions was the sum of the reported MINIPLAN prices for October, November, and December of each year from 1974 to 1984. Monthly rainfall figures obtained from the Meteorological Service were used as independent variables⁵. Table 5.3 summarizes adjusted R-square statistics, coefficients and T-statistics for the three regressions.

⁵The Meteorological Service recommended using data from the following stations for the three prefectures. Ruhengeri Prefecture: Nemba. Kigali Prefecture: Kigali Aero and Rulindo. Gitarama: Murambi and Gitwe. Where data from two stations were used, the two monthly observations were summed.

Table 5.3

Summary of Regression Results:
Rainfall - Bean Price Model

	Ruhengeri	Kigali	Gitarama
Adjusted R-square	0.80	0.72	0.33
α (Constant)			
Estimate	171.83	177.28	169.14
T-statistic	8.44	4.95	3.66
β_1 (May-June rain)			
Coefficient	-0.25	-0.18	-0.19
T-statistic	-4.38	-2.69	-2.46
β_2 (Sept. rain lagged)			
Coefficient	-0.70	-0.29	-0.11
T-statistic	-5.67	-3.57	-0.82
β_3 (Oct. rain lagged)			
Coefficient	0.30	0.16	0.14
T-statistic	4.32	1.77	0.76

The model has considerable power, as the signs on all coefficients are the same for the three equations, indicating that structural relationships are similar between prefectures. Higher rainfall in May and June means lower peak prices at the end of the year. Similarly, higher rainfall in September means lower prices in October, November and December of the next year. In contrast, higher rainfall in October, possibly indicating late planting rains, means higher prices one year later. One explanation is that a poor harvest in January-February means farmers begin consuming their May-June harvest early, with the result that supplies are shorter and prices are high in the months of October-December just prior to the next harvest. Thus the

effect of unfavorable planting rains for the crop to be harvested in January-February may be felt until over a year later.

The question arises, why does local rainfall appear to have such a dramatic effect on local prices when half of the beans purchased in the rural areas of Rwanda come from neighboring countries? Transfer costs, combined with dynamics of supply and demand in Rwanda and other countries provide a plausible explanation. Quantities marketed are only a small percentage of quantities produced. A 10% reduction in local production will likely cause a much larger percentage reduction of local marketed surplus. At the same time demand for marketed beans increases provided deficient households have adequate cash income. In the aggregate, when local supplies are low, a greater percentage of the beans in the market must be brought into the prefecture from external suppliers, including foreign countries. Because transfer costs are high in relation to the price of the commodity, prices rise substantially when the product must be imported. When a large proportion of consumption must be brought in from outside the prefecture, transfer costs cause prices to rise significantly above average levels.

The 20-67% of variation in prices not explained by local rainfall is probably due to weather conditions in areas exporting to Rwanda or the non-representativeness of the rainfall and price data.

The rainfall-price models are rough first attempts to study effects of rain on prices. More complete price and rainfall data from more prefectures (and from neighboring countries) will be needed before better models can be constructed. Much more could be done in relating

Rwanda bean prices to conditions in neighboring countries.

Nonetheless, there is some indication that it is possible to predict a potential bean price increase up to fourteen months prior to the event. If indications from the first season are that the harvest is poor, the GOR could begin to make provisional arrangements to increase local food supplies through relaxed controls on imports prior to the second season harvest. Should the second season harvest prove bountiful in Rwanda and neighboring countries, the provisional arrangements could be cancelled.

Efforts to examine carefully the supply conditions in other countries could also be extended beyond beans and sorghum. Analysis in this chapter suggests that a first line of defense in household transient food security strategies is to switch to less expensive foods in times of shortages.

Emergency government imports are not likely to be necessary very often. The possibility for substitution to foods other than beans appears to have been great in the most recent droughts for families with money to buy food. Only when regional supply is down significantly for most crops will there likely be a need for emergency imports from outside the region. Also, improvement in Rwanda's road system continues to reduce transfer costs from distant markets.

Prices are very easily collected, particularly in an urban setting. However, Rwanda's price data collection system needs strengthening. MINIPLAN is probably the most logical location for a price-based early warning system, because MINIPLAN has the best series of urban price data currently collected. Procedures to increase the speed and

frequency of transmission of price data from the prefectures to the central office in Kigali could reduce the time between data collection and crop forecasts. MINIPLAN agents in some of the more remote prefectural capitals could be given the support they need to increase the regularity of data collection. A technician trained in elementary price analysis based in MINIPLAN would facilitate comparison of price behavior between years.

Alternatively or in addition, MINAGRI could simply get the MINIPLAN price data as quickly as possible, and integrate it with rainfall and other agronomic information for an analysis which takes more of the relevant factors into consideration.

5.3 Farmer Strategies for Famine Prevention and Relief

It is commonly believed that farmers rely more heavily on tubers in drought years than in other years. To test this belief, farmers in SESA's sample were asked how they changed their cropping activities in response to the poor rains of 1984. The belief that there is a shift to tubers in drought years was upheld by farmer responses, as shown in Table 5.4. Over half of the respondents said they concentrated more of their activities on tubers in 1984. (This response may have been biased by the caterpillar attack which reduced sweet potato production.)

Table 5.4
Farmers' Cropping Activities in
Response to the 1984 Drought

Response	Percentage
Plant Tubers	54.3
No Change	39.3
Not Applicable (new household)	1.6
Other	4.8
Total	100.0

Changing the cropping pattern is only one of a range of options available to families facing a drought induced food deficit, and such shifts may still not provide adequate household food supplies. Reliance on the market to complement home produced food supplies appears to have been the most common strategy for survival in a drought year. Table 5.5 summarizes responses of farmers in SESA's sample to an open-ended, multiple response question concerning means of feeding themselves in 1984. Over seventy percent of the respondents mentioned selling labor or buying food as a means of acquiring supplemental food. Increased tuber consumption was mentioned second most frequently, with 37.7% of the respondents depending on home grown tubers to make up food shortages. These data highlight the importance of effective markets in times of food crises. Without the market option, many families would face much more difficult food acquisition problems in poor years. Government interventions have to be designed to complement, not disrupt, the normal flow of goods and services from supply areas to consuming areas. One way to help families in times of

food shortages would be to facilitate the cash income earning capacity of households in these periods.

Table 5.5
Farmer Methods of Food Acquisition
in the Poor Cropping Year of 1984
(multiple responses possible)

Response	Percentage
Buy food/ sell labor	70.7
Eat More Tubers	37.7
Eat Beer Bananas	5.8
Gifts from Neighbors	2.2
Government Aid	0.7
Not Applicable	1.8
Other	5.1
Total	124.0

Table 5.5 shows only a small percentage of families were highly dependent on government assistance for food in 1984. However, when the same families were asked directly if they had received food aid in 1984, almost 30% responded affirmatively. Some families may not have mentioned food aid out of embarrassment, but it seems more likely that the food aid was unimportant compared to total intake. As shown in Figure 4.9 (Chapter IV), the value of food aid imports (including food aid for refugee camps not in SESA's sample) in 1984 amounted to 1282 Million Frw or about 214 Frw/person. Minot and Niyibizi estimate annual per capita income at over 13,000 Frw, so food aid cannot have had a very significant effect on many households. The conclusion here is that while receipt of food aid was significant in 1984, the overall

importance of the aid in terms of families' diets must have been minimal.

Table 5.5 indicates that selling family labor to buy food was the most important strategy for food acquisition in 1984. This indicates that food markets must have been functioning well enough for families to acquire food. This hypothesis is supported by information in Table 5.2 which showed that bean and sorghum prices peaked at different times. Labor markets must have been operating reasonably well also, or families wouldn't have been able to earn money to pay for food by selling labor.

5.4 National Strategies for Transitory Famine Prevention

A. Rationale for Price Stabilization

Incomes of poor families are unlikely to keep pace with short term food price increases. Families may spend the same amount, but receive less food. High prices can therefore prevent families with some effective demand from buying adequate food supplies in food crises. Data from the SESA/MSU transactions survey illustrate the phenomenon to a certain extent. Table 5.6 shows farmer dry bean purchases by net transactions category in November-December 1985 compared with November-December 1986. Total purchases at the end of the year in 1986 were substantially higher in most net transaction categories than in 1985. This is related to lower local production at the end of 1986, but may also be a function of the lower 1986 prices. The value of dry bean purchases in 1985 was 372 million Frw. In 1986, with quantities purchased much higher, the value of dry bean purchases was 358 million Frw. An inflexible budget for food purchases may be the reason value

of purchases are almost identical for the same two months in 1985 and 1986. In 1985 and 1986, prices did not go above historical levels. Nonetheless, the data illustrate what might happen in the event of high prices for all commodities.

The GOR is therefore well founded in worrying about the effect of high prices in real food crises. OPROVIA has historically been the government's mechanism for reducing large price increases.

Table 5.6
Farmer Dry Bean Purchases and Prices Paid
November-December 1985 and November-December 1986
(Gifts Excluded)

Household Net Transactions Category	Metric Tons Bought in:			
	1985		1986	
	Nov	Dec	Nov	Dec
>60 Kg Sold	199	65	266	244
30-59 Kg Sold	62	40	62	34
<30 Kg Sold	317	63	178	277
No Net Transactions	59	8	103	26
<30 Kg Bought	1115	320	1329	1064
30-59 Kg Bought	1247	485	1175	880
>60 Kg Bought	3734	1737	3940	2758
Rwanda	6733	2718	7054	5282
Average Purchase Price (Frw/kg)	44	38	29	29

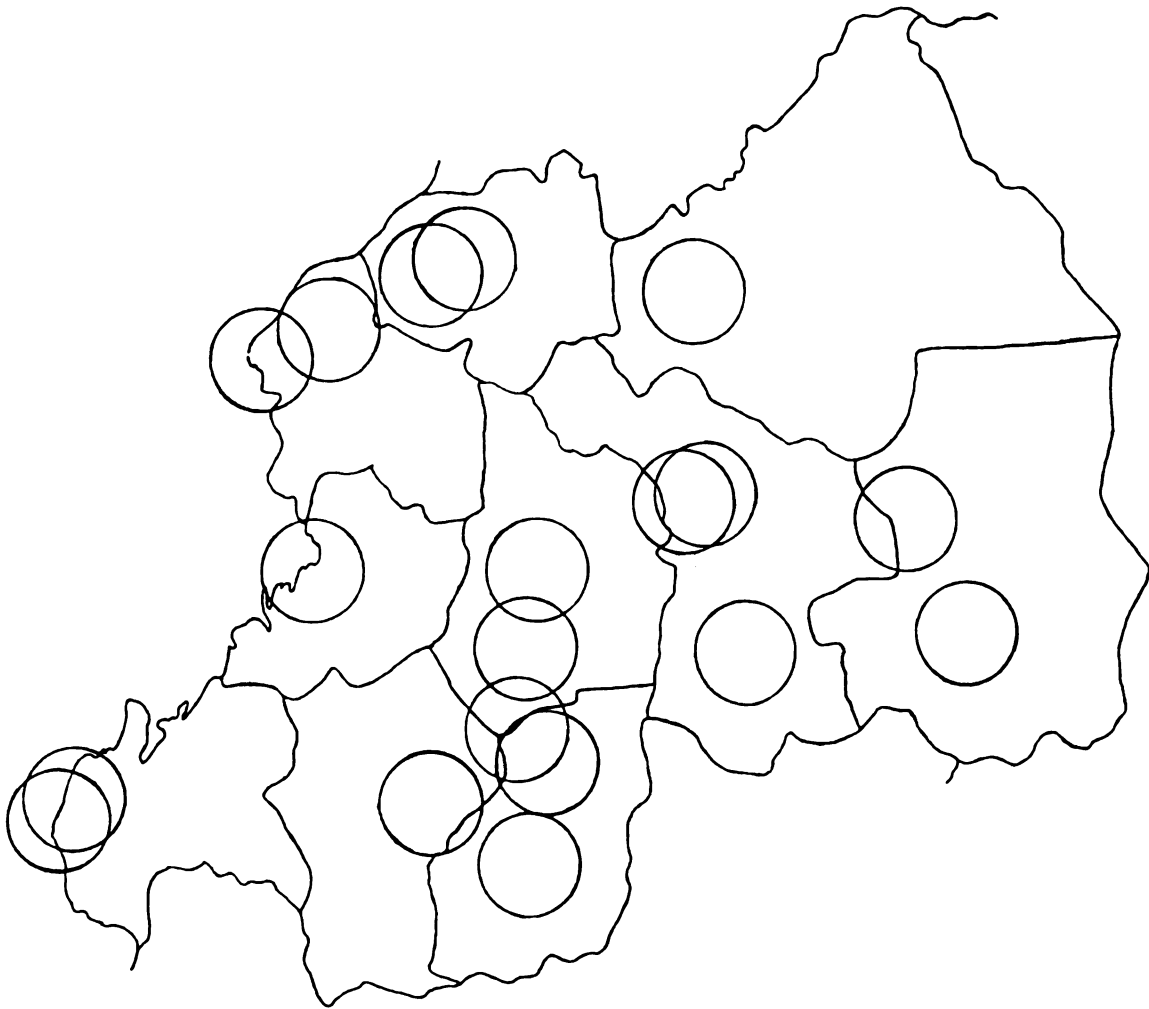
Note: Quantities destined for resale not included.

B. Investments in OPROVIA

OPROVIA is the GOR's major transient food security instrument. Significant investments have been made in OPROVIA's storage capacity, which now stands at 21,930 tons.

OPROVIA's geographic coverage also appears to be reasonably extensive. A significant proportion of the country is within 10 kilometers (approximately a two hour walk) of an OPROVIA outlet, as shown in Figure 5.11. OPROVIA is therefore already well positioned to oversee distribution of food aid in the event of a food emergency in Rwanda. The government can also rely on clinics, missions, and schools for emergency food distribution.

Figure 5.11
OPROVIA's Geographic Coverage:
Ten Kilometer Radii From OPROVIA Outlets



C. OPROVIA Activities in Reducing Transient Food Insecurity

Most of OPROVIA's storage capacity is devoted to interseasonal market stabilization and research purposes. As shown in Chapter II, OPROVIA usually buys most of its beans and sorghum from merchants and sells to the Ministry of Finance and the World Food Program. Three thousand tons of OPROVIA's current storage capacity (14% of the total) are designated "food security" stocks. The "food security" storage capacity was intended to be used to hold sorghum for emergency food distribution purposes.

To date, the only product held in OPROVIA's "food security" storage area has been rice purchased at above market prices from farmers participating in a rice growing project. The rice was purchased because farmers were refusing to continue their participation in the project due to unprofitable market prices. This is a good illustration of how buffer stock program funds and storage capacity can be transferred to serve ends other than the initial food security goals.

What can the present research contribute to the analysis of the viability of a strategic food reserve? OPROVIA's food reserve target volumes are 6,000 tons of sorghum and 2,000 tons of beans⁶. Since the demand for beans and sorghum is heavily influenced by local production, both total quantities utilized and quantities marketed are relevant for use in judging whether current target stocks could help the GOR meet its price stabilization goals.

⁶"Plan d'Amelioration des Performances de OPROVIA", Presidence de la Republique, OPROVIA/Centrale Comptable et Organisation, February 1986.

Information presented in Chapter II shows that rural utilization of sorghum in a normal year is approximately 197,000 metric tons, while rural utilization of beans is almost 261,000 metric tons. This means that the food reserve, when complete, would hold 3% of the country's annual rural needs in sorghum, and only 0.7% of its annual rural dry beans use. Based on these figures, OPROVIA could supply rural producers' sorghum needs for less than 12 days. For beans, the food reserve would cover less than 3 days' dry bean use. A rural dry bean and sorghum production drop of 6% below 1986 levels would mean a shortfall in these two crops which is larger than OPROVIA's total storage capacity.

Turning to quantities traded in local markets, if the 1986 agricultural year is representative, the strategic food reserve would cover 8% of annual sorghum purchases and 3% of annual dry bean purchases. This underscores the magnitude of product moved by the private sector *via-à-vis* the public sector. OPROVIA has an important role to play in helping improve the efficiency of the private sector in serving the needs of urban and rural consumers. It is unlikely that the government could afford to support a marketing board handling a large proportion of rural marketings.

Increasing OPROVIA's storage capacity does not seem advisable. The infrequency of severe food crises, the expense of managing a larger stock, and the potential disruptive effects an enlarged parastatal on private sector operations all argue against a larger role for OPROVIA's storage operations. Increased reliance imports from Zaire and Uganda, on emergency world market food imports in the event of a severe food

crisis, and improved early warning systems would be much more cost effective than increasing OPROVIA storage capacities and local market operations. Private distributors can efficiently move product to consumers who have purchasing power. A role for OPROVIA in severe food crises might be to make arrangements for emergency food shipments from world markets, and then sell to wholesalers. The wholesalers could then perform their normal function of moving food to consumers.

In times of severe food crop failures, some farmers may need emergency food aid. OPROVIA or another agency would probably need to handle food aid disbursements to those families who are unable to purchase food.

Emergency food aid is not without its disadvantages. One disadvantage arises from failure of emergency food provisions to arrive for timely utilization. The methods of improved crop forecasting described earlier in this chapter should temper the "on-time" problem. If OPROVIA is to be responsible for emergency food aid distribution, then crop forecasting may help it perform this task effectively.

A second disadvantage that Rwanda has faced in the past is gauging the quantity of emergency food provisions needed. In 1984, food aid was called for by the government. The food aid was late in arriving, and too much was sent. According to McClelland et al, the 1984 food aid was still being distributed in 1986. Again, crop forecasting may help alleviate this problem.

A third disadvantage of relying on emergency food aid is that the level of emergency provisions donated by more developed nations is dependent on world market prices. In the seventies, the Sahelian

countries faced severe food shortages when food aid was cut back due to high world market prices. Unreliability of food donations could be offset by a government contingency fund for emergency food purchases. The fund could be legally protected from being used for anything other than emergency food acquisition. Crop forecasting results for Rwanda and neighboring supplier nations could feed into the decision to activate any contingency fund purchases.

A fourth disadvantage of food aid is its adverse long run consequences. Consumers may develop preferences for commodities that are difficult to produce under local conditions. As Rwanda's agriculture moves towards a more market oriented mode, depressed prices related to food aid might reduce incentives for local production. Limiting the use of food aid to years when local and regional food production is well below normal levels should minimize potential long run adverse consequences.

Distribution of emergency food aid can be problematic. The biggest difficulties arise in deciding where to distribute, and who should benefit from food aid. The potential for abuse of the system is great. Prices could be extremely useful in identifying those areas where food shortages are most severe, assuming that there is enough purchasing power in the area to drive up prices. More importantly, food aid distribution in drought stricken areas would ideally be based on family need for food. A low cost set of health indicators (such as skin fold measurement) could be developed to screen families requesting food aid. Food aid in Rwanda is frequently distributed through food for work programs that do not apply any objective screening techniques to

participants⁷. This could mean that healthy people are benefitting from the programs while the undernourished go hungry.

There is considerable scope for OPROVIA to continue to improve the marketing system's capacity to respond to transitory food insecurity. Most of the areas where OPROVIA could have the greatest effect relate to improving the efficiency of the private sector rather than through OPROVIA's own retail operations.

OPROVIA cannot easily exert downward pressure on prices in local retail markets with its current system of retail outlets. Each of these outlets is staffed by a university trained manager who receives a salary commensurate with his education. The operating costs of these retail outlets is high compared to the more poorly paid typical independent operator. Independent operators often only conduct business on market days, combining bean and sorghum marketing business with activities ranging from transport and assembly to farming.

Tables in Chapter II show that for sorghum flour and beans, OPROVIA has been unable to generate high volume retail sales. Only in sorghum grain have retail sales been a significant proportion of OPROVIA's total volume, and even with this product the physical volumes have been very small, with the exception of 1986.

True to its mandate, OPROVIA has collaborated with local cooperatives in studying ways to reduce storage losses. Results showed that cooperative storage losses were low (less than 5% on average) because of relatively high product turnover rates⁸. OPROVIA's work at

⁷McClelland et al.

⁸Clarke.

the producer level showed that storage times are short and storage losses are minimal. Thus it would appear that further action in the area of improving cooperative and farmer storage conditions is of low priority.

In its research on storage in cooperatives, OPROVIA was frustrated by the fact that almost one third of the cooperatives that the USAID funded Local Crop Storage Project helped them select were non-functional⁹. Reasons cited for the "non-viability" of these coops were: "...never any stocks on hand, managers frequently absent, etc."¹⁰ One means by which OPROVIA could strengthen local marketing infrastructure would be to investigate the underlying causes for coop non-viability in spite of external assistance. One hypothesis worth investigating: lack of marketed surplus in the coop's area. If this hypothesis is shown to be true, perhaps efforts could be made to reorient the cooperative effort towards a consumers rather than producers. As cooperativess improve their supply sources, transient food insecurity could be reduced.

The SESA/MSU survey described in Chapter II found that, like cooperatives, merchants hold stocks for very short periods so it is unlikely that improving merchant storage practices would be fruitful. A study of merchant management practices and pitfalls could be an important OPROVIA contribution to improving movement, storage, and marketing of beans and sorghum. It is likely that merchants face the same supply problems as coops. OPROVIA might take the lead on

⁹Op. cit.

¹⁰Op. cit.

extension of improved management practices to merchants, as IWACU has done for coops. OPROVIA's could also begin to analyze trends in price data collected internally and by MINIPLAN. Findings could be extended to merchants and coops as well as being used to make decisions on emergency food acquisition.

OPROVIA's research component stuck to the objectives laid out for it at its inception. But OPROVIA's goals may need to be changed as greater understanding of the food system emerges. At the time the goals were established, little was known about producer and marketings and storage behavior.

The problems facing the entire OPROVIA organization (as opposed to its research component) are much more fundamental. OPROVIA was given an unreasonable mandate to begin with: how can the organization effectively stabilize consumer prices when over 50% of what is marketed comes from neighboring countries?

This point is illustrated by the parastatal's performance during the 1984 bean crop shortfall. DeJaegher and Ngarambe found the 1984 first season bean harvest was smaller than the first season of 1986. In comparing entire year production, they found that Rwandan bean production was not statistically different between the two years. Thus the shortfall in the total national supply of beans was slight in 1984. Yet real dry bean retail prices went 72% higher than their 17 year average in 1984 (43% above their seasonally adjusted average)-- indicating prices are affected by supplies in neighboring countries as well as by conditions in Rwanda.

What was OPROVIA's reaction to the price increase? According to their mandate, they should have released stocks in areas where prices were high in order to drive prices down. In fact, Tables 2.4 and 2.5 show that instead of drawing down its food security reserve in 1984, OPROVIA actually bought more beans in its local market operations than it sold! Further, OPROVIA made no substantial changes in its operating procedures in 1984--retail sales accounted for only 10% of total volume in beans that year. The bulk of the remaining sales were divided among the World Food Program (which feeds refugees) and the Ministry of Finance (which feeds the army and other government organizations). If OPROVIA cannot undertake market price reduction measures out of its strategic food reserve when bean prices are so much higher than normal, when can it do so? OPROVIA's parastatal status may make it difficult for it to respond quickly to a crisis.

If the Government wishes that OPROVIA continue managing a strategic food reserve, then it is important to review and streamline the procedures for utilizing the reserve. Reliance on private merchants to distribute food in crises is probably more cost effective than government buying and selling stations.

A system of using a "food reserve release price" could be established quite simply. OPROVIA could estimate what abnormally high bean and sorghum prices would be in each market town in Rwanda. OPROVIA could then offer to deliver beans at that price to merchants in the area at any time. This would mean that OPROVIA would have to maintain a stock sufficient to influence the market.

The amount of beans and sorghum that such a stock would need and the cost of rotation bears more careful study. For example, if the normal season high retail price for dry beans in Kigali is 50 FRW/kg, OPROVIA could offer to deliver dry beans to Kigali merchants at any time for 60 FRW/kg. If prices rose above 60 Frw/kg in Kigali (10 Frw/kg above the normal season high), merchants would begin to request OPROVIA beans. The increased supply would force prices back towards the 60 Frw/kg level.

The "food reserve release prices" could be reviewed annually, with a new price list being distributed in each market town once a year.

This system of "food reserve release prices" would take the burden of deciding when and where to draw on the food reserve off of the shoulders of the bureaucracy, and place it with those who are best informed on local market conditions: the merchants.

In normal years, OPROVIA would continue to rotate its food reserve stocks by purchasing from merchants and selling to the World Food Program and the Ministry of Finance. The stock would have to be large enough to supply these clients in poor years, yet small enough so that normal institutional demand would allow adequate rotation¹¹. In practice, this might mean recourse to a greater percentage of the stock in sorghum, which is more easily stored for long periods, allowing for a slower rate of rotation.

An OPROVIA-based food reserve would undoubtedly continue to require subsidies from the government and the donors. An alternative use for

¹¹Clarke found that OPROVIA can store beans at acceptable levels of hardness for 18 to 24 months.

these investments could be the development of indigenous productive and commercial capacity of and merchants households to withstand below average harvests.

D. Chapter Summary

The transitory dimension of food insecurity is much less of a problem than the chronic dimension of food insecurity in Rwanda. Perhaps the best way to improve transitory food security is to increase the productivity of the rural population; i.e. working on reducing Rwanda's chronic food insecurity problems. More productive farmers will have more alternatives both in good and bad crop years. Farm level productivity could be increased through research and extension on improved varieties, alternative crops, better methods of building and maintaining soil fertility, and exploitation of non-farm employment possibilities.

It appears that as long as farmers have purchasing power, the marketing system can respond by delivering food to meet problems of local crop failures. A problem is that lack of purchasing power can be linked to crop failure if farmers depend on cropping for income to buy food. Crop failure which is generalized across borders or crops is also problematic because food must then travel over long distances to supply local markets. The increased transport costs mean consumers must pay more for their food.

At the policy level, analysis suggests that a good transient food security strategy for Rwanda could be to develop better crop forecasting, putting emphasis on emergency food imports rather than

buffer stocks. If the government decides to maintain buffer stocks, a "food reserve release price" system could enhance their effectiveness.

The GOR could take an expanded role in forecasting price movements as indicators of food availability. Price peaks appear to be related to local rainfall in critical planting months and supply conditions in neighboring countries. Expanding the scope of crop forecasts beyond Rwanda's borders could greatly improve Rwanda's ability to predict food crises.

Legalizing food imports from neighboring countries would help the private sector respond to food crises quickly and efficiently. The GOR could also work to help its neighbors understand that international trade in food is mutually beneficial--both in terms of stability of food supply and in terms of appropriate incentives to farmers.

OPROVIA could help strengthen the private sector's ability to respond to food crises by providing management training to merchants and cooperatives.

CHAPTER VI

SUMMARY

6.1 Background on Bean and Sorghum Policy

The Government of Rwanda's activity in the bean and sorghum market is driven by good intentions. Data were not available on the bean and sorghum subsectors, so assumptions were made when existing programs were designed. One critical assumption was that Rwanda was self-sufficient in beans and sorghum. A second assumption was that merchants extract unfair profits from farmers, who are forced to sell food products at harvest for cash, and then buy them back later in the year. A third assumption was that low prices faced by farmers were retarding overall output expansion in the agricultural sector. A fourth assumption was that a government operated buffer stock was necessary and sufficient to avert price increases in bad years.

The Government of Rwanda operates a state trading agency, OPROVIA, through which it attempts to increase prices paid to farmers for beans and sorghum at harvest. OPROVIA was created to buy beans and sorghum from farmers and cooperatives at above market prices at harvest time, store, and sell to consumers at below market prices during the hungry season¹. In practice, OPROVIA normally buys mostly from merchants and sells to MINIFINECO, the World Food Program, and other institutional buyers². At various times the GOR has also tried to raise farm level prices through fixed and/or "indicative" pricing schemes. In 1986,

¹USAID/Kigali, 1981.

²Bylenga et al, 1987

the government integrated its two means of raising farm level prices. It instructed OPROVIA to buy from producers at fixed prices, and penalized merchants buying at prices below the official minimum.

6.2 Research Instruments

No extensive data on farm level bean and sorghum transactions had ever been collected in Rwanda. Under the SESA/MSU collaborative research project, a weekly bean and sorghum transactions survey was fielded with SESA's national sample. The transactions survey adopted SESA's innovative "red bucket" system to measure quantities bought, sold, and given, as well as prices paid and received.

To complement the weekly production and transactions data, several smaller surveys were also implemented with the same national sample. These included measurement of farm size, recording of family size, livestock ownership, and questions on household survival strategies. For a perspective on merchant numbers, investments, and behavior, two single visit trader surveys were fielded.

The rationale of the research design was to:

- 1) Estimate quantities marketed nation-wide
- 2) Investigate farm level price behavior
- 3) Examine market organization and performance
- 4) Typify households buying food
- 5) Identify household types selling food

The work was also designed to present relevant results to Rwandan policy makers in a timely fashion, and increase the demand for and use of policy relevant information about the agricultural sector.

6.3 Basic Results--Quantities Bought and Sold

The research raised doubts about conventional wisdom regarding beans and sorghum in Rwanda. The most surprising result arose from the following net informal import identity:

$$P - S - GG + GR - NSR = NII \quad (6.1)$$

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

Table 6.1 compares official statistics and common beliefs about beans and sorghum in Rwanda with results obtained by using estimates from the SESA/MSU national farm level transactions survey³ in equation 6.1, and calculating selected ratios. Table 6.1 indicates that the rural areas of Rwanda are importing 14% of rural dry bean availability and 20% of rural sorghum availability. These are informal imports previously unreported in official statistics.

³National rural estimates of production and marketing of dry beans and sorghum are presented in Annex II.

Table 6.1
Myths and Realities About Beans and Sorghum in Rwanda

Selected Market/Trade Indicators	Traditional Estimate	SESA/MSU Estimate
Percentage of Dry Bean Production Marketed....	30%	10%
Rural Self-sufficiency in Dry Beans.....	100%	86%
Rural Dry Bean Purchases Coming From Imports...	0%	60%
Percentage of Sorghum Production Marketed.....	35%	21%
Rural Self-sufficiency in Sorghum.....	100%	80%
Rural Sorghum Purchases Coming From Imports....	0%	50%

Prior to SESA's research on bean and sorghum marketings, it was believed that the country was 95% self-sufficient in basic foodstuffs⁴. The SESA/MSU data indicate that official food aid and reported commercial imports of basic crops are approximately equal in value to unreported rural bean and sorghum imports. Rural bean and sorghum imports are equal to roughly 5% of the value of production of the eight major Rwandan food crops.

⁴SESA's sample includes only rural households, so estimates from SESA surveys are for the rural areas only. It is reasonable to assume that urban households make more net purchases (per capita) than rural households. Total bean and sorghum imports are therefore slightly underestimated.

MINIPLAN undertook a 260 household budget and consumption survey in Rwanda in 1983 with French technical assistance. By mid-1987, with USAID assistance in data cleaning and analysis, survey results began to become available. The budget and consumption survey confirms findings from the SESA/MSU transactions survey: purchases of beans and sorghum were also significantly higher than farm-level sales in 1983.

The SESA/MSU merchant surveys and informal discussions with persons living in Rwandan border towns confirmed the flow of beans from Zaire and Uganda to Rwanda. The same informal discussions support a hypothesis that sorghum comes into Rwanda from Zaire. The indications are that a large percentage of the clandestine imports are head carried across the border near market towns in very small lots.

Examination of historical monthly urban dry bean and sorghum price patterns and historical production data provides insights into typical intra-annual price behavior and the influence imports may have on local prices. Prices in Rwanda appear to be related to local production, but the evidence is that supply and demand conditions in neighboring countries also have significant effect on prices in Rwanda. Real prices appear to have trended downward, possibly due to reduced regional transfer costs, increased use of Rwanda as a vent for surplus by Ugandan farmers during the Ugandan civil war.

Figures 6.1 and 6.2, based on historical MINIPLAN data, summarize typical urban dry bean and sorghum monthly price movements. For both products, three types of basic price patterns emerge. In normal years, prices vary seasonally around the reference period average. In high price years, seasonal price variations may be sharper, and overall

price increases are higher. Comparison of urban prices with available production data indicates that national production was normal in some high price years. It is likely that low production in supplier nations must caused the high price levels. In low price years, seasonal variations tend to be attenuated as prices remain stable at a low level. As with high price years, low price years appear to be a result of expanded production both in Rwanda and elsewhere. Dry bean prices appear to exhibit more variability than sorghum prices, but this may be an artifact of the longer price series used for beans, which incorporates the very poor 1974 agricultural year.

Figure 6.1

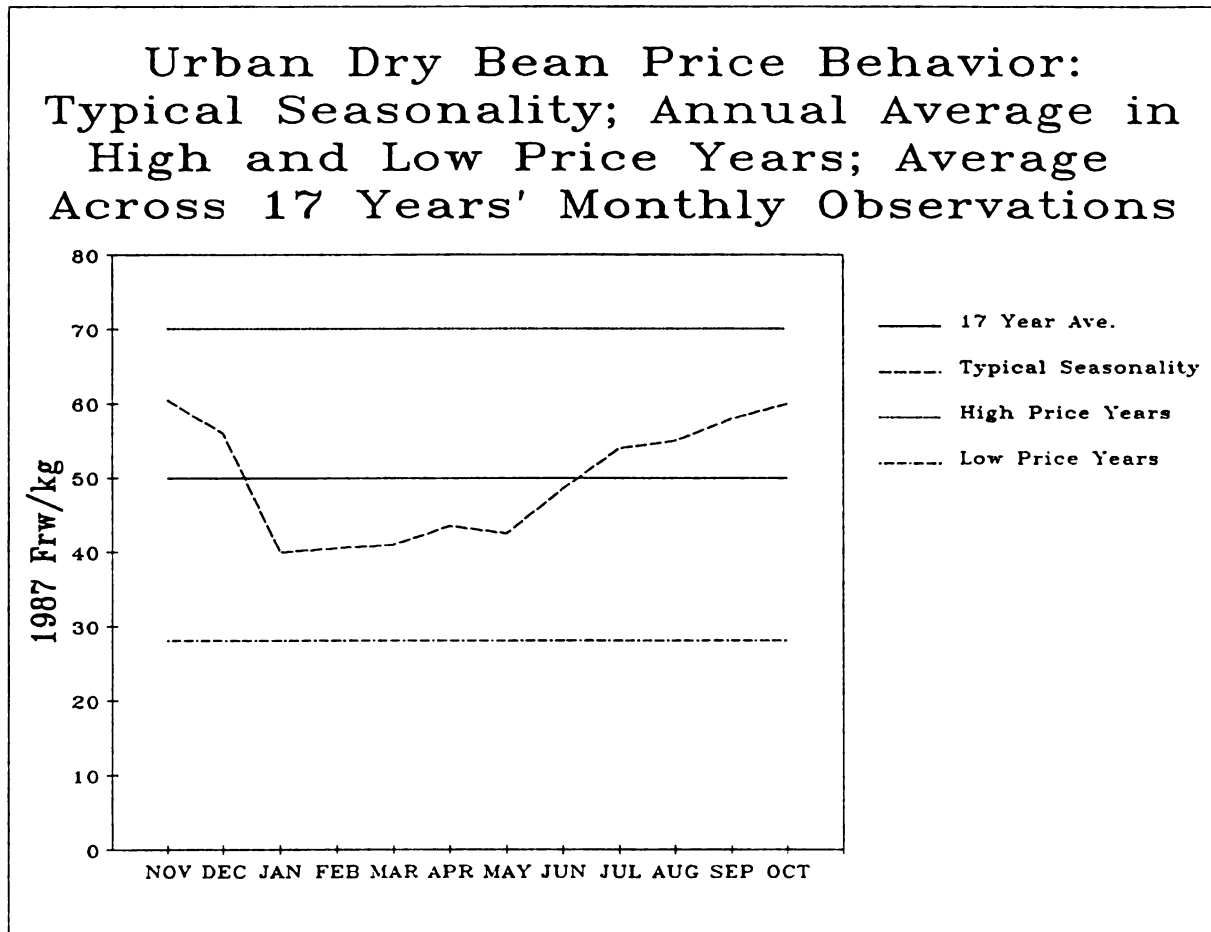
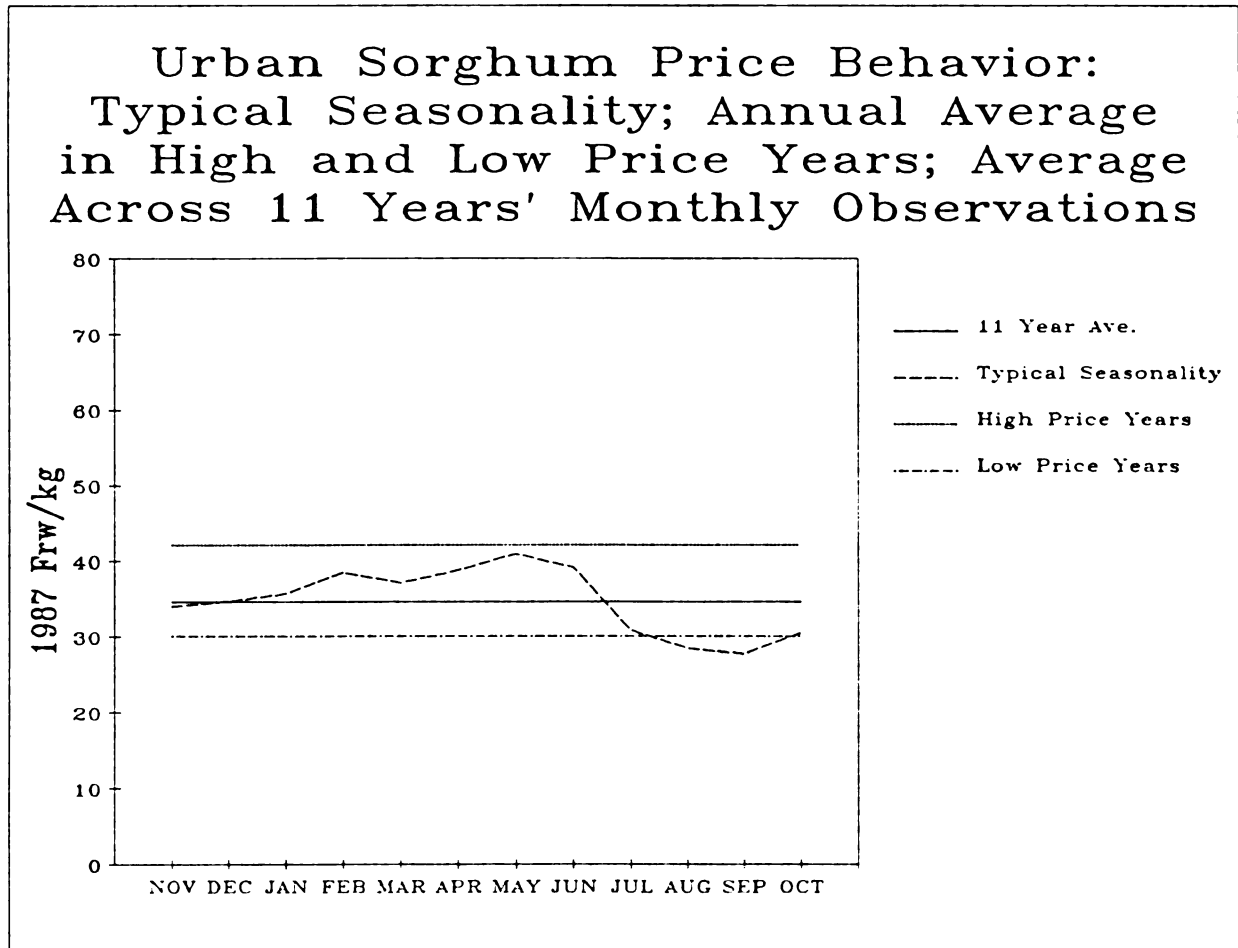


Figure 6.2



In general analysis of historical price patterns shows that prolonged periods of high prices are rare in Rwanda. Further, bean prices rarely peak at the same time or in the same year as sorghum prices. The multinational nature of supply reduces the effects of national variations in production on prices.

What are the implications of these findings for Rwanda's food policy? First, if Rwanda were successful in raising bean and sorghum prices above market levels, it would be inundated with imports from neighboring countries. A second implication is that Rwanda obtains a large measure of its food security through border trade. Understanding the nature of this trade is important in helping the government avoid unwittingly disrupting food supplies.

Closing the borders to raise bean and sorghum prices would be highly infeasible due to the permeability of the border. Border closings could also have significant negative effects on the regional economy. There is evidence that Rwanda exports beer⁵, livestock⁶, and reconditioned used clothing⁷ to Zaire and Uganda. Attempting to close the borders could increase costs for farmers selling their products due to the risks involved in conducting illegal trade. A risk premium associated with outlawing bean and sorghum imports would increase prices farmers and other Rwandan consumers pay for purchased beans and sorghum. Demand for Rwandan farmers' exports could also be reduced because of lower rural revenues in neighboring countries resulting from

⁵Haggblade with Minot.

⁶Gabriel

⁷Haggblade, 1986

lost bean and sorghum sales. In short, farmers' incomes and food security could drop significantly as a result of a closed border policy.

Given the land constraint and existing technology in production it is unlikely that higher prices alone would result in a significant increase in production of beans or sorghum. The extent production of these crops increased, it would be at the expense of alternative crops. In a SESA/MSU single visit opinion survey, over 76% of the respondents listed soil fertility problems, lack of land, or drought as the factor which limited production the most. Higher output prices by themselves are unlikely to help farmers overcome these obstacles. Higher food prices within a feasible range are not likely to help increase aggregate production without technological improvements in agricultural production. There are few technical production packages available for Rwandan agriculture, and few are likely to become available in the near future.

Setting feasibility and macro-economic issues aside, consider the incidence of increased bean and sorghum prices on Rwandan farmers. In the short run (and in the long run as well, without technical packages to improve yields), increasing bean and sorghum prices would hurt many more farm families than it would help, and it would hurt families with the greatest food security problem the most. Data from the SESA/MSU transactions survey show that just 7% of farm families⁸ (those selling more than 60 kilos) account for over 80% of the marketed surplus in

⁸For SESA, a family is a group which shares over 50% of its meals. A small percentage of marriages are polygamous. Wives live and work independently, so they are separate households. Husbands are counted in the households where they eat most often.

beans, and that 73% of rural families are net bean buyers. Thus an increase in bean prices would benefit 7% of farm families while decreasing access to food for 73% of rural households.

Net sellers tend to have larger farms than net buyers, indicating that they have more access to productive resources. Net seller households produce more total kilocalories per capita than net buyers. Families buying more than 60 kilos of beans make up almost a third of rural households, and depend on the market for 50% of the beans available to them for consumption or planting. These large net buyers would suffer the most from a bean price increase.

A similar set of relationships holds for net sorghum sellers and net sorghum buyers; a few families have the majority of net sales, and produce more kilocalories per capita than the other groups, while the majority of the households are net buyers⁹.

How do net buyers cope with their food deficit? Results of a single visit retrospective opinion survey for these families indicate the net buyers differ from net sellers in that they depend more heavily on selling their agricultural labor and on coffee and tea to supplement their income. The Rwandan coffee and tea marketing board imposes a *de facto* export tax on coffee and tea sales. When the government uses general revenue to increase bean and sorghum prices, the effect for some farmers is to take income from their coffee and tea sales and have the government use it to increase prices they pay for beans and sorghum.

⁹Loveridge et al, 1988.

The potential geographic costs and benefits of increased bean and sorghum prices would be similarly skewed, with the eastern part of the country capturing most of the gains associated with the higher prices. Kigali is the only prefecture which is a net exporter of sorghum, and thus would be the only prefecture to benefit from a price increase (although some families in every prefecture are net sellers). The western prefectures are the largest sorghum importers. None of the prefectures are net bean exporters, with the western prefectures importing a much larger percentage of total bean use than the southeast. The western prefectures would therefore be hurt most in the event of bean and sorghum price increases.

The western areas of the country produce fewer calories per capita (all crops) than the eastern and central parts of the country. Evidence from Catholic Relief Services nutritional centers indicates that people in the western part of the country are less well-nourished than in other areas¹⁰. Despite this geographical concentration of food insecurity, food aid programs are evenly distributed throughout the country.

6.4 Prices and Market Efficiency

In April 1986, OPROVIA purchased 3290 metric tons¹¹ of dry beans (equivalent to approximately 5% of total annual rural private sector purchases), at a price 75% higher than prevailing farm level market prices. In a deviation from historical patterns, OPROVIA's purchases

¹⁰McClelland et al.

¹¹Bylenga et al.

were made in small lots from farmers and coops, rather than from merchants. OPROVIA's activities were associated with increased farm level selling prices in April, but that effect was transitory. Prices slumped after the April buying campaign was over.

In July 1986, OPROVIA also bought sorghum from farmers at official prices. The prevailing farm level market sales price for sorghum was about 40% lower than the official sorghum price in the month before the buying campaign. Farm level sorghum selling prices moved down slightly between June and July. It is possible that prices would have dropped more without OPROVIA's intervention because the major sorghum harvest comes in July.

OPROVIA was able to liquidate its high priced beans because the government encouraged other official organizations (mainly the Army and the World Food Program) to purchase from OPROVIA at prices high enough to cover all OPROVIA costs. With sorghum, OPROVIA was less fortunate. As of May 1988 it was still carrying 1986 stocks. The small quantities sold up to that point were sold at a loss¹².

It should be clear by now that it would be very costly for the Rwandan government to sustain prices above market clearing levels through market interventions and administrative fiat. If the government increased its purchases at above market prices beyond 1986 levels, it could soon have to manage a large and expensive stock because OPROVIA's clients are not willing to buy at such high prices.

As mentioned earlier, an assumption underlying the attempt to set minimum prices was that merchants were not behaving competitively. But

¹²Kayumba

bean and sorghum markets appear to conform reasonably well to structure, conduct, and performance framework norms for workable competition.

Testing for market integration provides an indirect means of studying market efficiency (and therefore merchant behavior). Markets are said to be integrated if price movements in different parts of the country tend to behave similarly, reflecting costs of storage and costs of transferring product between geographic locations. Integrated markets are important in transferring price signals to producers effectively and in stimulating the movement of product from surplus to deficit zones.

Price integration tests give results that indicate moderate to well integrated markets, depending on the statistical formulation used for the test.

Analysis has shown a clear pay off in improved market integration from prior government investment in upgrading and paving major national highways. Still, high transport and transactions costs appear to be the principal barriers to better market integration in Rwanda. The government might consider improvement of secondary roads and reduction of import duties on vehicles, parts, and fuel as means of cutting transport costs. Reducing transactions costs is more difficult because they are related to the low levels of marketable surplus produced by the typical Rwandan farm enterprise. Improving farm productivity and marketed surplus in Rwanda will take time.

6.4 Prospects for Food Security in the Future

Problems of chronic food insecurity appear to need much more attention than transitory food insecurity in Rwanda. The rapid population growth currently projected for Rwanda will put tremendous pressure on the food system. Overall production is not likely to be sufficient to meet the food needs of a growing population even in the near future. Per capita food availability from local production will likely continue to decrease if current yield, land use, and population trends continue. Given existing technology, farm size is positively related to the family's ability to produce enough to sustain itself from own production. Average farm size will likely decrease substantially over the next few years. Without technological changes (which are now in view), as average farm size decreases, fewer and fewer families may be able to produce enough to feed themselves.

Small farmers already plant a much higher proportion of tubers in their crop mix than do large farms. Tubers appear to provide several advantages to the small farmer. First, there is less seasonal variability in tuber production than in crops such as beans and sorghum. Thus farmers can harvest on an "as needed" basis--they may harvest more tubers when they have less non-farm income to purchase the supplemental foods they require. Second, at least in the short run, tubers provide more calories per land unit per year than beans or sorghum. (In the long run, little crop rotation resulting from overdependence on tubers may reduce soil fertility and total caloric output.) Farmers with insufficient production appear to be maximizing caloric output rather than output which is well balanced

nutritionally. Food purchases play an important role in allowing these households obtain a more balanced diet.

A two pronged approach may help alleviate chronic food insecurity problems. First, an emphasis on increasing the productivity of land in agriculture through improved varieties and soil fertility maintenance practices. ISNAR has identified some crops currently grown in Rwanda which might be improved¹³. Improvements in high calorie yielding plants such as sweet potato and manioc would probably benefit the poor more than improvements in other crops. Means of improving output on the large farms now producing a surplus would also help Rwanda meet its food needs. Second, the encouragement of non-cropping forms of rural employment which will allow families to complement their own production with food purchases. Improvement of trade links with neighboring countries and with more developed countries will help foster local employment opportunities.

Price policies designed to stimulate production and/or reduce marketing margins based on assumptions of autarky will be ineffective. Restricting unrecorded border trade could have negative effects on the regional exchange of goods and services, with potential for reduced incomes on both sides of the borders.

6.6 Conclusions: Uses of Survey Data in Planning Future Research

A. Production - Technology Research Priorities

This research has shown that the prospects for adequate levels of domestic food production and consumption in the near term are

¹³"Agricultural Research in Rwanda: Assessment and Perspectives", ISNAR, 1983.

diminishing unless substantial transformation of the agricultural and non-agricultural sectors can be accomplished. Research to improve yields through varietal improvements, increased soil fertility, and technical change is vital to help reduce chronic food insecurity in the future.

Farmer production systems and the reasons for technology adoption are not well understood in Rwanda. Too little has been invested in agronomic research. Most agronomic research to date has been conducted on experiment stations or with purposively sampled farmers. More on farm research will help develop varieties and technologies that are acceptable to farmers. At the same time, more on farm work will have low pay off if the on station component of research is lacking.

In the past, this type of strategy has been necessary because researchers did not have adequate budgets to carry out broad based research on a national sample. Now the national SESA sample has improved understanding of basic farm characteristics. Researchers from ISAR can now take advantage of this knowledge to draw samples which are more representative of the rural population.

All agronomic research must take into account farm level constraints, profitability, and food availability. This research showed that only a few farms cite labor constraints to expanding output, but these farms appear to have the greatest capacity to generate surpluses. Increasing the output of those most capable of generating surpluses may be a good strategy to expand total output and improve opportunities for the poor to sell labor. Examination of seasonal labor markets may provide insights on how to ease the labor constraint for these few

farms. Soil fertility and lack of land appear to be the principal obstacles to increased productivity in for most Rwandan farmers. Agronomic research focused on removing these constraints will also have a high payoff. Studies which examine means of utilizing human waste may provide a partial solution to the long term soil fertility problem. Chemical fertilizers may also be feasible in the long run. Survey-based data on farmer needs can improve recommendations on how, where, and when to improve soil fertility.

Yield improvements will not be enough, however. Projections in this document indicate that considerable movement from cropping to non-cropping activities will be necessary to maintain farms at a size adequate for family self-sufficiency given current population growth. Productive non-cropping activities must be found and fostered to induce growth in the non-agricultural sector. There appears to be considerable scope for exchange of labor-intensive goods for food between Rwanda and nearby countries. This research showed that Rwandan households in rural areas appear to be shifting towards calorie intensive crops. Labor intensive export items such as livestock, alcoholic beverages, and reconditioned used clothing appear to be exchanged for basic foodstuffs that help provide a balanced diet: beans and sorghum. Investigation and promotion of labor-intensive light industries can therefore be one avenue by which Rwandan research programs and policies can improve the potential for national food self-reliance.

Farmers store many crops in the ground. Farm level bean and sorghum storage losses are minimal. Therefore, additional research on improved farm level storage techniques is probably unnecessary.

An area which deserves more attention in the future is the development of more fuel efficient cooking techniques. Reduced fuel consumption could make it possible to manage the area currently devoted to woodlots differently. Less intensive wood harvesting could mean more cropland, and the research has underscored the importance of transforming more land to crops in the medium term.

Should production research focus on commodities like beans and sorghum, or on high calorie starchy crops such as sweet potatoes? In the long run, Rwanda needs a diversified set of high yielding crops in order to help maintain soil fertility through crop rotation. In the shorter run, more calories are what Rwandan farmers will need to survive.

B. Market Research - Price Data

This research has shown the value of accurate and complete price data in formulating national policies in Rwanda. The research has shown how prices at different levels in the system can be used to identify times when food is flowing from the urban to the rural areas, indicating rural food shortages.

The research has also shown that price data can be used to evaluate the level of competitive behavior in the system.

Prices were also used to show that severe food shortages have been infrequent and of short duration in recent years--indicating that programs to alleviate chronic food insecurity may deserve higher

priority in government spending than programs to reduce transitory food insecurity. The same line of analysis showed that potential for substitution to less expensive crops appears to be possible when bean or sorghum prices are high, provided consumers have income.

Strengthening the existing price collection system in Rwanda could greatly improve understanding of market behavior in the future. The most cost effective means of reinforcing the current system would be at the level of the agencies currently collecting the best price data: MINIPLAN and the BNR. The MINIPLAN urban price series would be much more useful for future policy analysis if a standard method for price collection could be implemented in each prefecture. MINIPLAN needs more resources for its price data collection activities. The resources for strengthening MINIPLAN's price data collection activities could be used for training in price collection and analysis, a budget for price analysis and report dissemination, and a budget for supervisory activities. The MINIPLAN price collection service could feed into a variety of analyses by other ministries and into a early warning system to help avert transient food crises.

The BNR's price series would be more useful for policy analysis if it could be given the resources to increase the frequency of its rural price observations. Monthly BNR rural price estimates by prefecture would then be used by the bank for its own purposes, and forwarded to MINIPLAN and MINAGRI for incorporation into their analysis of price movements.

The SESA/MSU research showed that Rwanda is importing significant quantities of beans and sorghum from neighboring countries. It may

therefore be wise to extend efforts to improve the data collection system to areas outside of the country which supply Rwandan markets. Ideally, this would be accomplished through price and production information exchange with the foreign governments. Foreign rainfall might also be useful in predicting local price fluctuations. If international cooperation proves difficult to achieve, an informal price and rainfall check during the major growing and harvest periods could improve forecasting of food prices in Rwanda.

A more detailed study of the means by which product moves into Rwanda--from where and when, would complement the research in this document. Such knowledge would make it easier to identify foreign markets and supply areas to survey to help forecast extremely high or low prices in Rwanda. It would also help examine the feasibility of using more imports from these sources during periods of very high prices in Rwanda. Such a study could also include examination of potential for technical improvements in the marketing system. Are there means by which the relatively high transfer costs uncovered in this research could be reduced? Are there means to enhance inter-regional trade to the benefit of countries on both sides of the border?

Market research into the needs of the Rwandan consumer of the future might also help policy makers set goals and priorities for the development of the marketing system. More research work on merchant management practices may one day help OPROVIA or some other organization extend improved techniques to these entrepreneurs.

C. Priority Data and Surveys for SESA

This research has shown how the production data gathered by SESA provides a valuable foundation upon which to build other policy relevant data sets. For example, the bean transaction data, when combined with production data, allowed demonstration that large net buyers produce less food than other groups. SESA's number one priority should be to continue to collect production data regularly, and to use this base to add selected agronomic, transaction, income, and consumption data that help build policy relevant information.

A better picture of food flows in the rural household would greatly facilitate future food policy analysis. The bean and sorghum transactions data gathered in the course of this research has shown how transactions data can shed new light on the agricultural sector. Information on transactions of other commodities would help complete the picture of food flows in Rwandan households. With transactions data on all major commodities, a much better picture of total food availability per person can be developed. When total food availability is known along with household production and other characteristics, food insecure families can be identified much more precisely. Better data on farm level transactions can also be used to pinpoint seasonal food shortages, and to weight price observations collected by MINIPLAN and the BNR.

Better information on non-cropping sources of income can greatly improve understanding of how small farms are obtaining supplemental income. If policy makers have information on how farmers earn money to buy food, government policies will be less likely to disrupt these

activities inadvertently. Promotion and extension of non-cropping income could be facilitated by improved information on farmers' current income earning strategies.

Farmer standard practices for food production, acquisition, and marketing are not well understood. The research has enabled a much better picture of the bean and sorghum economy to be developed. Extension of this research to other crops would add new dimensions to understanding of farmer coping mechanisms.

Field specific information such as soil type, slope, planting densities, fertility maintenance methods, labor inputs, and yields could be a valuable source of information for agronomists and policy makers in Rwanda. On the other hand, these types of information are difficult to collect. SESA's efforts to develop streamlined methods of collecting field specific information may make a valuable contribution to decreasing the costs of such information in the future.

The move to higher input production technology will probably be essential to reduce chronic food insecurity in the future. The joint SESA/MSU/CIAT cultural practices survey showed how collaboration between economists and agronomists can help identify specific needs of different types of farms. Continuation and extension of this type of collaborative activity could help identify target areas for research on high input technical improvements.

The above highlights the need for continuing data collection on a statistically valid sample frame. The GOR has requested SESA to help it develop a method to replace the traditional way of estimating production at the commune level. While SESA needs to meet the GOR's

request for commune level data, giving up its on-going data collection activities on the 1000 household sample might be a mistake. The 1000 household sample can be used to complement production data gathered by the upgraded traditional system through special studies which go beyond estimating production.

D. Comments on Survey Data and Needs for Policy Purposes

Some of the principal recurrent issues in Rwandan policy making are soil fertility, prices, food consumption, and population. This research has shown that all these issues will need much more attention in the future. In addition, non-cropping rural income will become more important as Rwanda continues to move from a subsistence to a market economy. Projections of the average farm size in the near future indicate that linking yields to specific farm practices will be essential in formulating an agronomic research agenda.

Policy makers need information which will allow them to differentiate between normal price fluctuations and food crises. The research has shown that it is possible to make reasonable short and long run projections of food availability based on limited information. Improving the range of data sources which feed into a crop forecasting system can help policy makers better understand and prepare for extreme fluctuations in prices.

This research shows that certain areas of Rwanda are likely to be harder hit by a bean and sorghum price increase than others. This kind of information can allow better geographic targetting of emergency food aid programs. Policy makers will continue to need better information on geographic diversity in Rwanda.

Specific data needs of policy makers change quickly. It is difficult to predict which data will be relevant to policy one or two years in advance. Yet many surveys require one or two years for conception, development, fielding, data management and analysis. A good strategy is to consider not only what policies are topical at the moment, but whether they will likely remain important issues in the future. Recurrent issues are likely to be areas where national sample surveys can be most helpful in the policy debate.

E. The Potential and Limitations of Farm and Market Survey Data for Policy Purposes

Survey data can be useful in providing an accurate and comprehensive picture of the Rwanda's economy. Nationally based survey data can be used to identify groups and regions that are most at risk in terms of food insecurity. Survey data can be used to discover new dimensions of the economy; for example the quantification of previously unrecognized bean and sorghum imports in Rwanda.

Nationally based survey data can also be used to better identify research priorities for agronomists through development of indicators of regions and types of farmers with similar production constraints.

The principal disadvantages of national surveys are time and cost considerations. Care must be taken to avoid using a national sample frame to investigate questions which are of limited relevance of which need to be answered immediately.

There are also research issues which are of national and long term importance which do not merit a national survey based approach. For example, the production and marketing of rice is an important topic for

the government. Rice imports are increasing at the same time that various rice growing schemes in Rwanda are having problems motivating farmers to grow rice. This topic, while important and relevant to government policy, does not merit a full blown random sample national survey because the crop is grown in only a few selected areas of the country. Studies limited to project participants could resolve many issues at a much lower cost.

Survey results need to be extended to agronomists and agricultural engineers for incorporation into their research programs. Similarly, improved survey data cannot lead to improved policies if the research results are not presented to policy makers in a coherent fashion. Without this vital extension link, survey data will not be very useful in helping Rwanda's people improve their living conditions.

6.7 Epilogue

The preliminary results on the level of bean imports and their implications were informally circulated in various Rwandan ministries beginning in January 1987--less than two months after the SESA/MSU transactions survey was completed. Seminars presented on the basic research results in March and May of 1987 helped officials interpret the survey results and stimulated Rwandan government dialogue on price policies.

One month later the government unofficially withdrew attempts to fix bean and sorghum prices at minimum levels. The director of OPROVIA reported to USAID/Washington that results from the SESA/MSU transactions survey were instrumental in convincing the government to reconsider its position on official prices.

In April 1988, survey results on sorghum were presented in a seminar format to the government. Substantiating evidence from a budget and consumption survey was presented by Ministry of Planning analysts. A representative from OPROVIA made a presentation at the end of the day which pointed out the difficulties OPROVIA faced in trying to implement the old fixed price policy.

In April 1988, the government began implementing a system closer to its old "indicative price" policy, whereby the government would meet with merchants and field staff on a monthly basis to determine the level of market prices of basic commodities. Official government prices will vary by month and by region. This indicates that the Government of Rwanda is responsive to policy relevant information.

SESA and the Government of Rwanda are studying ways of integrating more rigorous data collection methods into the traditional system for annual crop estimations. This indicates the Government of Rwanda's appreciation for SESA's data in policy design and execution.

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USES OF FARM AND MARKET SURVEY DATA TO INFORM
FOOD SECURITY POLICY IN RWANDA

Volume II

By

Scott Loveridge

A DISSERTATION

Submitted to
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ANNEX I

SURVEY INSTRUMENTS USED IN JOINT SESA/MSU FIELD WORK

This annex contains the survey instruments developed specifically for joint SESA/MSU data collection activities. The annex is arranged in the following order:

1. Merchant I
2. Merchant II
3. Farmer I
4. Farmer II
5. Farmer III
6. Farmer IV

Coding sheets which were separate from the interview schedule, when used, are included.

Merchant I

Survey characteristics: Single visit, merchants with store front operations in 5 prefectures. The enumerator was a SESA analyst.

ENQUETE COMMERCEANT 1 1 1

I. QUESTIONNAIRE

1. Quels sont les produits vivriers que vous commercialisez?

- | | |
|------------------|-----------------------|
| 1 Haricot | 6 Manioc |
| 2 Sorgho | 7 Pois |
| 3 Pomme de terre | 8 Banane |
| 4 Arachide | 9 Patate douce |
| 5 Mais | 10 Autre (a preciser) |

2. Quels sont les produits que vous commercialisez toute l'année?
(Possibilite d'avoir le produit dans le stock chaque mois au moins.)

- | | |
|------------------|-----------------------|
| 0 Aucun | |
| 1 Haricot | 6 Manioc |
| 2 Sorgho | 7 Pois |
| 3 Pomme de terre | 8 Banane |
| 4 Arachide | 9 Patate douce |
| 5 Mais | 10 Autre (a preciser) |

3. Sur quoi est-ce que vous vous etes bases pour choisir votre (vos) produit(s)?

1. Disponibilite sur le marche
2. Nombre de clients (marche assure)
3. Facilite de stockage
4. Disponibilite de fonds de roulement
5. Autre (a specifier)

4. Y-a-t-il eu des modifications dans le choix des produits?

- 1) Non
 - 2) Oui
- Si oui, pourquoi?

2.1 Manque de clients

2.2 Augmentation de capacite de stockage

- 2.3 Augmentation de capacité financière
- 2.4 Augmentation de disponibilité des moyens de transport
- 2.5 Diminution de capacité de stockage
- 2.6 Diminution de capacité financière
- 2.7 Diminution de disponibilité des moyens de transport
- 2.8 Manque de fournisseurs
- 2.9 Marge bénéficiaire insuffisant
- 2.11 Difficultés de stockage
- 2.12 Changement des besoins de clients
- 2.13 Autre (à spécifier)

5. Y-a-t-il eu des changements dans la tenue de vos stocks?

1 Non

2 Oui

- 2.1 Commence insecticide
- 2.2 Commence à stocker dans les sacs
- 2.3 Commence triage
- 2.4 Laisse tomber insecticide
- 2.5 Laisse tomber stockage dans les sacs
- 2.6 Laisse tomber triage
- 2.7 Autre

6. Comment obtenez-vous les produits? Comment ces produits vous parviennent-ils?

1 Les fournisseurs me les amènent

- 1.1 Producteurs 1.2 Petit Assembleurs 1.3 Assembleurs
- 1.4 Camionneurs 1.5 Autre (à spécifier)

2 Je vais les chercher moi-même chez les:

- 2.1 Producteurs 2.2 Petit Assembleurs 2.3 Assem-
2.4 Camionneurs 2.5 Autre (à spécifier)
- 3 J'envoie mes ouvriers chez: 3.1 3.2 3.3 3.4 3.5
- 4 Je fais les commandes chez: 4.1 4.2 4.3 4.4 4.5 ,
- 5 Autre (à préciser)
7. Quelle est la quantité actuelle de (1 à 10) disposez-vous?
8. Dans les conditions normales de marche, en combien de temps cette quantité peut-elle être écoulée (de 1 à 10)?
S'il ne sais pas estimer: demander la quantité (en Kg) écoulée par jour.
9. Utilisez-vous des produits chimiques pour protéger vos produits en stock?
10. Quelles sont les raisons qui ont motivé le choix de ce lieu particulier de vente?
- 1 Disponibilité de magasin
- 2 Nombre de clients
- 3 Nombre de fournisseurs
- 4 J'habite le centre ou dans les environs
- 5 Autre (à spécifier)
11. Quels sont les jours de la semaine êtes-vous disponibles (trouvables) ici au centre?
- 1 Lundi 4. Jeudi 7. Dimanche
- 2 Mardi 5. Vendredi 8. Tous les jours
- 3 Mercredi 6. Samedi 9. Lundi à Samedi
12. Avez-vous votre (vos) propre(s) moyen(s) de transport?
- 1 Non (Si non, passez à la question 17)
- 2 Si oui, combien?

quel(s) type(s) et marque(s)?

13. Pourquoi avez-vous choisi ce(s) moyen(s) de transport?
 - 1 J'ai trouve en bonne occasion
 - 2 On trouve facilement les pieces de rechange
 - 3 Transporte une bonne quantite de marchandise
 - 4 Les frais de transport sont moins eleves avec cette marque
 - 5 Flexibilite
 - 6 Correspond a mes capacites financieres
 - 7 Autre (a specifier)
14. Savez-vous les frais de transport pour aller d'ici a Kinali quand votre (vos) vehicule (s) est (sont) charge? (N.B.: Pour les commercants a Kigali, il faut poser la question en utilisant "...d'ici a Kibungo...")
15. Quelle est la distance (approximative) qui vous separe du lieu d'approvisionnement le plus frequente?
16. Est-ce que votre moyen de transport est:
 1. Plus frequemment charge a l'aller seulement
 2. Plus frequemment charge au retour seulement
 3. Plus frequemment charge aller-retour
 4. Autre (a preciser)
17. Combien de membres de votre famille qui vous aident regulierement (plus qu'un jour par semaine)?
18. Combien de personnes en dehors de vos membres de famille utilisez-vous dans ce commerce?
19. Est-ce que vous avez votre (vos) propre(s) magasin(s) ici au centre?
 - 1 Non (location)
 - 2 Oui
20. Est-ce que vous avez d'autre(s) magasin(s) ailleurs?
 - 1 Non
 - 2 Oui (specifiez lieu)
21. Si plusieurs magasins ici au centre, pour quelles raisons

avez-vous choisi cet emplacement?

1 Taille du magasin

2 Circulation

3 L'endroit est bien connu pour le commerce de mes produits

4 Autre (à spécifier)

22. Quelle est la capacité totale en tonnes de votre (vos) magasin(s)?

23. Quel est l'ordre d'importance que vous accordez à chaque produit (de 1 à 10) selon l'espace réservé pour le stockage?

24. Est-ce que vous achetez seulement à certaines périodes de l'année?

1 Non 2 Oui (lesquelles?)

2.1 A la fin de chaque saison (à la récolte)

2.2 Achat progressif sur toute l'année

2.3 Achat progressif toute l'année avec grand achat avant la pénurie

2.4 Autre (à préciser)

25. Quelle est votre stratégie de vente?

1 Stockage et vente progressive

2 Achat, stockage et vente plus tard (pénurie)

3 Combinaison de 1 & 2 (stockage avant la pénurie)

4 Autre (à préciser)

26. y-a-t-il eu de changement du moment achat/vente?

27. Quel montant ajoutez-vous par kilo du produit (de 1 à 10) par mois de stockage?

28. Faites-vous des promesses à vos fournisseurs avant qu'ils vous livrent le(s) produit(s)?

1 Non 2 Oui (lesquelles?)

2.1 Commande- prix seul

2.2 Commande- quantité seule

2.3 Commande- prix et quantite

2.4 Commande- (autre a preciser)

2.5 Credit

29. Faites-vous des promesses a vos clients (acheteurs) avant qu'il viennent acheter chez vous?

1 Non 2 Oui (lesquelles?)

2.1 Commande- prix seul

2.2 Commande- quantite seule

2.3 Commande- prix et quantite

2.4 Commande- (autre a preciser)

2.5 Credit

30. Comment vous y prenez-vous pour fixer (decider) les prix d'achat et de vente?

1 Sur base des informations des fournisseurs

2 Sur base des informations des acheteurs

3 Sur base de la disponibilite du produit sur le marche

4 Sur base des informations des concurrents

5 Autre (a preciser)

31. Faites-vous l'achat en gros?

1 Plus que 5 fois par Jour

2 Entre 1 - 5 fois par Jour

3 Moins qu'une fois par Jour, mais plus qu'une (ou egale a une) fois par semaine

4 Moins qu'une fois par semaine, mais plus qu'une (ou egale a une) fois par mois

5 Cela arrive, mais moins qu'une fois par mois

6 Jamais

32. Si vous aviez achete un tonne de (1 a 10) lors de votre derniere achat combien auriez vous paye?

33. Faites-vous l'achat detail?

- 1 Plus que 5 fois par Jour
- 2 Entre 1 - 5 fois par Jour
- 3 Moins qu'une fois par Jour, mais plus qu'une (ou egale a une) fois par semaine
- 4 Moins qu'une fois par semaine, mais plus qu'une (ou egale a une) fois par mois
- 5 Cela arrive, mais moins qu'une fois par mois
- 6 Jamais

34. Si vous avez achet un kilo lors de votre derniere achat combien auriez vous paye? (1 a 10)?

35. Faites-vous la vente detail?

- 1 Plus que 5 fois par Jour
- 2 Entre 1 - 5 fois par Jour
- 3 Moins qu'une fois par Jour, mais plus qu'une (ou egale a une) fois par semaine
- 4 Moins qu'une fois par semaine, mais plus qu'une (ou egale a une) fois par mois
- 5 Cela arrive, mais moins qu'une fois par mois
- 6 Jamais

36. Quel est le prix vente au kilo de (1 a 10)?

37. Faites-vous la vente gros?

- 1 Plus que 5 fois par Jour
- 2 Entre 1 - 5 fois par Jour
- 3 Moins qu'une fois par Jour, mais plus qu'une (ou egale a une) fois par semaine
- 4 Moins qu'une fois par semaine, mais plus qu'une (ou egale a une) fois par mois
- 5 Cela arrive, mais moins qu'une fois par mois

6 Jamais

38. Quel est le prix vente tonne de (1 à 10)?

39. Quels sont les principaux problèmes que vous rencontrez dans votre métier?

1 Manque de clients

2 Manque de fonds de roulement suffisant

3 Manque de moyens de transport

4 Faible capacité de stockage

5 Taxes

6 Insectes et maladies (pertes lors du stockage)

7 Autres (à préciser)

40. Depuis quand avez-vous commencé d'exercer le métier de commerçant?

II. IDENTIFICATION

Noms.....Préfecture.....

Commune.....Centre.....Date.....

III. APPRECIATION DE L'ENQUETEUR

1. Ouverture

2. Type de balance

3. Description du magasin

3.1 Entretien

3.2 En matériaux durables

3.3 Commercialisation des produits manufacturés

Date.....

Enquete Comercant 1 Prefecture de.....

Identification: Communes.....Centre.....

Noms.....

H	S	P	A	M	M	P	B	P
A	O	O	R	A	A	O	A	A
R	R	M	A	I	N	I	N	T
I	G	E	C	S	O	S	A	A
C	H		H		C		N	T
O	O		I				E	E
T			D					

- 1 Princip.
Produits
- 2 Toute l'annee
- 3 Base sur
- 4 Modifications
- 5 Tenue
- 6 Obtention
- 7 Quantite Actuel
- 8 Temps ecoule
- 9 Chimiques

- 10 Choix Centre
- 11 Trouvable
- 12 Moyen Transp.
- 13 Choix Moyen
- 14 Frais Transp.
- 15 Distance
- 16 Vehicule Charge
- 17 Membre Famille
- 18 Ouvriers
- 19 Propre Mag.
- 20 Mag. Ailleurs
- 21 Plusiers Mag.
- 22 Capac. Total

	H A R I C O T	S O R G H O	P O M M E	A R A C H I D	M A I S	M A N I O C	P O I S	B A N A N E	P A T A T E
23 1 ^{er} Ordre									
4 Periode Achat									
25 Strategie Vente									
26 Change. Moment									
27 Ajoutez:									
28 Promesses Fourn.									
29 Promesses Achet.									
30 Fixer Prix									
31 Achat Gros									
32 Prix Achat Gros									
33 Achat Detail									
34 Prix Achat Detail									
35 Vente Detail									
36 Vente Kilo									
37 Vente Gros									
38 Vente Tonne									
39 Problemes									
40 Depuis									

Appreciation

Merchant II

Survey characteristics: Single visit, merchants with store front operations in 5 prefectures. The enumerator was a SESA analyst.

ENQUETE COMMERCEANT III. IDENTIFICATION

Date.....Préfecture.....

Commune.....Centre.....

Noms.....

II. QUESTIONNAIRE

1. D'où vient principalement le produit que vous achetez?

- 1 De la même commune
- 2 Des communes environnantes
- 3 Autre(s) préfecture(s) (à spécifier)
- 4 En dehors du RWANDA (à spécifier)

2. Si le produit ne vient pas de cette préfecture, comment vous parvient-il jusqu'ici?

- 1 Par voie directe (sans un aucun centre intermédiaire)
- 2 Les commerçants de la région productrice le déposent à KIGALI, puis d'autres commerçants l'amènent au centre ici
- 3 Les producteurs des pays voisins amènent le produit chez les commerçants assembleurs au-delà de la frontière et ces derniers vendent aux camionneurs qui nous font parvenir le produit
- 4 Combinaison de 2 et 3
- 5 Autre (à préciser)

3. Vous vendez vos produits à qui?

- 1 Consommateurs
- 2 Camionneurs
- 3 Institutions
- 4 Combinaison de 1, 2 et 3
- 5 Autre (à préciser)

4. Si pas moyen de transport et que vous allez chercher le produit ailleurs de temps en temps:

- 1 Transport par tête
- 2 Location vélo
- 3 Location moto
- 4 Location véhicule
- 5 Je ne vais nulle part
- 6 Autre (à préciser)

5. Coût de location: basé sur

- 1 Distance
- 2 Consommation
- 3 Nombre d'heures
- 4 Nombre de jours
- 5 Mois
- 6 Autre (à préciser)

6. Si je vous dis que je viens d'interviewer un commerçant qui, pour un produit comme le votre, vend à 3FRWS moins cher le kilo:

- 1 Je vais vérifier et si vrai, je diminue
- 2 Je diminue mon prix immédiatement
- 3 Je vais convaincre celui-là d'augmenter le prix
- 4 Je vais alors stocker si possible
- 5 Change rien
- 6 Autre (à préciser)

7. Même question, mais 3FRWS plus cher

- 1 Je vais vérifier et si vrai, j'augmente
- 2 Je vais augmenter mon prix immédiatement
- 3 Change rien
- 4 Autre (à préciser)

8. Comment vous occupez-vous si vous n'êtes pas au centre 2-3 jours par semaine?

- 1 Travaille sur mon exploitation
- 2 Travaille sur l'exploitation d'autrui
- 3 Cherche les produits pour mon magasin
- 4 Travaille dans un autre magasin ailleurs
- 5 Autre (à préciser)

9. Est-ce que quelqu'un de vos concurrents (collègues) ici a quitté le centre depuis 1984?

- 1 Si oui,
 - 1.1 Par manque de fonds de roulement
 - 1.2 Par manque de clients
 - 1.3 Il a trouvé une autre occupation ailleurs
 - 1.4 Par mauvaises conditions du bâtiment
 - 1.5 Il a abandonné car vieillesse (Age)
 - 1.6 Autre (à préciser)
- 2 Non

10. Volume des achats et prix:

11. Volume des ventes et prix:

12. Si vous avez un contrat achat-vente d'un produit et que le produit vient à manquer:
- 1 Révision des termes du contrat (adaptation à la situation)
 - 2 Je fais appel aux produits des pays voisins
 - 3 Je laisse tomber le produit
 - 4 Je m'adresse à un commerçant ami pour respecter le contrat
 - 5 Rupture du contrat
 - 6 Je le remplace par un autre produit
 - 7 Pas de contrat
 - 8 Autre option (à préciser)
13. Si aujourd'hui vous achetez un produit à plus cher et que le lendemain le même produit connaît une baisse du prix d'achat:
- 1 Je stocke si possible en attendant que la situation se rétablisse
 - 2 Je vend à mon prix d'achat
 - 3 Je vend au prix actuel
 - 4 J'achète encore plus pour augmenter la quantité du même produit
 - 5 J'achète encore pour que le nouveau lot fasse écouler l'ancien
 - 6 Autre (à préciser)
14. Quelle(s) condition(s) (critères) devrait remplir quelqu'un à qui vous devez octroyer un crédit?
- 1 Etre un commerçant
 - 2 Avoir un compte dans une banque
 - 3 Etre mon client (acheteur ou fournisseur)
 - 4 Etre société financée par l'état ou par les autres bienfaiteurs
 - 5 Etre en mesure de rembourser (garantie)
 - 6 Je ne donne jamais
 - 7 Autre (à préciser)
15. Vous apprenez que les produits connaissent des prix bas ailleurs alors que hauts ici:
- 1 Je m'organise pour aller m'y approvisionner (transport calculé)
 - 2 Je m'arrange pour avoir des commandes des commerçants ailleurs
 - 3 Je cherche à augmenter le prix de vente
 - 4 Change rien
 - 5 Autre (à préciser)

16. Vous remarquez que les produits connaissent des prix hauts ailleurs alors que bas ici :
- 1 Je cherche le produit pour aller ravitailler ailleurs (transport calculé)
 - 2 Je m'arrange pour donner des commandes aux commerçants d'ailleurs
 - 3 Je cherche à augmenter le prix de vente
 - 4 Change rien
 - 5 Autre (à préciser)
17. Vous remarquez que la saison normale a raté et pas de stock pour tel ou tel produit recherché :
- 1 Je vais le chercher à l'extérieur (pays voisins) ou dans d'autres préfectures si j'en ai l'autorisation
 - 2 Je vais augmenter le prix d'achat au fournisseur
 - 3 Je vend exclusivement au détail le peu que j'ai
 - 4 Autre (à préciser)
18. Vous apprenez que la saison normale a très bien réussi à l'extérieur et vous remarquez que le marché local est inondé par un produit extérieur :
- 1 Je m'organise pour écouler vite mon produit si le même.
 - 2 Je garde mon stock et achète encore ce produit extérieur et vente progressive
 - 3 Je continue à acheter le même produit pour vendre plus tard si stockable
 - 4 Voir 1 et acheter
 - 5 Autre (à préciser)
19. Vous avez un produit, il y a manque de clients, obligation stockage puis Insectes et/ou maladies :
- 1 Je jette le produit
 - 2 Je donne aux animaux
 - 3 Je donne aux nécessiteux
 - 4 Je fais un triage sévère
 - 5 J'utilise les produits chimiques
 - 6 Triage et traitement chimique
 - 7 Je vend à un prix dérisoire
 - 8 Non applicable
20. Vous remarquez qu'un même commerçant au même centre est plus connu par les clients pour un produit comme le votre :
- 1 Je diminue ma marge bénéficiaire de très peu par rapport à la sienne
 - 2 Je donne des cadeaux (sucre, sel, ...) à mes clients
 - 3 J'améliore l'efficacité de mon service
 - 4 Je fais la publicité
 - 5 Je vend à ce même commerçant à un prix relativement faible
 - 6 Je me contente des clients qui le veulent
 - 7 Non applicable

21. Est-ce que vous achetez aux prix officiels?
- 1 Si oui, et que les autres non et vous vous retrouvez avec un grand stock d'un produit:
 - 1.1 J'arrête mes achats
 - 1.2 Je diminue mes prix d'achat
 - 1.3 Pas de problème: l'OPROVIA m'assure une marge bénéficiaire satisfaisante
 - 1.4 Autre (à préciser)

PROBLEMES:

.....

- 2 Si non, pourquoi?

.....

22. Croyez-vous que l'OPROVIA influence votre (le) marché ?

- 1 Si oui, 1.1 quand?

- 1.2 comment?

.....

- 2 Si non, 2.1 pourquoi?

.....

23. Avez-vous une idée sur l'année de construction de ce magasin?

- 1 Oui: Nombre d'années (depuis)

- 2 Non

24. Etes-vous la première personne à occuper la maison?

- 1 Oui

- 2 Si non,

- 2.1 Que faisait de la maison le dernier occupant?

- 2.2 Quand est-ce qu'il a quitté?

- 2.3 Durée de chômage du bâtiment?

- 2.4 Pourquoi a-t-il quitté?

- 1 Faillite

- 2 Installation ailleurs

- 3 Autre (à préciser)

25. Quel le coût mensuel de location (loyer) de ce magasin?

- 1 M'appartient

- 2 Si pas sien: Montant.....FRWS

26. Combien coûterait une maison pareille (si sienne, frais de construction)?

- 1 Ignore

- 2 Montant.....FRWS

27. Depuis combien d'années avez-vous utilisé ce magasin (années après fin construction)?
 1 Ignore
 2 Nombre d'années.....
28. Où avez-vous trouvé les fonds pour commencer le métier de commerçant?
 1 Don des parents
 2 Propre production
 3 Salaire
 4 Crédit banque
 5 Crédit ami
 6 Autre (à préciser)
29. Est-ce que vous achetez le haricot qui vient d'un autre pays?
 1 Si oui, d'où?
 1.1 UGANDA
 1.2 ZAIRE
 1.3 TANZANIE
 1.4 Autre (à préciser)
 2 Non (passez à 34)
30. Comment reconnaissez-vous la provenance ?
 1 Couleur
 2 Calibre
 3 Couleur et Calibre
 4 Fournisseurs
 5 Autre (à préciser)
31. Le haricot étranger vient-il chaque année ?
 1 Si oui, pourquoi?.....

 2 Si non, la dernière fois que vous l'avez eu c'était quand ?

32. Le haricot extérieur arrive jusqu'ici par quelle(s) voie (s) ?
 1 Je vais à l'extérieur
 2 Les producteurs des pays voisins amènent le produit chez les assembleurs au-delà de la frontière et ces derniers vendent aux camionneurs qui nous le font parvenir
 3 Les camionneurs vont chercher le haricot à l'extérieur et nous l'amènent jusqu'ici
 4 Autre (à préciser)
33. Pouvez-vous compter sur le flux de ce haricot ?
 1 Si oui, pourquoi ?.....

-
- 2 Si non,pourquoi ?.....
- 34.Est-ce que les clients ont-ils des préférences pour le haricot LOCAL quand ils achètent pour manger ?
- 1 Si oui,pourquoi ?.....
-
- 2 Si non,pourquoi ?.....
-
- 35.Etes-vous obligé de diminuer le prix du haricot étranger ?
- 1 Si oui,pourquoi ?.....
-
- 2 Si non,pourquoi ?.....
-
- 36.Est-ce que vos clients ont-ils des préférences pour le haricot LOCAL quand ils achètent pour les semences ?
- 1 Si oui,pourquoi ?.....
-
- 2 Si non,pourquoi?.....
-
- 37.Est-ce que les prix de.....varient pendant chaque saison ?
- 1 Si oui,
- 1.1 En quel(s) mois sont-ils normalement bas ?
- 1.2 En quel(s) mois augmentent-ils ?
- 1.3 En quel(s) mois sont-ils normalement élevés ?
- 1.4 En quel(s) mois baissent-ils ?
- (Mettre 0 si ignore)
- 2 Si non,pourquoi ?.....
-
- 38.Est-ce cette tendance change-t-elle quand il s'agit d'une bonne(ou mauvaise) récolte ?
- 1 Oui
- 2 Non
- 39.Pourquoi la fluctuation des prix ?
- 1 Quantité de produit disponible
- 2 Pas moyens de prévoir les activités de l'OPROVIA
- 3 Autre (à préciser)

40. Le prix de.....sera de combien par kilo lors de la prochaine récolte ?
(Mettre 0 si ignore)
41. Le prix de.....sera de combien par kilo lors de la prochaine période des semilles ?
(Mettre 0 si ignore)
42. Comment avez-vous changé vos achats et ventes quand le prix du haricot était 90 FRWS le kilo en 1984 ?
1 Arrêt transactions
2 Achats-ventes petites quantités à plus cher
3 Non applicable
4 Autre (à préciser)
43. Pourquoi les prix étaient si élevés cette année-là ?
1 Sécheresse
2 Attaque par des pucerons
3 Sécheresse et pucerons
4 Autre (à préciser)
44. Vous arrive-t-il de stocker le haricot pendant 3-4 mois au cours d'une saison ?
1 Si oui, quelle(s) saison(s) ?.....
combien de temps ?.....
2 Si non, pourquoi ?.....
3 Non applicable
45. Vous arrive-t-il de stocker le haricot d'une saison à une autre ?
1 Si oui, combien de temps(mois) ?.....
entre quelles saisons ?.....
2 Si non, pourquoi ?.....
3 Non applicable
46. Quelles sont les informations que vous utilisez quand vous essayez de prévoir les mouvements futurs des prix ?
1 N'y songe pas
2 Climat
3 Autre (à préciser)
47. Comment vous informez-vous sur les prix dans les autres préfectures ?
1 Mes déplacements
2 Déplacements des collègues du centre
3 Camionneurs ambulants

- 4 Ne m'intéressent pas
- 5 Autre (à préciser)

48. Si les prix sont élevés ici et bas dans les autres préfectures, d'autres commerçants ou camionneurs vont-ils venir ici pour vendre le(s) produit(s) en question ?

1 Si oui, comment savent-ils que les prix sont élevés ici ?

2 Si non, pourquoi pas ?

3 Je ne sais pas

49. Comment peut-on aider les producteurs à augmenter la production ?

1 Faire respecter les prix officiels (autorités)

2 Prévision du temps

3 Autre (à préciser)

50. Croyez-vous que les commerçants peuvent aider les fermiers qui veulent augmenter leurs productions ?

1 Si oui, comment ?

2 Si non, pourquoi ?

51. Avez-vous jamais fait quelque chose pour stimuler le producteur à augmenter sa production ?

1 Si oui, quoi ?

2 Si non, pourquoi ?

52. Est-ce que la quantité que vous achetez change d'une saison à l'autre ?

1 Si oui, comment ?

2 Si non, pourquoi ?

3 Non applicable

(Mettre 0 si ignore)

53. Est-ce que la quantité que vous vendez change d'une saison à l'autre ?

1 Si oui, comment ?

2 Si non, pourquoi ?

3 Non applicable

(Mettre 0 si ignore)

54. Pensez-vous que les autres commerçants font le stockage d'une saison à une autre ?
 1 Si oui, quelles sortes de commerçants ?.....

 2 Si non, pourquoi ?.....
 3 Je ne sais pas
55. Pensez-vous que les producteurs font le stockage en attendant une augmentation éventuelle des prix ?
 1 Oui
 2 Si non, pourquoi ?.....
56. Avez-vous des problèmes de manque de fonds de roulement pendant une (quelques) saison(s) particulière(s) ?
 1 Oui
 2 Non
57. Avez-vous souvent besoin d'augmenter la quantité que vous commercialisez d'une saison à une autre ?
 1 Si oui, comment procédez-vous ?.....

 2 Si non, pourquoi ?.....

 3 Si ça dépend, de quoi ?.....

ENQUETE COMMERCEANT III. IDENTIFICATION

Date.....Préfecture.....

Commune.....Centre.....

Noms.....

II. FICHE REPONSES

	Haricot	Sorgho	Pomme de terre
1. Origine Produit			
2. Parvient			
3. A Qui			
4. Aller Chercher			

5. Coût Location.....

6. Moins Cher.....

7. Plus Cher.....

8. Occupation.....

9. Quitté.....

10. Achats et Prix

	Semaine Passée		Mois Passé	
	Quantité	Prix	Quantité	Prix
Haricot				
Sorgho				
Pomme de terre				

11.Ventes et Prix

					
	;	Semaine	Passée	;	Mois
	;			;	Passé
	;			;	
	;	Quantité	;	Prix	;
	;		;	Quantité	;
	;		;	Prix	;
.....	;		;		;
;	Haricot	;		;	
;		;		;	
;	Sorgho	;		;	
;		;		;	
;	Pomme de terre	;		;	
;		;		;	

12.Contract.....

					
	;	Haricot	;	Sorgho	;
	;		;	Pomme de terre	;
	;		;		;
13.Aujourd'hui	;		;		;
	;		;		;

14.Crédit.....

15.Prix Bas Ailleurs.....

16.Prix Hauts Ailleurs.....

					
	;	Haricot	;	Sorgho	;
	;		;	Pomme de terre	;
	;		;		;
17.Saison Ratée	;		;		;
	;		;		;

18.Marché Inondé.....

					
	;	Haricot	;	Sorgho	;
	;		;	Pomme de terre	;
	;		;		;
19.Manque Clients	;		;		;
	;		;		;

20.Plus Connue.....

.....
 ; Haricot ; Sorgho ; Pomme de terre ;
 !.....!
 21.Prix Officiels :
 !.....!

.....
PROBLEMES.....

.....
 22.OPROVIA
 1.Si oui, 1.1 Quand?.....
 1.2 Comment?.....

 2. Si non,pourquoi?.....

23.Année Construction.....

24.Première Personne.....

Dernier.....

Quand ?.....

Durée.....

Pourquoi?.....

25.Loyer.....

26.Codt Magasin.....

27.Années Utilisation.....

28.Fonds Démarrage.....

29.Haricot Etranger.....

30.Reconnaissance.....

31.Chaque Année.....

32.Voie(s).....

33.Compter Sur.....

34.Local Manger.....

35. Diminuer Prix.....

36. Local Semences.....

	
	; Haricots ; Sorgho ; Pomme de terre ;
	!.....!
37. Prix Varié	!.....!
	!.....!
	!.....!
	!.....!

.....

38. Tendance.....

39. Fluctuation.....

	
	; Haricot ; Sorgho ; Pomme de terre ;
	!.....!
40. Prochaine Récolte	!.....!
	!.....!
41. Prochaines Semailles	!.....!
	!.....!

42. Prix Kilo 1984.....

43. Pourquoi Elevé.....

.....

44. Stock 3-4 mois

1. Si oui, quelle(s) saison(s) ?.....

combien de temps ?.....

2. Si non, pourquoi ?.....

.....

45. Stock saison: TEMPS.....

	
	; UMUHINDO-ITUMBA ; ITUMBA-IKI ; IKI-UMUHINDO ;
.....	!.....!
; Haricot	!.....!
.....	!.....!

.....

46. Informations Prévoir.....

47. Informations Préfectures.....

48. Commerçants Venir

1. Si oui, comment.....

.....

2. Si non, pourquoi ?.....

.....

49. Comment Aider.....

50. Commerçants Aider.....

51. Avez-vous Stimulé.....

52. Quantité Achetée Change

	HAR.	SORG.	POMM.		HAR.	SORG.	POMM.		HAR.	SORG.	POMME
UMUH.				ITU.				IKI			
Petit											
Moyen											
Grand											

.....

53. Quantité Vendue Change

	HAR.	SORG.	POMM.		HAR.	SORG.	POMM.		HAR.	SORG.	POMM.
UMUH.				ITU.				IKI			
Petit											
Moyen											
Grand											

.....

54. Autres Commerçants Stocker

1. Sortes.....

2. Si non, pourquoi ?.....

.....

55. Producteurs Stocker

1. Oui.....

2. Si non, pourquoi ?.....

.....

56. Problèmes Fonds.....**57. Besoin Augmenter**

1. Si oui, procédés.....

.....

2. Si non, pourquoi ?.....

.....

3. Si dépendance, de quoi ?.....

.....

Farmer I

Survey characteristics: Four visits per month to over 1000 rural households divided between the 10 prefectures. The survey lasted over 14 months for beans, and 20 months for sorghum. The enumerators were SESA's 78 production survey enumerators.

INSTRUCTIONS POUR LES FICHES ACHATS DES HARICOTS ET DE SORGHO

1. Combien d'achats (cadeaux) de haricots (sorgho) avez-vous effectué (reçu) depuis la dernière visite concernant les achats?

Si zéro achats, rien à enregistrer à partir de la 2ème colonne.

ATTENTION!!! POUR CHAQUE ACHAT EFFECTUE PAR L'EXPLOITANT, IL FAUT REPETER TOUTES LES QUESTIONS SUIVANTES!!!!

2. Sous quelle forme avez-vous achete (reçu) ce haricot (sorgho)?

- | | | |
|-------------------|-----------------------|------------------|
| 1- Haricots secs | 3- Sorgho grains secs | 5- Sorgho farine |
| 2- Haricots verts | 4- Sorgho germe | 6- Autre |

3. De qui avez-vous acheté (reçu) ce haricots (sorgho)?

- | | | |
|----------------------------|---------------------|----------|
| 1- Paysan (non-commerçant) | 3- Coopérative | 5- Don |
| 2- Commerçant | 4- OPROVIA/GRENARWA | 6- Autre |

4. Quelle est la destination du haricot (sorgho) acheté (reçu)?

- | | | |
|-----------------|-----------|-----------------------------|
| 1- Consommation | 2- Ventes | 3- Consommation et semences |
| 4- Bière Sorgho | 5- Autre | |

5. Quelle distance avez-vous parcouru pour réaliser cette achat?
(en minutes)

6. Quelle unite de mesure avez-vous utilise?

- | | | |
|---------------|---------------|----------------------|
| 1- Kilogramme | 2- Petit seau | 3- Seau de l'enquete |
| 4- Assiette | 5- Ikibo | 6- Sac (100 kg) |
| 7- Panier | 8- Verre | 9- Autre à spécifier |

7. Combien de ces unités avez-vous acheté (reçu)?

8. A quel prix (total) avez-vous acheté ce haricot (sorgho)?
Spécifiez le prix total en espèces et ajoutez éventuellement un paiement en nature ou à crédit.

9. Le quantité que vous-avez acheté (reçu) est égal de combien de seaux de haricots (sorgho)?

10. Si vous-aviez acheté un seau plein de haricots (sorgho), combien d'argent auriez-vous payé pour cet achat?

INSTRUCTION POUR LES FICHES VENTES DES HARICOTS ET DE SORGHO

1. Combien de ventes (don) de haricots (sorgho) avez-vous effectuée depuis la dernière visite concernant les ventes?

Si zéro ventes, rien à enregistrer à partir de la 2ème colonne.

ATTENTION!!! POUR CHAQUE VENTE EFFECTUEE PAR L'EXPLOITANT, IL FAUT REPETER TOUTES LES QUESTIONS SUIVANTES!!!!

2. Sous quelle forme avez-vous vendu (donné) ce haricot (sorgho)?

1-Haricots secs	3-Sorgho grains secs	5-Sorgho farine	7-Autre
2-Haricots verts	4-Sorgho germe	6-Biere sorgho	

3. A qui avez-vous vendu (donné) ce haricots (sorgho)?

1- Paysan (non-commerçant)	3- Coopérative	5- Don
2- Commerçant	4- DPROVIA/GRENARWA	6- Autre

4. Quelle est l'origine du haricot (sorgho) vendu (donné)?

1- Récolte la saison passée	4- Autre paysan-acheté
2- Récolte la saison actuelle	5- Autre Paysan-don
3- Commerçant	6- Autre

5. Quelle distance avez-vous parcouru pour réaliser cette vente? (en minutes)

6. Quelle unité de mesure avez-vous utilisé?

1. Kilogramme	2. Petit Seau	3. Seau de l'enquete
4. Assiette	5. Ikibo	6. Sac (100 kg)
7. Panier	8. Verre	9. Autre à spécifier

7. Combien de ces unités avez-vous vendu (donné)?

8. A quel prix (total) avez-vous vendu ce haricot (sorgho)?
Spécifiez le prix total en espèces et ajoutez éventuellement un paiement en nature ou à crédit.

9. Pourquoi avez-vous effectuée cette vente (don)? (Motif principal)

1. Besoin M.O.	2. Paiement de l'école	3. Achat de vêtements
4. Achat de savon	5. Achat du sel	6. Achat de pétrole
7. Achat de nourriture	8. Autre à spécifier	

10. Le quantité que vous-avez vendu (donné) est égal de combien de seaux de haricots (sorgho)?

11. Si vous-aviez vendu un seau plein de haricots (sorgho), combien d'argent auriez-vous reçu pour cette vente?

IBIBAZO BYEREKEYE IGURWA LY'IBISHYIMBO N'AMASAKA

1. Kuva aho mberukiye aha nkubaza ibyerekeye igurwa ry'ibishimbo n'amasaka mwaguze cyangwa mwahawe ibishyimbo (amasaka) inshuro zingahe?

Niba ntacyo yaguze cyangwa yahawe andika zero.

Icyitonderwa: kuli buli nshuro, baza ibi bibazo bikulikira!!!!

2. Ibishyimbo (amasaka) mwaguze cyangwa mwahawe byali bimeze bite?

- | | |
|--|------------------|
| 1. Ibishyimbo byumye | 4. Amamera |
| 2. Ibishyimbo bibisi (Umutonore imiteja) | 5. Ifu y'amakoma |
| 3. Amakoma | 6. Ibindi |

3. Ibyo bishyimbo (Amasaka) mwabiguze nande?

- | | |
|----------------------------|---------------------|
| 1. Umuturage wabyiyejereje | 4. OPROVIA/GRENARWA |
| 2. Umucuruzi | 5. Ubuntu |
| 3. Amashyirahamwe | 6. Ahandi |

4. Ibyo bishyimbo (amasaka) waguze cyangwa wahawe wabigeneyiki?

- | | |
|-----------------------|-------------------|
| 1. Kulibwa | 4. Kwenga ikigage |
| 2. Kugulisha | 5. Ibindi |
| 3. Kulibwa no guhinga | |

5. Mwakoze urugendo rungana iki (iminota) kugirango mugere aho twavanyye 1/0 myaka?

6. Ese bakugereye muki cyangwa se babiguhaye muki?

- | | | |
|------------------|--------------------|---------------------------|
| 1. Umunzani (kg) | 4. Isahane | 7. Igitebo |
| 2. Akadobo | 5. Ikibo | 8. Ikirahuli |
| 3. Indobo yacu | 6. Umufuka (100kg) | 9. Ikindi (ukagisobanura) |

7. Bakugereyemo cyangwa baguhayemo inshuro zingahe?

8. Wabyishyuye iki?

Niba ari amafaranga andika umubare wayo, Niba ari ideni byandike, cyangwa se niba baraguze badakoresheje amafaranga ubisobanure.

9. Ibyo waguze (wahawe) bihwaye n'inshuro zingahe ugeze mu indobo twabahaye?

10. Iyo uramuka uguze indobo yuzuye, urabona wali gutanga amafaranga angahe?

IBIBAZO BYEREKEYE IGULISHWA LY'IBISHYIMBO N'AMASAKA

1. Kuva aho mperukiye aha nkubaza ibyerekeye igulishwa ry'ibishyimbo n'amasaka, mwagulishije cyangwa mwatanze ibishyimbo (amasaka) inshuro zingahe?

Niba ntacyagulishijwe cyangwa cyatanzwe andika zero.

ICYITONDERWA: Kuli buli inshuro, baza ibi bibazo bikulikira.

2. Ibishyimbo (amasaka) mwagulishije cyangwa mwatanze byali bimeze bite?

- | | |
|--|------------------|
| 1. Ibishyimbo byumye | 5. Ifu y'amakoma |
| 2. Ibishyimbo bibisis (umutonore, imiteja) | 6. Ikigage |
| 3. Amakoma | 7. Ibindi |
| 4. Amamera | |

3. Ibyo bishyimbo (amasaka) mwabigulishije nande?

- | | |
|-----------------------------|---------------------|
| 1. Umuturage utazabicuruzza | 4. UPROVIA/GRENARWA |
| 2. Umucuruzi | 5. Ubuntu |
| 3. Amaghyirahamwe | 6. Ahandi |

4. Ibyo bishyimbo (amasaka) mwagulishije byavuye nehe?

- | | |
|-------------------|----------------------------------|
| 1. Umwero ushize | 4. Ku baturage--abiguze |
| 2. Kuli uyu mwero | 5. Ku baturage--abiherewe ubuntu |
| 3. Ku baturuzi | 6. Ahandi |

5. Mwakoresheje urugendo rungana iki (iminota) kugirango mugere aho mwatangirye icyo myaka?

6. Wabagereye cyangwa se wabitanze muki?

- | | | |
|-------------------|---------------------|---------------------------|
| 1. Umunzani (kg) | 4. Isahane | 7. Igitebo |
| 2. Akadobo | 5. Ikibo | 8. Ikinahure igikombe |
| 3. Indobo mwahawe | 6. Umufuka (100 kg) | 9. Ikindi (ukagisobanura) |

7. Wabagereyemo cyangwa se wabahayemo inshuro zingahe?

8. Bakulishye iki?

Niba ari amafaranga andika umubare wayo, niba ari ideni byandike, cyangwa se niba barakwishyuye mudakoresheje amafaranga nabwo ubisobanure.

9. Ni izihe mpambu zatanye ugulisha cyangwa utanga icyo myaka?

- | | | |
|------------------------|--------------------|---------------------------|
| 1. Gukenereza umukozi | 4. Kugura isabune | 7. Kugura ibilibwa |
| 2. Amafaranga y'ishuri | 5. Kugura umunyu | 8. Ibindi (ukabisobanura) |
| 3. Kugura imyambaro | 6. Kugura peteroli | |

10. Ibyo wagulishije (watanze) bihwaye n'inshuro zingahe ubigeze um ndobo twabanaye?

11. Iyo uramuka ugulishije indobo yuzuye, bali kuguha amafaranga angahe?

Fiche Achats des Haricots

Identification: -- - ---- - ---- ---- ----
 Pref - Comm - Sect Mois Période

[illegible]

Fiche Achats des Haricots

Identification: -- - ---- - ---- ---- ----
 Pref - Comm - Sect Mois Période

[illegible]

[illegible]

Fiche de Ventes de Sorgho

Identifications: _____ - _____ - _____
 Pref Comm Sect Mois Periode

[illegible]

Farmer II

Survey characteristics: Single visit to 120 rural households divided among 5 prefectures. The enumerators were 5 SESA prefectural supervisors.

S.E.S.A

ENQUETE PRODUCTEUR II

IDENTIFICATION: PREFECTURE _____ COMMUNE _____

SECTEUR _____ MENAGE _____

1. Avez-vous acheté les semences pour la saison en cours?

		:	Haricot	:	Sorgho	:
Codes:	1-Oui	:		:		:
	2-Non	:		:		:

	:	:	:
Et pour l'année passée?	:	:	:
	:	:	:

2. Quelles quantités (en seaux) vous restait-il juste après les dernières semences ?

Haricot: _____ Sorgho: _____

3. Quelles quantités (en seaux) de produit avez-vous en stock maintenant? Combien aviez-vous en stock juste avant la récolte de l'umuhindo passé?

		:	Maintenant	:	Avant Récolt Umuhindo	:
Haricot	:	:		:		:
	:	:		:		:
Sorgho	:	:		:		:
	:	:		:		:

4. Savez-vous qu'il existe les semences améliorées?

1 Si oui, lesquelles 1.1-Haricot 1.2-Sorgho 1.3-Pomme

1.4-Mais 1.5-Patate

2 Non

5. Quand est-ce que vous avez commencé à essayer une nouvelle variété de semences de...? (Si jamais, on met "jam")

		:	Haricot	:	Sorgho	:	Pomme	:
5. Commencer	:	:		:		:		:
	:	:		:		:		:
6. Source	:	:		:		:		:
	:	:		:		:		:

6. Codes pour la source:

1 projets agricole 2 voisins 3 commerçants 4 s.s.s
5 cooperative 6 autre (à préciser)

7. En 1984, quand vous avez remarqué que la récolte ne s'annonçait pas très bonne, comment avez-vous réagi, vos activités du champs?

1. Rien change
2. Cultiver les tubercules
3. Autre (à préciser)

8. Suravez-vous fait en cette période pour vous approvisionner en produits vivriers?

- 1 Manger patate 2 Manger pâte 3 Manger banane & biere
- 4 Chercher aide alimentaire du Gouvernement
- 5 Chercher aide alimentaire chez voisins/parentes
- 6 Rien change
- 7 Autre (à préciser)

9. Pour la saison actuelle, pensez-vous que vous aillez avoir une bonne récolte?

	Mar	Sen	PdT
1 Si oui, qu'allez-vous en faire?	:	:	:
	:	:	:
1.1 Stockage et vendre plus tard	:	:	:
	:	:	:
1.2 Vente immédiate	:	:	:
	:	:	:
	:	:	:
1.4 Consommation progressive	:	:	:
	:	:	:
1.5 Autre (à préciser)	:	:	:
	:	:	:
2 Si non, qu'allez-vous faire?	:	:	:
	:	:	:
2.1 Diminuer la ration quotidienne	:	:	:
	:	:	:
2.2 Acheter	:	:	:
	:	:	:
2.3 Planter les tubercules	:	:	:
	:	:	:
2.4 Autre (à préciser)	:	:	:
	:	:	:

10. Dans les cas où la récolte est très faible, pensez-vous que le gouvernement va vous aider?

- 1 Oui
- 2 Non

11. Est-ce que vous avez reçu une aide alimentaire gouvernementale lors de la mauvaise saison de récolte de 1984?

1 Oui 2 Non (Si non, passez au question 13)

12. Qu'auriez-vous fait si vous n'aviez pas reçu cette aide?

1 Diminuer la ration quotidienne 2 Acheter
3 Manger les tubercules 4 Autre (préciser)

13. Y a-t-il d'autres moments que vous avez reçu une aide?

1 Si oui, quand et quelle en était l'origine?

2 Non

14. Avez-vous reçu certains produits vivriers à prix réduits?

1 Si oui, ils étaient de quelle origine?

2 Non

15. L'année dernière, pour les produits suivants, votre famille était-elle?

	Haricot	Sorgho	Mais	Banane	Manioc	Pomme
1 excédentaire	:	:	:	:	:	:
2 autosuffisante	:	:	:	:	:	:
3 déficitaire	:	:	:	:	:	:

16. Est-ce qu'il y a certains produits dont vous avez la difficulté d'écouler? (il faut beaucoup insister pour trouver la réponse)

1 Si oui, lesquelles?

1.1 Haricot 1.2 Sorgho 1.3 MANIOC

1.4 Mais 1.5 Patate 1.6 Pomme

1.7 Autre (préciser)

2 Non (Si non, passez au question 18)

17. Si oui, augmenteriez-vous leur production si vous aviez les marchés sûrs (avec prix raisonnables)?

1 Oui 2 Non

18. Est-ce qu'il y a certains produits dont vous avez la difficulté de stocker?

1 Si oui, lesquelles?

1.1 Haricot 1.2 Sorgho 1.3 Pomme de terre

2 Non (Si non, passez à la question 20)

19. A quoi ces difficultés sont-elles dues:

1 manque d'espace

2 beaucoup de pertes lors du stockage?

3 manque de fonds pour acheter les fongicides

4 autres (à préciser)

20. L'année passée, dans quels mois avez-vous vendu?

Mois	Jan	Fev	Mar	Avr	Mai	Jun	Jul	Aou	Sep	Oct	Nov	Dec	Pas
Haricot	:	:	:	:	:	:	:	:	:	:	:	:	:
Sorgho	:	:	:	:	:	:	:	:	:	:	:	:	:

21. Pourquoi avez-vous vendu ^{le} ce mois?

1 Attendre un prix plus élevé

2 Commence détérioration de la qualité

3 Inondation par produit étranger

4 Impôts ~~CO~~ ^{COTISATION}

5 Frais scolaires

6 Payer main-d'œuvre

7 Achat produits manufacturés

8 Autre (à préciser)

22. Quelle est votre source d'information en ce qui concerne les prix? (en ordre d'importance)

Ordre

ma présence au marché.....

un producteur du village.....

un producteur d'un autre village.....

un commerçant du village.....

un commerçant d'autre village.....

autre (à préciser)

23. Quel est le prix^{actuel} par kilo de: Haricot?.....

Sorgho ?..... Pomme de terre.....

Patate douce..... Mais?..... Café?.....

24. Le prix^{actuel} par kilo en Août sera à quel niveau? en Octobre? en Janvier

	Août	Octobre	Janvier
Haricot	: _____	: _____	: _____
Sorgho	: _____	: _____	: _____
Pomme	: _____	: _____	: _____
Patate	: _____	: _____	: _____

25. Dans les mois à venir, vous allez acheter ou vendre?
(produit par produit) Codes: 1=ACHAT 2=VENTE 3=PAS DE TRANSACTION

Haricot _____ Sorgho _____ Pomme _____

Patate _____ Banane _____ Mais _____

Manioc _____

26. Avez-vous entendu parler des prix officiels?

1 Oui 2 Non (Si non, passez au question 3;)

27. Quel est le prix officiel (par kilo) du haricot? _____

sorgho? _____ pomme de terre? _____ patate douce? _____

maïs? _____ café ? _____

28. Si la saison prochaine on élevait le prix officiel du (haricot, sorgho) à (haricot=40, sorgho=30) frw, est-ce que vous allez augmenter la production de ce produit?

	Haricot	Sorgho
1 Si oui, en faisant quoi?	:	:
1.1 Utilisation des semences améliorées...	: _____	: _____
	:	:
1.2 Utilisation des fertilisants.....	: _____	: _____
	:	:
1.3 Lutte phytopathologique.....	: _____	: _____
	:	:
1.4 Réserver plus d'espace à la culture...	: _____	: _____
	:	:
1.5 Lutte anti-érosive.....	: _____	: _____
	:	:
1.6 Autre (à préciser) Har.....Sor.....	: _____	: _____
	:	:
2 Non.....	: _____	: _____

29. Si on élevait le prix officiel de (haricot/sorgho), est-ce que vous allez diminuer la quantité que vous mangez de ce produit?

Haricot..... 1 Oui..... 2 Non

Sorgho..... 1 Oui..... 2 Non

30. Avez-vous stocké au moment de la récolte pour attendre que les prix officiels commencent à être appliqués?

1 Oui 2 Non

31. Avez-vous entendu parler de l'OPPROVIA?

1 Oui 2 Non (Si non, passez au question 34)

32. Avez-vous une fois vendu vos produits à l'OPPROVIA?

1 Oui (préciser les produits)

1.1 Haricot 1.2 Sorgho 1.3 Pois

2 Non

33. Avez-vous une fois acheté à l'OPPROVIA?

1 Oui (préciser les produits)

1.1 Haricot 1.2 Sorgho 1.3 Pois

1.4 Lait 1.5 Sucre 1.6 Riz

1.7 Autre (préciser)

2 Non

34. Est-ce que quand vous allez vendre votre production, vous vendez à n'importe qui ou il y a certaines personnes que vous préférez?

1 Oui 2 Non

35. Si oui, pourquoi?

1 c'est une parenté

2 c'est une personne honnête

3 il me donne un crédit

4 il vient ramasser les produits chez moi

5 il me donne des conseils techniques

6 il me promet d'acheter la production à venir à tel prix

7 il me donne la promesse de l'acheter sans fixer le prix

8 il m'offre un prix plus élevé

9 m'informe sur la situation future du marché?

10 habitude

36. Depuis quand avez-vous des relations commerciales avec cette personne? (Mettez l'année)

37. Est-ce qu'il y a des commerçants qui vous ont encouragé à augmenter la production?

1 Si oui, comment?

1.1 octroi de crédit

1.2 octroi de semences

1.3 contrat d'achat

1.4 conseils techniques

1.5 autre (à préciser)

2 Non

38. Est-ce que quand vous établissez une culture prenez-vous en considération la vente ou seulement la consommation?

	Consommation et Vente	Consommer	Seulement
Haricot	: : :_____:	: : :_____:	: : :_____:
Sorgho	: : :_____:	: : :_____:	: : :_____:
Pomme	: : :_____:	: : :_____:	: : :_____:

39. Pourquoi ces considérations? (avec même ordre des cultures)

	Har	Song	Pomme
1 sont très productives (très efficaces pour nourrir la famille)	: : :_____:	: : :_____:	: : :_____:
2 ont un prix très élevé	: : :_____:	: : :_____:	: : :_____:
3 sont très rentables	: : :_____:	: : :_____:	: : :_____:
4 on écoule la production facilement	: : :_____:	: : :_____:	: : :_____:
5 résistent à la sécheresse	: : :_____:	: : :_____:	: : :_____:
6 on exige que l'on cultive cette culture	: : :_____:	: : :_____:	: : :_____:

40. Est-ce que si les prix des denrées alimentaires sur le marché augmentaient, essaieriez-vous d'augmenter la production totale?

1 Si oui, comment?

1.1 Utilisation des semences améliorées

1.2 Utilisation des fertilisants

1.3 Lutte phytopathologique

1.4 Réserver plus d'espace à la culture

1.5 Lutte anti-érosive

1.6 Autre (à préciser)

2 Non

41. Avez-vous stocké au moment de la récolte passée pour attendre que les prix sur les marchés montent? (pour les patates douces, le manioc et les pommes de terre; demander si on a attendu un certain moment avant de les déterrer pour que les prix montent)

	Haricot	Sorgho	Pomme	Patate	Manioc
	:	:	:	:	:
1 Oui.....	:	:	:	:	:
2 Non.....	:	:	:	:	:

42. Si les prix de tous les biens et services non agricoles que vous achetez diminuaient, augmenteriez-vous la production? (en investissant en agriculture ce qu'on récupère sur les dépenses)

1 Oui 2 Non

43. Est-ce que dans les années prochaines, allez-vous essayer d'augmenter la production de certains produits par rapport aux autres?
1 Si oui, comment?

1.1 changement de la superficie totale allouée à cette culture

1.2 changement de rotation -jachère

1.3 changement de main d'oeuvre

1.4 changement de semences

1.5 autres méthodes à préciser

2 Non (Si non, passez au question 45)

44. Tout en essayant d'augmenter la production de certaines cultures, allez vous maintenir les mêmes quantités récoltées pour d'autres cultures?

1 Oui 2 Non

45. Avez-vous d'autres sources de revenus?

1- m.o chez autre paysan

4-une parenté qui aide

2-travail au projet

5-vente bière de banane

3-culture industrielle

6. autre à préciser

46. Quels sont les besoins auxquels vous consacrez le plus de dépenses?

Ordre

- impôts.....
- taxes scolaires.....
- achats des médicaments.....
- vêtements.....
- achat de nourriture.....

47. Quelle est la contrainte la plus importante qui vous handicape pour augmenter la production? (insister sur l'ordre)

Ordre

- la superficie insuffisante.....
- m.o.....
- semences.....
- engrais(terres non fertiles).....
- pesticides etc.....
- beaucoup de pluies.....
- peu de pluies.....
- prix bas des produits vivriers.....
- manque de débouchés.....
- autres (à préciser).....

Farmer III

Survey characteristics: Three successive visits to 15 rural households in Kigali prefecture. A different interview schedule was used for each visit. The enumerators were a SESA analyst and an ISAR analyst.

SESA/ISAR ENQUETE PRODUCTEUR III, PRATIQUES CULTURALES, PARTIE A

PREFECTURE: _____: _____ COMMUNE: _____: _____ DATE: _____

SECTEUR: _____: _____ MENAGE: _____: _____

- 1A. Quelles sont les cultures les plus importantes dans votre exploitation pour faire nourrir votre famille?

Ni ibihe bihingwa by'ingenzi muhinga mu milima yanyu bikunze kubaramira?

1. _____ 2. _____

3. _____ 4. _____

(Si le haricot se trouve parmi les quatre choix, va à la partie "c" pour cette culture.)

- 1B. Auriez-vous (mentionner les quatre cultures, culture par culture) en suffisance pour faire nourrir la famille si vous plantiez plus de haricots l'année prochaine par rapport à cette année?

Uramutse wongereye igihingwa cy'ibishyimbo umwaka utaha ugereraniye n'uyu, urabona wakomeza kubona bihagije kugira ngo uramire umuryango wawe?

- 1C. Culture 1: Si oui, pourquoi n'avez-vous pas planté une plus grande quantité de haricots cette année?
Niba ali byo kuki utahinze ibishyimbo byinshi uyu mwaka?

Non. _____

- Culture 2: Si oui, pourquoi n'avez-vous pas planté une plus grande quantité de haricots cette année?

Non. _____

- Culture 3: Si oui, pourquoi n'avez-vous pas planté une plus grande quantité de haricots cette année?

Non. _____

- Culture 4: Si oui, pourquoi n'avez-vous pas planté une plus grande quantité de haricots cette année?

Non. _____

2. Qu'est ce que vous faites pour éviter la diminution de la fertilité du sol? (Méthodes de mener le compost et le fumier.)
 Mukora iki kugira ngo ubutaka bwanyu mubulinde kurumba?
 (Uburyo bwo gukora ingarani cyangwa ifumbire)

3. Depuis quand cette exploitation a-t-elle été mise en valeur?
 Uyu mulima wanyu mwatangiye kuwuhinga ryari?

- | | | |
|---------------|------------|--------------|
| 1. 0-4 ans | 2. 5-9 ans | 3. 10-14 ans |
| 4. 15 et plus | 5. autre | |

4. Nombre de parcelles de haricots. _____
 Mufite imilima ingahe y'ibishyimbo?

5. D'habitude, mangez-vous le haricot chaque jour?
 Ubusanzwe murya ibishyimbo buli muni? 1. Oui 2. Non

6. A votre avis, quelles sont les raisons principales qui limitent votre rendement de haricot? (Indiquez l'ordre des réponses)

Ku bwanyu ni ibihe bintu by'ingenzi mubona bitubya umusaruro wanyu w'ibishyimbo? (mubikulikiranye uko bigiye bisumbana)

Fertilité du sol _____	Superficie insuffisante..... _____
Maladies..... _____	Manque de bonnes semences.... _____
Secheresse..... _____	Manque de tuteurs..... _____
Trop de pluie... _____	Pas de temps..... _____
Manque de M.O... _____	Attaque des insectes/ravageurs _____

7. Avez-vous les dégâts causés par les insectes dans vos champs ?

Haba hali udukoko tubonera imyaka tukayangiza?

1. Oui. Si oui, lesquels? _____
2. Non

8. D'habitude, cultivez-vous le haricot dans la meme parcelle une saison après l'autre?

Ubusanzwe, muhinga ibishyimbo ku butaka bumwe buli gihe cy'ihinga?

1. Oui 2. QQF 3. Non

Si non, ou QQF, y-a-t-il une culture particulière que vous semez après le haricot?
Niba mutabigira cg. niba mubigira limwe na limwe, hali igihingwa cyihaliye muhinga nyuma y'ibishyimbo?

1. Oui, la quelle _____ 2. Non.

9. Semez-vous le haricot avec houe courte(1) ou longue(2)? _____
Mukoresha isuka ngufi cg. ndende iyo mubiba ibishyimbo?

10. Comment mettez-vous le haricot dans la terre?
Kugira ngo bigere mu butaka se mubigenza mute?

1. Buccal 2. En poquet 3. Jetter

11. Votre méthode de semer le haricot change-t-il selon la saison?
Uburyo mukoresha mubiba bwaba buhinduka bitewe n'igihe mubibiye?

1. Oui. Si oui, comment? _____

2. Non.

12. Méthodes de traiter les déchets des haricots:

Ibishogoshogo by'ibishyimbo mubigenza mute?

1. Mettre dans la compostière 2. Matériel de chauffage

3. Fourage du bétail 4. Bruler

5. Laisser aux champs

6. Remettre aux champs et enterrer

7. Autres (à préciser) _____

13. Avez-vous constaté que les plantes meurent ou se fanent aux champs?

Mwigeze mubona ibihingwa bipfa cg. byumira mu milima?

1. Oui.

Si oui: a. A quel degré? 1. Peu 2. Moyen 3. Beaucoup

Nko kuruhe rugero?

- b. Est-ce que ce problème arrive plus souvent sur un sol fertile, infertile, ou tous les deux?

Ibyo bintu bikunze kuba cyane cyane ku mulima wera, utera, cyangwa byombi?

1. Fertile 2. Infertile 3. Les deux

- c. Ce problème arrive -t-il plus souvent quand il pleut beaucoup, pendant la période de sécheresse, ou les deux?

Ibyo se biba cyane igihe cy'invura nyinshi, cy'izuba, cyangwa igihe cyose?

1. Pleut 2. Sécheresse 3. Les deux

- d. Ce problème arrive -t-il plus souvent juste après l'émergence, à la floraison, à la formation des gousses, ou pendant toutes les périodes?

Ibyo bibazo bikunda kuvuka cyane cyane igihe cy'imigondoro, cy'ururabyo, cy'imiteja, cyangwa igihe cyose?

1. Emergence 2. Floraison 3. Gousse 4. Toutes

2. Non

14. De quoi avez-vous besoin pour intensifier votre production de haricot?

Ni ikihe kintu wunva ukeneye cyagufasha gutubura umusaruro wawe w'ibishyimbo?

- | | |
|-----------------------|-------------------|
| 1. Superficie élargie | 2. Semences |
| 3. M. O. | 4. Fumure/engrais |
| 5. _____ | |

SESA/ISAR ENQUETE PRODUCTEUR III, PRATIQUES CULTURALES, PARTIE B

PREFECTURE: _____: _____ COMMUNE: _____; _____ DATE: _____

SECTEUR: _____: _____ MENAGE: _____: _____

1. Comment pourriez-vous augmenter la récolte du haricot?

2. Est-ce qu'il y a des autres moyens?

3. Essayez-vous quelquefois de nouvelles semences de haricot que vous n'aviez jamais semées avant?

1. Oui 2. Non

Si oui, où avez-vous obtenu ces semences de haricot? _____

Codes pour semences: 1=famille 2=voisin
3=projet 4=commerçant avec magasin
5=marché en l'air 6=SSS 7=Autre

4. Existe-t-il les semences améliorées pour le haricot?
Mwigeze munva ko habaho imbuto z'indobanure z'ibishyimbo?

1. Oui Si oui, utilisez-vous ces semences
améliorées? Niba muzi ko zibaho
murazikoresha?

1. Oui Si oui, est-ce qu'ils sont plus
productive que vos mélanges locaux?

2. Non Si non, pourquoi?
Niba mutazikoresha biterwa n'iki?

2. Non

5. D'habitude, perdez-vous beaucoup, un peu, ou rien du haricot pendant le stockage?

Ubusanzwe iyo muhunitse ibishyamba byanyu, halimo byinshi byangilika, bike se, cyangwa ntabyangilika na busa?

1. Beaucoup 2. Un peu Si beaucoup ou un peu, ces pertes sont dues à quoi?
Niba ari byinshi cyangwa se ari bike, biterwa n'iki?

1. Rongeurs 2. Insectes

3. Moisissures 4. _____

3. Rien

6. Qu'est que vous mettez dans le haricot pendant le stockage?

1. Chimiques 2. Cendre
3. Kaolin 4. Pili pili
5. Feuilles des arbres
6. Fleurs ou plantes
7. Rien
8. _____

7. Stockez-vous le haricot destiné à la semence à part?

1. Oui 2. Non

8. En quoi stockez-vous le haricot?

	Consommation :	Semences
1. Panier avec fumier.....	:	
2. Panier sans fumier.....	:	
3. Grenier.....	:	
4. Pot de terre.....	:	
5. Sac.....	:	
6. Gourde.....	:	
7. Autre.....	:	

5. D'habitude, perdez-vous beaucoup, un peu, ou rien du haricot pendant le stockage?

Ubusanzwe iyo uhunitse ibishyamba byanyu, halimo byinshi byangilika, bike se, cyangwa ntabyangilika na busa?

1. Beaucoup 2. Un peu Si beaucoup ou un peu, ces pertes sont dues à quoi?
Niba ari byinshi cyangwa se ari bike, biterwa n'iki?

1. Rongeurs 2. Insectes

3. Moisissures 4. _____

3. Rien

6. Qu'est que vous mettez dans le haricot pendant le stockage?

1. Chimiques 2. Cendre
3. Kaolin 4. Pili pili
5. Feuilles des arbres
6. Fleurs ou plantes
7. Rien
8. _____

7. Stockez-vous le haricot destiné à la semence à part?

1. Oui 2. Non

8. En quoi stockez-vous le haricot?

	Consommation :	Semences
1. Panier avec fumier.....	:	:
2. Panier sans fumier.....	:	:
3. Grenier.....	:	:
4. Pot de terre.....	:	:
5. Sac.....	:	:
6. Gourde.....	:	:
7. Autre_____	:	:

9. D'habitude, récoltez-vous plus de, moins de, ou la même quantité de haricot que celle d'il y a cinq ans?
 Ubusanzwe muri iyi myaka itanu ishize, umusaruro wanyu w'ibishyimbo ukunze guhindagurika wiyongera, ugabanuka, cyangwa wakomeje kuba umwe?

1. Plus 2. Moins

Si plus de, ou moins de, pourquoi?
 Niba se wariyongereye ubu cyangwa waragabanutse, ibyo biterwa n'iki?

3. Même

10. D'habitude, plantez-vous avec plus de, moins de, ou la même quantité d'espace entre chaque plante de haricot par rapport à celle d'il y a cinq ans?
 Ku byerekeye guhinga ibishyimbo musiga umwanya hagati y'igishyimbo n'ikindi, hali ubwo uwo mwanya wakunze guhindagurika uba mwinshi, muke, cyangwa wakomeje kuba umwe?

1. Plus 2. Moins Si plus de, ou moins de, pourquoi?
 Niba se ari munini cyangwa muto ibyo biterwa n'iki?

3. Même

11. D'habitude, plantez-vous les mêmes cultures ensemble avec le haricot maintenant que vous avez planté avec le haricot il y a cinq ans?

1. Oui 2. Non Si non, expliquer quelles cultures associez-vous avec le haricot maintenant par rapport aux cinq dernières années?

-
12. Est-ce que votre façon de semer le haricot a changé pendant les derniers cinq ans?
 Muri iyi myaka itanu ishize mwaba mwaligeze muhindura uburyo bwo gutera ibishyimbo?

1. Oui Si oui, comment?
 Niba ari byo mubabigenje gute?

2. Non

13. Avez-vous changé votre façon de protéger/soigner le sol pendant les derniers cinq ans?

Mwigeze muhindura uburyo bwo kulinda ubutaka bwanyu cyangwa bwo kubufata neza muri iyi myaka itanu ishize?

1. Oui Si oui, comment?
Niba warabigerageje, wabigenje gute?

2. Non

14. Plantez-vous une plus grande, plus petite, ou même superficie de haricot par rapport à celle d'il y a cinq ans?

1. Plus grande

Comment avez-vous obtenue cette superficie elargi?

2. Même

3. Plus petite...pourquoi_____

SESA/ISAR ENQUETE PRODUCTEUR III, PRATIQUES CULTURALES, PARTIE C

PREFECTURE: _____:__ COMMUNE: _____:__ DATE: _____

SECTEUR: _____:__ MENAGE: _____:__

1. D'habitude enlevez-vous les feuilles d'ingarama de vos haricots?

1. Si oui, pourquoi? _____

- Quand? A. Avant floraison
 B. Apparition des gousses
 C. Apparition des graines
 D. Murissement des gousses

2. Non.

2. Est-ce que vous avez des problèmes avec les insectes/ravageurs dans vos champs de haricots?

1. Si oui, à quel degré?

- A. Peu
 B. Moyen
 C. Beaucoup

3. Utilisez-vous jamais une houe courte dans vos champs de haricots?

1. Si oui, pour faire quelles activités du champs et dans quelle saison?

2. Si non, pourquoi?

4. Utilisez-vous jamais une houe longue dans vos champs de haricots?

1. Si oui, pour faire quelles activités du champs et dans quelle saison?

2. Si non, pourquoi?

5. Semez-vous toujours en poquet en saison A?

1. Si oui, pourquoi?

2. Si non, pourquoi?

6. Semez-vous toujours en jettant en saison B?

1. Si oui, pourquoi?

2. Si non, pourquoi?

7. Pourriez-vous augmenter votre rendement de haricot en utilisant les semences sélectionnées?

1. Si oui, utilisez-vous ces semences?
Si non, pourquoi?

2. Non.

3. Ne sait pas.

8. Pourriez-vous augmenter votre rendement si vous multipliez le haricot destiné à la semence dans une petite parcelle fertile?

1. Si oui, faites vous cela?

2. Si Non pourquoi?

3. ne sait pas.

9. Pourriez-vous augmenter votre rendement de haricot en sélectionnant vos semences à partir des plantes avec beaucoup de gousses et peu de marques noires sur les feuilles et les gousses?

1. Si oui, pourquoi?

si oui, faites vous cela? si non pourquoi?

2. Si non, pourquoi?

10. Avez-vous utilisé les produits chimiques pour le stockage de vos haricots la saison passée?

1. Si oui, combien avez-vous dépensé pour ces produits?_____

Si oui, où les avez-vous achetés?

2. Non.

11. Nombre de seaux récoltés cette saison :

Haricots secs:_____

haricots verts:_____

SESA/ISAR: ENQUETE PRODUCTEUR III

OBSERVATION PONCTUELLE DES CHAMPS

IDENTIFICATION:

Date:

PREFECTURE: _____: _____ COMMUNE: _____: _____

SECTEUR: _____: _____ MENAGE: _____: _____

1. Nombre de parcelles de haricot.

~~Nombre de parcelles de haricot.~~ _____

2. Superficie des parcelles de haricots.

Croquis: 1. 2. 3.

1. _____

2. _____

3. _____

Croquis: 4. 5. 6.

4. _____

5. _____

6. _____

3. ~~Type~~ de semences haricot.

Parcelle no. 1

	: 1	: 2	: 3	: 4	: 5	: 6	:
Melange (1) ou	:	:	:	:	:	:	:
Pur (2)?.....	_____	_____	_____	_____	_____	_____	_____
La meme sorte ou unique?..	_____	_____	_____	_____	_____	_____	_____
Echantillon pris? (O/N)...	_____	_____	_____	_____	_____	_____	_____
Source de semences	:	:	:	:	:	:	:
cette saison?.....	_____	_____	_____	_____	_____	_____	_____

Codes pour semences: 1=lui meme 2=famille 3=voisin
 4=projet 5=commerçant avec magasin
 6=marché en l'air 7=SSS 8=_____

4. Caractéristiques des parcelles de haricots.

	Parcelle no.:					
	1	2	3	4	5	6
Culture semée	:	:	:	:	:	:
la saison passée	:	:	:	:	:	:
(n'inclut pas	:	:	:	:	:	:
la saison sèche)	:	:	:	:	:	:
Fertilité	:	:	:	:	:	:
(1=riche, 2=moyenne	:	:	:	:	:	:
3=pauvre)	:	:	:	:	:	:
Proximité du rigo	:	:	:	:	:	:
1=proche (<5 min)	:	:	:	:	:	:
2=loin (>6 min)	:	:	:	:	:	:
Propriétaire	:	:	:	:	:	:
(1=loué, 2=chef)	:	:	:	:	:	:
Quand	:	:	:	:	:	:
avez-vous fertilisé	:	:	:	:	:	:
1=cette saison	:	:	:	:	:	:
2=saison passée	:	:	:	:	:	:
3=depuis longtemps	:	:	:	:	:	:
Comment? 1=compost	:	:	:	:	:	:
2=fumier	:	:	:	:	:	:
3=mauv. herbes	:	:	:	:	:	:
4=déchet de récolt.	:	:	:	:	:	:
5=_____	:	:	:	:	:	:

4. Caractéristiques des parcelles de haricots (suite).

Parcelle no.:

	1	2	3	4	5	6
Culture	:	:	:	:	:	:
perenne?	:	:	:	:	:	:
(voir	:	:	:	:	:	:
codes)	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Cultures	:	:	:	:	:	:
semeés	:	:	:	:	:	:
cette	:	:	:	:	:	:
saison	:	:	:	:	:	:
(voir	:	:	:	:	:	:
codes)	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Densité	:	:	:	:	:	:
haricot	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Code 1ère	:	:	:	:	:	:
cult. ass.	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Densité	:	:	:	:	:	:
1ère cult.	:	:	:	:	:	:
associée	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Code 2ème	:	:	:	:	:	:
cult. ass.	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____
Densité	:	:	:	:	:	:
2ème cult.	:	:	:	:	:	:
associée	:	:	:	:	:	:
	_____	_____	_____	_____	_____	_____

*****1

CODES POUR LES CULTURES:

1=Mais 2=manioc 3=patate 4=colocase 5=haricot
 6=banane 7=sorgho 8=pt pois 9=pomme 10=jachere

11=_____ 12=_____ 13=_____

SESA/ISAR

ENQUETE PRODUCTEUR III

REGISTRE PERIODIQUE UTILISATION DE MAIN D'OEUVRE ET TRANSACTIONS

IDENTIFICATION: Dates: 1ère _____ 2ème _____ 3ème _____

PREFECTURE: _____: _____ COMMUNE: _____: _____

SECTEUR: _____: _____ MENAGE: _____: _____

1. Disponibilité de M. O. la semaine passée:

Adultes dans la famille:

Noms.	Rel.* avec* chef*	Travaille sur l'exploitation					
		<1 hr/jr	* 1-3 * hr/jr	* 3-5 * hr/jr	* >5 * hr/jr	*	*
1. _____	: *	: :	: *	: :	: *	: :	: *
2. _____	: *	: :	: *	: :	: *	: :	: *
3. _____	: *	: :	: *	: :	: *	: :	: *
4. _____	: *	: :	: *	: :	: *	: :	: *
5. _____	: *	: :	: *	: :	: *	: :	: *
6. _____	: *	: :	: *	: :	: *	: :	: *
7. _____	: *	: :	: *	: :	: *	: :	: *

Codes pour relation avec le chef: 1=épouse 2=mère 3=soeur
 4=frère 5=tante 6=oncle
 7=grandpère 8=grandmère

9= _____

10= _____

11= _____

Enfants dans la famille:

Noms.	Age	Travaille sur l'exploitation							
		E							
		c							
		o	* <1	* 1-3	* 3-5	* >5			
		l	* hr/jr	* hr/jr	* hr/jr	* hr/jr			
		e	* *	* *	* *	* *			
1. _____			* : : *	* : : *	* : : *	* : : *			
2. _____			* : : *	* : : *	* : : *	* : : *			
3. _____			* : : *	* : : *	* : : *	* : : *			
4. _____			* : : *	* : : *	* : : *	* : : *			
5. _____			* : : *	* : : *	* : : *	* : : *			
6. _____			* : : *	* : : *	* : : *	* : : *			
7. _____			* : : *	* : : *	* : : *	* : : *			

Ouvriers:

Noms.	Travaille sur l'exploitation							
	* <1	* 1-3	* 3-5	* >5				
	* hr/jr	* hr/jr	* hr/jr	* hr/jr				
1. _____	* : : *	* : : *	* : : *	* : : *				
2. _____	* : : *	* : : *	* : : *	* : : *				
3. _____	* : : *	* : : *	* : : *	* : : *				
4. _____	* : : *	* : : *	* : : *	* : : *				
5. _____	* : : *	* : : *	* : : *	* : : *				
6. _____	* : : *	* : : *	* : : *	* : : *				
7. _____	* : : *	* : : *	* : : *	* : : *				

2. Budget familial:

Quelles cultures
avez-vous vendues la
semaine passée?

Passage:

1ère 2ème 3ème

:	:	:	:	1. Haricot
:	:	:	:	2. colocase
:	:	:	:	3. banane à cuire
:	:	:	:	4. banane fruit
:	:	:	:	5. banane à bière (non-transformée)
:	:	:	:	6. banane à bière (transformée)
:	:	:	:	7. patate douce
:	:	:	:	8. pomme
:	:	:	:	9. sorgho (non-transformé)
:	:	:	:	10. sorgho (transformé)
:	:	:	:	11. légumes
:	:	:	:	12. arachides
:	:	:	:	13.
:	:	:	:	14.
:	:	:	:	15.

Quelles cultures
avez-vous achetées
la semaine passée?

Passage:

1ère 2ème 3ème

:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:
:	:	:	:

Farmer IV

Survey characteristics: A single visit to over 1000 rural households divided between the 10 prefectures. The enumerators were SESA's 10 prefectural supervisors.

18.8.86

S.E.S.A.

ENQUETE PRODUCTEUR IV

IDENTIFICATION:

No.

No.

PREFECTURE: _____: _____ COMMUNE: _____: _____

SECTEUR: _____: _____ MENAGE _____: _____

DATE: _____

UTILISATION B. C.: _____
a b c

1. Quelles quantités (en seaux) vous restait-il juste après les dernières semailles?(S'ils ne cultivent pas, mettez "cult. pas".)

Mwali musigaranye ibishyimbo (amasaka) bingana bite (indobo! murangiza gutera mw'ihinga lishize?

Haricot: _____ Sorgho: _____

2. Quelles quantités (en seaux) avez-vous en stock maintenant? Combien aviez-vous en stock juste avant la récolte de l'umuhindo passé? (Si c'est zero, mettez 0, et non un tiret!)

Ubu muhunitse (mubitse) ibishyimbo (amasaka) bigana iki? Mwali mufite ibingana iki mbere y'isarura lya k'umuhindo?

	Maintenant	:	Avant Récolte Umuhindo
Haricot	:	:	:
	:	:	:
Sorgho	:	:	:
	:	:	:

3. En 1984, quand vous avez remarqué que la récolte ne s'annonçait pas très bonne, comment avez-vous réagi dans vos activités du champs?

Muli 1984, igihe mwabonaga ko umusaruro utazaba mwiza mwifashe mute mubyerekeye ubuhinzi bwanyu?

(Une réponse--voir codes) _____

1. Rien changé
2. Cultiver les tubercules
3. Question non-applicable--nouveau ménage
4. Autre(préciser au-dessous)

4. Qu'avez-vous fait en 1984 pour vous approvisionner en produits vivriers?

Muri: Iki kugirango mubone ibibatunze?

1. Manger une plus grande quantité de tubercules
2. Manger banane à bière
3. Chercher aide alimentaire auprès du Gouvernement
4. Chercher aide alimentaire chez voisins/parentés
7. Acheter et/ou travailler hors exploitation
8. Question non applicable--nouveau ménage
9. Autre (à préciser) _____

5. Est-ce que vous avez reçu une aide alimentaire gouvernementale lors de la mauvaise saison de récolte de 1984?

Muli 1984, mwigeze mubona imfashanyo y'ibilibwa ya Leta?

1 Oui 2 Non

6. L'année dernière, pour les produits suivants, votre famille était-elle?

Umwaka mushize, umusaruro w'.....wanganaga iki? (1=Utubutse, 2=Ugagije, 3=Udahagiye)

	Haricot	Sorgho	Mais	Banane	Manioc	Pomme	Patate
1. Excédentaire	:	:	:	:	:	:	:
2. Autosuffisante	:	:	:	:	:	:	:
3. Déficitaire	:	:	:	:	:	:	:
4. Ne cultive pas	:	:	:	:	:	:	:

7. Dans les six mois à venir, allez-vous acheter ou vendre?
(produit par produit)

Mumezi atandatu ali mbere, murumva muzahaha cg muzagulisha?

Codes: 1=Acheter 2=Vendre 3=Pas de transactions.

Haricot_____ Sorgho_____ Pomme_____

Patate_____ Banane_____ Mais_____

Manioc_____

8. Quand vous établissez vos cultures, prenez-vous le prix du marché en considération?

Iyo mwitegura gutera(kubiba) imyaka iyi n'iyi. mubikora munibana ibiciro by'iyi myaka ku masoko?

1. Oui 2. Non (si non, passez à la question 10).

9. Quand vous prenez le prix du marché en considération, est-ce que vous réfléchissez sur le prix actuel ou sur le prix à l'avenir?

Iyo muzilikanye ibyo biciro, muba mutekereza ibiciro biliho ubu cg ibiciro bizaza?

1. Prix actuel 2. Prix à l'avenir

10. Avez-vous stocké au moment de la récolte passée pour attendre que les prix sur les marchés montent? (pour les patates douces, le manioc et les pommes de terre, demander si on a attendu un certain moment avant de les déterrer pour que les prix montent).

Mwigaze muhunka ku mvero ushize mutegereje ko ibiciro by'imyaka bizamuka? (Kubyerekeye ibijumba, imyumbati n'ibirayi baza niba barorohere - bararetse kubikura)

	Haricot	Sorgho	Pomme	Patate	Manioc
1.	:	:	:	:	:
2.	:	:	:	:	:

11. Si les prix des denrées alimentaires sur le marché augmentaient, essaieriez-vous d'augmenter la production totale? (Voir codes)

Mumva ibiciro by'inyaka byiyongereye mwagerageza kwongera umusaruro wanyu?

Si oui, quel est le moyen le plus important que vous allez utiliser? _____

- 1.1 Utilisation des semences améliorées
- 1.2 Utilisation des fertilisants
- 1.3 Lutte phytopathologique
- 1.4 Planter/semer une superficie totale élargie
- 1.5 Lutte anti-érosive
- 1.6 Autre (à préciser au-dessous)

2. Non

12. Dans les années prochaines, allez-vous essayer d'augmenter la production de certains produits par rapport aux autres?

Mumva mumyaka itaha muzagerageza kwongera umusaruro w'ibibingwa bimwe na bimwe kurusha ibindi?

1. Oui 2. Non (si non, passez à la question 15)

13. Quel est le moyen le plus important que vous allez utiliser pour augmenter la production de certains produits par rapport aux autres? (Une réponse! Voir codes.) _____

Ni ubuhe bulwo nutekoreza kuzakoresha cyane cyane kugirango muzamure uwo musaruro?

- 1. Changement de la superficie allouée à cette culture
- 2. Changement de rotation/jachère
- 3. Changement de main-d'œuvre
- 4. Changement de semences
- 5. Fumure
- 6. Lutte anti-érosive
- 7. Autre méthodes(à préciser)

14. Tout en essayant d'augmenter la production de certaines cultures, allez-vous maintenir les mêmes quantités récoltées pour d'autres cultures?

Nimuramuka mwongereye umusaruro wabiliya bihingwa mwatubwiye, murumva murakomeza kubona umusaruro mwabonaga kubindi bihingwa?

1. Oui 2. Non

15. Dans les années dernières, avez-vous essayé d'augmenter la production de certains produits par rapport à d'autres?

Ku myaka ishize, hali ibihingwa bimwe na bimwe mwaba mwaragerageje kwongerere umusaruro kurusha ibindi?

1. Oui 2. Non (si non, passez à la question 17.)

16. Quel est le moyen le plus important que vous avez utilisé pour augmenter la production de certains produits par rapport aux autres? (Une réponse--voir liste des codes) _____

Ni ubuhe bulye waba warakoresheje cyane cyane kugirango umusaruro w'ibyo bihingwa wihitiyemo?

1. Changement de la superficie allouée à cette culture
2. Changement de rotation/jachère
3. Changement de main-d'œuvre
4. Changement de semences
5. Fumure
6. Lutte anti-érosive
7. Autre méthodes (à préciser au-dessous)

17. Est-ce qu'il y a quelqu'un qui vous donne des conseils en matière d'agriculture?
 N.B.: Il faut bien préciser que vous posez la question sur les agents de vulgarisation et non sur les enquêteurs!
 Haba hali umuntu (abantu) ukugira (bakugira) inama mu byerekeye ubuhinzi?

Si oui, quelle est la personne qui vous conseille le plus fréquemment? _____

- 1.1 Moniteur agricole 1.2 Chef de cellule
 1.3 Conseiller de secteur 1.4 Autre (à préciser)

2 Non (si non, passez à la question 21)

18. Si oui, quelle est la fréquence de contact? _____

Niba uwo muntu ahali, mubonana kangahe?

- 1 Une fois par jour 2 Deux à six fois par semaine
 3 Une fois par semaine 4 Deux ou trois fois par mois
 5 Une fois par mois 6 Une fois dans deux mois
 7 Une fois dans 3 mois 8 Une fois dans 4 mois
 9 Moins qu'une fois dans quatre mois, mais plus qu'une fois par an
 10 Moins qu'une fois par an 11 Autre (à préciser au-dessous)

19. Vos contacts avec cette personne ont lieu sur votre exploitation ou ailleurs?

Uwo muntu muhulira mungo/imilima yanyu cy ahandi?

1. Sur mon exploitation 2. Ailleurs

20. Cette personne vous conseille sur quoi? (Plusieurs réponses sont possibles)

Uwo muntu akugira inama kubyerekeye iki?

1. Lutte anti-érosive 2. Lutte phytopathologique
 3. Hygiène/santé 4. Rotation/jachère
 5. Méthodes de stockage 6. Fumure
 7. Prix du marché/ stratégies de vente
 8. Sélection de variétés de semences
 9. Elevage 10. Autres (à préciser) _____

21. Pendant quel(s) mois avez-vous la plus grande difficulté de finances? (encerclez un maximum de six mois)

Ni muryahe mesi kurusha ayandi mugira ingorane zikabije
cyane kubona amafaranga?

Jan Feb Mar Avr Mai Jun Jul Aou Sep Oct Nov Dec Fas

Ces difficultés sont dues à quel besoin?

(Une réponse--voir codes): _____

Ibyo muba mukeneye cyane cyane ninkibihe muri byo muri?

- | | |
|---|----------------------|
| 1. Besoin d'acheter nourriture | 2. Impôts/cotisation |
| 3. Besoin de payer main d'oeuvre | 4. Frais scolaires |
| 5. Peu de revenu ce(s) mois par rapport aux autres mois | |
| 6. Autre (à préciser) | |

22. Quelle est votre source de revenu la plus importante? _____
(Voir liste des codes en-dessous.)

Ahanini cyane niho mukunze gukomora agafaranga? .

Et la seconde en importance? _____

(Voir liste des codes en-dessous.)

- | | |
|----------------------------------|-----------------------------------|
| 1. M.O. chez un autre exploitant | 7. Salaire |
| 2. Travail au projet | 8. Vente de produits vivriers |
| 3. Culture industrielle | 9. Vente élevage |
| 4. Une parenté qui aide | 11. Travail artisanal |
| 5. Vente bière de banane/sorgho | 12. Commerce |
| 6. Location champs | 13. Autre (à préciser au-dessous) |

23. Quel est le besoin auquel vous consacrez le plus de dépenses? (voir liste des codes en-dessous)_____

Ni ikihe kintu cyane cyane gikunze kugutwara amafaranga?

Et le second en importance?(voir liste des codes)_____

- | | |
|---------------------------|-----------------------------------|
| 1. Impôts | 2. Frais scolaires |
| 3. Achats des médicaments | 4. Vêtements |
| 5. Achat nourriture | 6. Achat pétrole |
| 7. Achat bière | 8. Achat savon |
| 9. Main-d'oeuvre | 10. Achat articles de cuisine |
| 11. Location champs | 12. Achat semences |
| 13. Achat outillage | 14. Autre (à préciser au-dessous) |

24. Quelle est la contrainte la plus importante qui vous handicape pour augmenter la production? (voir liste des codes en-dessous)_____

Ni ikihe kintu cyane cyane cyikubangamira mukuzamura umusaruro mu buhinzi bwawe?

Et la seconde en importance?(voir codes)_____

- | | |
|----------------------------|------------------------------------|
| 1. Superficie insuffisante | 2. Main-d'oeuvre |
| 3. Semences | 4. Engrais ou terres non-fertiles |
| 5. Manque de pesticides | 6. Beaucoup de pluies |
| 7. Peu de pluies | 8. Prix bas des produits vivriers |
| 9. Manque de débouchés | 10. Autres (à préciser au-dessous) |

Annex II:
Monthly Dry Bean and Sorghum Grain Production, Purchases, and Sales
by Prefecture; Number of Months Families Harvest;
Indications of the Time Between Harvest and Sale;
Regressions on Determinants of Production and Net Transactions

Table A2.1
1986 Agricultural Year Monthly Dry Bean Production by Prefecture
(Metric Tons)

Préfecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Butare	25	5245	17403	2789	90	19	1110	4309	255	16	18	164	31443
Byumba		1614	10803	4840	31		118	5906	3523	1112	107	54	28109
Cyangugu	25	749	3491	929	272		97	1598	1185	568	5	41	8959
Gikongoro	126	1345	5733	508	189	329	200	412	271	61			9176
Gisenyi	68	444	8099	2568	427	88	77	2270	3552	470	171	8	18241
Gitarama	256	5243	12088	1204	34	653	3094	4192	814	251	271	1144	29246
Kibungo		1059	7067	6592	1736	606	229	3647	3039	833		49	24858
Kibuye	21	1430	4263	1290	518	39	178	199	1018	1117	329	41	10443
Kigali	1429	2569	22514	7349	508	233	935	6665	2753	124	71	719	45870
Ruhengeri		2795	5313	896	164	60	10	52	4103	4445	492	38	18368
Rwanda	1951	22494	96774	28966	3970	2027	6048	29250	20514	8996	1464	2257	224712

Table A2.2
1986 Agricultural Year Monthly Sorghum Production by Préfecture
(Metric Tons)

Préfecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Butare							181	3235	21351	2014	34		26816
Byumba			1419	3701	322		43	1689	9613	10619	1527	103	29036
Cyangugu			10	275	280	29			137	353			1083
Gikongoro								344	3342	3065	116	87	6954
Gisenyi			41	1074	167	304		67	13	13			1680
Gitarama			199	636	319	69		1048	12359	3551	851		19032
Kibungo		168	330	266	277	62		441	6047	8494	623		16708
Kibuye								743	2694	1125	108		4670
Kigali			83	293	277	8	32	3047	29719	7421	578		41458
Ruhengeri			619	3508	2706	284	136	63	2951	946	215		11426
Rwanda		168	2701	9752	4348	757	392	10677	88226	37601	4051	190	158863

Table A2.3
Quantity of Sorghum Grain (Metric Tons) Bought by Rural Rwandans
1986 Agricultural Year

	85					86					Total		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Butare	444	509	633	689	611	633	381	322	637	237	365	228	5690
Byumba	470	379	535	640	593	687	517	533	711	539	247	946	6798
Cyangugu	256	258	237	195	166	126	202	128	237	232	141	222	2401
Gikongoro	1169	1593	1465	2282	1656	1579	1510	1468	1622	2511	1121	1225	19201
Gisenyi	412	499	233	183	230	198	144	271	410	433	428	211	3652
Gitarama	317	533	502	595	459	398	451	249	349	354	380	259	4846
Kibungo	866	672	479	366	399	301	457	604	892	634	388	304	6361
Kibuye	1533	574	494	569	363	503	475	566	650	626	1026	912	8291
Kigali	100	235	295	293	227	306	226	108	1481	505	166	321	4264
Ruhengeri	235	531	405	511	448	381	242	372	351	239	278	334	4328
Rwanda	5802	5783	5280	6323	5152	5113	4603	4623	7342	6310	4540	4961	65832

Note: quantities bought for resale not included, unless they were to be sold in the form of sorghum beer. Germinated sorghum and sorghum flour not included.

Table A2.4
Quantity of Sorghum Grain (Metric Tons) Bought by Rural Rwandans
1st Season 1987

	1986				1987			
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Butare	548	429	574	1155	754	985	1290	787
Byumba	284	558	295	559	1027	907	461	722
Cyangugu	141	179	118	145	169	157	153	185
Gikongoro	1061	1291	809	1054	1334	1655	1131	1224
Gisenyi	261	205	148	373	358	243	174	287
Gitarama	312	329	522	578	715	552	502	529
Kibungo	370	362	510	358	555	536	649	452
Kibuye	627	430	614	517	469	580	542	364
Kigali	145	154	227	462	561	208	496	166
Ruhengeri	262	274	440	535	306	348	372	437
Rwanda	4012	4210	4256	5737	6248	6171	5771	5152

Note: quantities bought for resale not included, unless they were to be sold in the form of sorghum beer. Germinated sorghum and sorghum flour not included.

Table A2.5
Quantity of Sorghum Grain (Metric Tons) Sold by Rural Rwandans
1986 Agricultural Year

	85					86					Total		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Butare	104	97	172	7	21	2	20	65	662	874	382	247	2654
Byumba	322	222	590	1212	1668	73	212	213	352	279	395	332	5869
Cyangugu	27	2	3		90				28	32			182
Gikongoro			34	2					39	143	7	2	226
Gisenyi				216	38	41	3	7	23		3		332
Gitarama	117	71	88	50	38	60	39	54	562	682	352	71	2185
Kibungo	494	448	509	364	293	242	205	232	321	1091	535	1825	6560
Kibuye	8								33	103	4	2	150
Kigali	485	1859	201	199	59	55	237	582	2034	4125	2542	1190	13568
Ruhengeri	12		3	171	277	164	178	21	144	155	188	45	1359
Rwanda	1570	2698	1600	2221	2485	638	894	1174	4200	7484	4407	3713	33084

Note: quantities not produced on the farm not included.

Table A2.6
Quantity of Sorghum Grain (Metric Tons) Sold by Rural Rwandans
1st Season 1987

	Nov	1986		Jan	Feb	1987		May	Jun
		Dec				Mar	Apr		
Butare	94	159	144	15	62				16
Byumba	93	156	311	1299	1890	187	191	353	
Cyangugu					17	20		10	
Gikongoro	2		13						
Gisenyi				217	13	8	35		
Gitarama	50	135	26	68	63	45	69	48	
Kibungo	431	581	79	307	104	190	170	33	
Kibuye	13								
Kigali	359	317	99	79	138	58	164	125	
Ruhengeri			52	520	294	462	130	166	
Rwanda	1043	1349	724	2505	2581	970	759	750	

Note: quantities not produced on the farm not included.

Table A2.7
Quantity of Dry Beans (Metric Tons) Sold by Rural Rwandans
1986 Agricultural Year

	85					86					Total		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Butare	59	146	911	563	609	153	31	51	52	38	111	168	2894
Byumba	91	43	438	821	500	152	100	515	967	255	1301	129	5311
Cyangugu	54	11	57	22	27	74	12	102		3	135		496
Gikongoro		15	84	175	110	15		12	4		10	27	453
Gisenyi	15	26	122	108	46	173	40	6	104	38	126	231	1037
Gitarama	81	168	447	373	134	33	187	457	218	234	68	141	2542
Kibungo	85	34	357	252	203	710	738	560	123	158	89	200	3508
Kibuye		6	37	89	80	46	3	21	30	19	32	19	381
Kigali	363	680	780	1488	764	360	194	157	244	145	56	584	5816
Ruhengeri	23	27	181	166	82	45	20		4	40			587
Rwanda	773	1156	3414	4058	2553	1761	1326	1881	1747	929	1927	1500	23026

Note: quantities not produced on the farm not included.

Table A2.8
Quantity of Dry Beans (Metric Tons) Sold by Rural Rwandans
November and December 1986

	Nov	Dec
Butare	70	12
Byumba	49	46
Cyangugu		
Gikongoro		3
Gisenyi	58	64
Gitarama	125	23
Kibungo	250	75
Kibuye	4	
Kigali	531	547
Ruhengeri		4
Rwanda	1087	774

Note: quantities not produced on the farm not included.

Table A2.9
Quantity of Dry Beans (Metric Tons) Bought by Rural Rwandans
1986 Agricultural Year

	85					86					Total		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Butare	512	83	222	472	378	366	298	470	780	700	785	1215	6280
Byumba	1104	454	192	631	1390	1213	1193	960	571	888	1051	1544	11189
Cyangugu	315	122	100	123	198	471	160	94	287	214	535	326	2946
Gikongoro	201	174	48	137	189	199	310	605	339	717	600	552	4072
Gisenyi	1383	790	334	373	292	547	530	516	644	585	1168	894	8057
Gitarama	571	116	124	265	389	294	309	532	741	524	424	667	4954
Kibungo	489	210	311	329	361	134	195	44	250	255	245	640	3463
Kibuye	333	128	24	224	172	305	147	356	242	185	336	395	2844
Kigali	800	242	76	356	472	354	525	668	780	913	865	1180	7231
Ruhengeri	1025	400	87	613	1028	935	1454	980	557	519	961	892	9450
Rwanda	6733	2718	1518	3524	4868	4819	5120	5224	5191	5499	6968	8305	60486

Note: quantities bought for resale not included.

Table A2.10
Quantity of Dry Beans (Metric Tons) Bought by Rural Rwandans
November and December 1986

	1986	
	Nov	Dec
Butare	583	449
Byumba	1468	728
Cyangugu	271	193
Gikongoro	377	372
Gisenyi	860	794
Gitarama	680	366
Kibungo	764	572
Kibuye	296	136
Kigali	761	974
Ruhengeri	994	698
Rwanda	7054	5282

Note: quantities bought for resale not included.

Table A2.11
Average Prices Paid by Farmers Buying Dry Beans
1986 Agricultural Year

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Year
Butare	46	28	25	28	28	30	30	28	28	32	34	32	31
Byumba	44	41	22	25	24	24	23	24	27	29	29	28	28
Cyangugu	46	39	27	26	28	31	30	34	32	39	41	40	36
Gikongoro	48	45	24	26	28	25	26	26	30	32	32	32	31
Gisenyi	47	36	28	24	23	29	27	26	27	29	27	29	32
Gitarama	43	34	22	28	27	24	23	29	29	32	32	33	31
Kibungo	45	28	15	22	22	20	19	17	15	22	23	23	24
Kibuye	42	45	29	24	30	27	28	29	32	34	33	33	32
Kigali	43	37	27	23	26	24	25	27	26	28	29	29	29
Ruhengeri	42	43	28	28	28	28	24	26	28	29	29	29	30
Rwanda	44	38	23	25	26	27	25	27	28	30	31	30	30

Note: Reported averages are quantity and population weighted averages of cash sales. Year and Rwanda averages may not equal the simple mean of their respective rows and columns.

Table A2.12
Average Prices Paid
by Farmers Buying Dry Beans
Nov. and Dec. 1986

Prefecture	Nov	Dec
Butare	32	31
Byumba	28	29
Cyangugu	35	36
Gikongoro	31	30
Gisenyi	30	30
Gitarama	32	32
Kibungo	22	25
Kibuye	30	32
Kigali	29	28
Ruhengeri	31	30
Rwanda	29	29

Note: Reported averages are quantity and population weighted averages of cash sales. Rwanda averages may not equal the simple mean of their columns.

Table A2.13
Average Prices Received by Farmers Selling Dry Beans
1986 Agricultural Year

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Year
Butare	38	19	21	22	13	21	26	20	27	28	31	31	21
Byumba	40	25	18	21	18	20	27	18	20	20	22	28	21
Cyangugu	51	29	24	19	24	28	26	31	.	.	38	.	34
Gikongoro	.	20	23	26	21	24	.	21	.	.	51	45	26
Gisenyi	37	41	19	24	20	45	22	27	38	24	30	28	26
Gitarama	44	22	23	24	22	24	19	21	29	27	26	33	25
Kibungo	43	30	20	22	15	29	17	14	17	18	24	23	20
Kibuye	.	.	24	25	29	32	27	31	37	31	35	41	31
Kigali	39	33	21	22	20	21	18	17	22	29	29	19	23
Ruhengeri	43	32	24	24	25	26	24	.	20	25	.	.	25
Rwanda	41	29	21	22	18	25	18	19	22	23	24	23	23

Note: Reported averages are quantity and population weighted averages of cash sales. Year and Rwanda averages may not equal the simple mean of their respective rows and columns. Periods indicate that no cash sales were recorded.

Table A2.14
Average Prices Received
by Farmers Selling Dry Beans

Nov. and Dec. 1986

Prefecture	Nov	Dec
Butare	34	26
Byumba	20	24
Cyangugu	.	.
Gikongoro	.	20
Gisenyi	41	.
Gitarama	27	24
Kibungo	21	26
Kibuye	49	.
Kigali	19	23
Ruhengeri	.	.
Rwanda	22	24

Note: Reported averages are quantity and population weighted averages of cash sales. Rwanda averages may not equal the simple mean of their columns. Periods indicate that no cash sales were recorded.

Table A2.15
Average Prices Paid by Farmers Buying Sorghum
1986 Agricultural Year

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Year
Butare	23	30	26	27	28	30	33	33	22	27	26	28	28
Byumba	25	29	30	25	29	28	32	30	26	24	27	23	27
Cyangugu	23	22	25	21	23	25	34	37	27	30	31	33	27
Gikongoro	29	27	29	27	25	26	28	31	23	21	24	23	26
Gisenyi	30	32	30	28	26	29	29	28	23	28	27	28	28
Gitarama	25	27	27	29	30	31	33	34	24	24	25	25	28
Kibungo	17	18	22	20	21	23	27	23	17	15	16	18	19
Kibuye	23	32	30	25	29	30	34	34	26	26	27	26	27
Kigali	30	27	28	28	30	33	34	32	18	22	27	26	24
Ruhengeri	32	30	25	30	26	31	29	30	29	24	26	25	28
Rwanda	24	27	28	27	26	28	31	31	22	22	25	25	26

Note: Reported averages are quantity and population weighted averages of cash sales. Year and Rwanda averages may not equal the simple mean of their respective rows and columns.

Table A2.16
Average Prices Paid by Farmers Buying Sorghum
First Season 1987

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Butare	26	27	29	29	28	28	28	29
Byumba	20	23	32	24	22	25	25	26
Cyangugu	33	34	34	28	23	29	28	34
Gikongoro	23	26	27	26	26	26	26	25
Gisenyi	31	31	32	29	26	28	28	26
Gitarama	27	29	29	29	31	29	30	30
Kibungo	18	21	22	21	21	22	22	21
Kibuye	28	29	30	31	30	29	27	29
Kigali	25	27	31	25	25	28	27	29
Ruhengeri	30	29	27	26	27	26	27	25
Rwanda	25	27	28	27	26	27	26	27

Note: Reported averages are quantity and population weighted averages of cash sales. Rwanda averages may not equal the simple mean of their columns.

Table A2.17
Average Prices Received by Farmers Selling Sorghum
1986 Agricultural Year

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Year
Butare	21	26	23	27	30	31	25	24	21	18	22	21	20
Byumba	24	27	16	17	19	30	17	17	16	21	20	20	19
Cyangugu	28	37	36	.	21	.	.	.	24	23	.	.	24
Gikongoro	.	.	28	35	.	.	.	.	22	21	23	.	22
Gisenyi	.	.	.	25	24	23	23	23	26	.	23	.	25
Gitarama	23	26	22	29	24	31	27	17	19	22	22	21	22
Kibungo	19	17	19	18	20	22	25	19	15	19	17	23	20
Kibuye	33	.	.	.	.	.	.	.	23	21	26	.	22
Kigali	23	21	20	20	22	20	30	18	16	19	21	20	19
Ruhengeri	29	.	46	21	23	24	24	23	20	22	22	25	23
Rwanda	22	21	18	19	20	25	24	18	17	19	20	21	20

Note: Reported averages are quantity and population weighted averages of cash sales. Year and Rwanda averages may not equal the simple mean of their respective rows and columns. Periods indicate that no cash sales were recorded.

Table A2.18
Average Prices Received by Farmers Selling Sorghum
First Season 1987

Prefecture	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Butare	21	19	18	29	23	.	.	22
Byumba	20	21	20	16	19	16	16	14
Cyangugu	.	.	.	.	22	29	.	35
Gikongoro	23	.	46	.	.	.	.	.
Gisenyi	.	.	.	29	23	24	25	.
Gitarama	23	25	26	29	18	16	21	23
Kibungo	20	24	18	21	23	22	23	24
Kibuye	17	.	.	.	.	.	.	.
Kigali	20	21	23	24	31	28	21	18
Ruhengeri	.	.	22	20	22	15	27	24
Rwanda	20	23	20	19	20	18	25	18

Note: Reported averages are quantity and population weighted averages of cash sales. Rwanda averages may not equal the simple mean of their columns. Periods indicate that no cash sales were recorded.

Table A2.19
Number of Months For Which a Dry Bean Harvest Was Recorded
(Percentage of Families)

Préfecture	Number of Months								
	0	1	2	3	4	5	6	7	10
Butare		16.4%	29.1%	32.1%	14.2%	6.0%	1.5%	.7%	
Byumba	1.8%	10.8%	25.2%	34.2%	21.6%	5.4%	.9%		
Cyangugu	1.2%	3.6%	33.7%	24.1%	24.1%	9.6%	2.4%	1.2%	
Gikongoro		18.1%	38.6%	28.9%	13.3%		1.2%		
Gisenyi	15.5%	14.5%	34.5%	23.6%	10.0%	1.8%			
Gitarama		.7%	19.4%	32.4%	29.5%	12.9%	5.0%		
Kibungo		2.4%	17.9%	36.9%	27.4%	10.7%	3.6%	1.2%	
Kibuye	1.2%	18.5%	28.4%	23.5%	11.1%	11.1%	6.2%		
Kigali		7.1%	25.0%	26.4%	23.6%	8.6%	5.7%	2.9%	.7%
Ruhengeri	10.8%	14.4%	27.0%	27.9%	17.1%	2.7%			
Rwanda	3.1%	10.4%	27.4%	29.2%	19.5%	7.0%	2.7%	.7%	.1%

Table A2.20
Number of Months For Which a Sorghum Harvest was Recorded
(Percentage of Families)

Préfecture	Number of Months						
	0	1	2	3	4	5	6
Butare	3.0%	46.3%	42.5%	8.2%			
Byumba	3.6%	34.2%	35.1%	22.5%	3.6%	.9%	
Cyangugu	69.9%	15.7%	12.0%	1.2%	1.2%		
Gikongoro	8.4%	42.2%	43.4%	6.0%			
Gisenyi	69.1%	27.3%	3.6%				
Gitarama	16.5%	39.6%	30.9%	7.9%	3.6%	1.4%	
Kibungo	10.7%	35.7%	33.3%	17.9%	2.4%		
Kibuye	40.7%	28.4%	24.7%	6.2%			
Kigali	19.3%	46.4%	25.7%	3.6%	3.6%	.7%	.7%
Ruhengeri	28.8%	39.6%	23.4%	7.2%	.9%		
Rwanda	25.4%	36.7%	27.8%	8.0%	1.7%	.4%	.1%

Table A2.21
 Percentage of Rural Rwandan Sorghum Sales Transactions Occurring the
 Same Month as a Sorghum Harvest, One Month, Two Months,
 Three Months, and Four Months After a
 Sorghum Harvest

	% Same Month	% One Month Later	% Two Months Later	% Three Months Later	% Four Months Later
Butare	24.4%	35.6%	31.1%	20.6%	9.3%
Byumba	25.3%	27.8%	25.2%	20.6%	15.8%
Cyangugu	51.4%	22.9%	7.6%		
Gikongoro	50.5%	56.2%	20.0%	1.9%	2.3%
Gisenyi	37.4%	6.9%	16.0%	5.3%	
Gitarama	31.3%	42.8%	28.0%	12.1%	7.1%
Kibungo	19.7%	22.2%	13.5%	15.6%	11.5%
Kibuye	51.3%	61.8%	21.0%	4.3%	6.2%
Kigali	21.4%	32.6%	27.2%	17.4%	9.3%
Ruhengeri	38.8%	38.4%	21.1%	8.1%	5.0%
Rwanda	26.4%	32.2%	24.4%	15.9%	9.6%

Note: sales transactions, not volumes, are reported in this table. When a family harvested during two or more months and sold within a four month period, the transaction is reported in more than one column.

Table A2.22
 Percentage of Rural Rwandan Dry Bean Sales Transactions Occurring the
 Same Month As a Dry Bean Harvest, One Month and Two Months After a
 Dry Bean Harvest

	% Same Month	% One Month Later	% Two Months Later
Butare	49.6%	56.4%	33.4%
Byumba	39.5%	53.0%	32.4%
Cyangugu	57.2%	51.8%	37.5%
Gikongoro	36.0%	50.9%	42.9%
Gisenyi	26.9%	21.8%	27.7%
Gitarama	49.3%	58.8%	39.9%
Kibungo	29.6%	34.3%	34.1%
Kibuye	43.0%	56.9%	38.0%
Kigali	40.8%	47.2%	33.7%
Ruhengeri	48.7%	42.8%	11.9%
Rwanda	40.9%	47.3%	33.6%

Note: transactions, not volumes, are recorded in this table. The same transaction is recorded in more than one column if the household harvested two or three months in a row, and then sold.

Table A2.23
Average Weight (kg) Per Sorghum Dry Grain Transaction
by Net Transaction Category of Household

Household Net Transaction Category	Sales	Purchases
Net Sorghum Sellers:		
Households That Sold Beer And Sorghum	28	9
Households That Sold Sorghum, But No Beer:		
>60 Kg Sold	44	16
30-59 Kg Sold	15	8
<30 Kg Sold	9	4
No Net Sorghum Transactions	5	3
Net Sorghum Buyers:		
Households That Bought Sorghum And Sold No Beer:		
<30 Kg Bought	10	4
30-59 Kg Bought	9	8
>60 Kg Bought	10	16
Households That Sold Beer And Bought Sorghum	10	30
Rwanda	25	14

Note: households that sold sorghum beer, but which had no net transactions in sorghum are lumped with households which had no beer sales and no net sorghum transactions.

Table A2.24
Average Weight (kg) Per Dry Bean Transaction
by Net Transaction Category of Household

Household Net Transaction Category	Sales	Purchases
>60 Kg Sold	18	10
30-59 Kg Sold	7	11
<30 Kg Sold	6	6
No Net Transactions	7	6
<30 Kg Bought	6	5
30-59 Kg Bought	5	6
>60 Kg Bought	5	9
Rwanda	10	8

Table A2.25
Family Composition by Household Net Dry Bean
Transactions Category

Household Net Transaction Category	Percent of Household Members Aged:			Total
	Less Than 15 Years	15-64 Years	More Than 64 Years	
>60 Kg Sold	49.4%	47.7%	2.9%	100%
30-59 Kg Sold	49.0%	44.6%	6.3%	100%
<30 Kg Sold	48.1%	47.7%	4.2%	100%
No Net Trans.	41.7%	53.0%	5.3%	100%
<30 Kg Bought	48.0%	47.4%	4.6%	100%
30-59 Kg Bought	46.7%	48.6%	4.7%	100%
>60 Kg Bought	52.1%	46.1%	1.8%	100%
Rwanda	49.1%	47.3%	3.6%	100%

Table A2.26
Family Composition by Household Net Sorghum
Transactions Category

Household Net Transactions Category	Percent of Household Members Aged:			Total
	Less Than 15 Years	15-64 Years	More Than 64 Years	
Net Sorghum Sellers:				
Households That Sold Sorghum and Beer	54.1%	44.0%	1.9%	100%
Household That Sold Sorghum, But No Beer:				
>60 Kg Sold	52.4%	45.1%	2.5%	100%
30-59 Kg Sold	52.3%	45.4%	2.3%	100%
<30 Kg Sold	49.6%	45.4%	5.0%	100%
No Net Sorghum Transactions:	45.7%	46.0%	8.3%	100%
Net Sorghum Buyers:				
Households That Bought Sorghum and Sold No Beer:				
<30 Kg Bought	49.6%	47.5%	2.8%	100%
30-59 Kg Bought	46.9%	48.4%	4.7%	100%
>60 Kg Bought	49.8%	46.6%	3.5%	100%
Households That Sold Beer and Bought Sorghum:	46.3%	50.1%	2.8%	100%
Rwanda	49.1%	47.3%	3.6%	100%

Table A2.27
Sex and Mean Age of the Household Head
by Household Net Dry Bean Transactions Category

Household Net Transaction Category	Mean Age	Sex--percent:	
		Male	Female
>60 Kg Sold	42.24	62.5%	37.5%
30-59 Kg Sold	48.74	81.7%	18.3%
<30 Kg Sold	48.14	68.4%	31.6%
No Net Trans.	50.19	79.6%	20.4%
<30 Kg Bought	47.20	69.8%	30.2%
30-59 Kg Bought	47.21	74.3%	25.7%
>60 Kg Bought	42.38	85.5%	14.5%
Rwanda	45.67	75.8%	24.2%

Table A2.28
Sex and Mean Age of the Household Head
by Household Net Sorghum Transactions Category

Household Net Transaction Category	Mean Age	Sex--percent:	
		Male	Female
Net Sorghum Sellers:			
Households That Sold Sorghum and Beer	44.06	78.7%	21.3%
Household That Sold Sorghum, But No Beer:			
>60 Kg Sold	39.76	76.1%	23.9%
30-59 Kg Sold	44.28	74.6%	25.4%
<30 Kg Sold	47.72	71.0%	29.0%
No Net Sorghum Transactions:	49.32	71.9%	28.1%
Net Sorghum Buyers:			
Households That Bought Sorghum and Sold No Beer:			
<30 Kg Bought	44.55	73.3%	26.7%
30-59 Kg Bought	48.21	79.1%	20.9%
>60 Kg Bought	47.15	80.2%	19.8%
Households That Sold Beer and Bought Sorghum:	45.36	81.8%	18.2%
Rwanda	45.67	75.8%	24.2%

Table A2.29
Series Constructed by Combining MINIPLAN Kigali Urban Dry Bean Prices
With MINIPLAN Gikongoro Dry Bean Prices
Inflated to 1987 Levels

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1971	47	47	47	42	47	56	56	65	70	70	70	70
1972	56	60	60	55	46	50	59	59	64	68	68	72
1973	58	44	44	44	43	43	47	55	55	50	42	54
1974	36	40	47	49	48	51	71	87	85	83	126	100
1975	80	72	68	87	111	67	73	69	75	71	94	51
1976	50	55	52	50	49	49	56	60	62	57	68	59
1977	56	55	50	48	45	46	52	56	57	65	68	63
1978	49	48	42	42	38	46	44	47	51	50	57	59
1979	36	36	39	42	40	41	43	43	42	54	52	53
1980	51	40	46	49	47	48	46	48	53	50	47	49
1981	36	29	31	29	26	29	30	32	35	33	31	29
1982	26	26	28	33	30	36	42	40	40	44	50	51
1983	26	27	.	29	28	30	37	42	39	38	38	42
1984	23	30	33	36	37	55	67	62	69	86	81	48
1985	41	45	43	46	44	46	45	45	43	43	48	40
1986	27	30	28	28	26	26	28	29	32	32	32	32
1987	31	28	28	29	37	42	51	53	54	55	58	52

Notes: Prices are inflated using the Urban Consumer Price Index as published in International Financial Statistics. Prices from January 1972 through December 1974 are from Gikongoro. All others from Kigali.

Table A2.30
MINIPLAN Kigali Urban Sorghum Prices
Inflated to 1987 Levels

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	40	38	39	37	38	38	31	25	31	40	26	28
1978	37	41	33	51	41	54	35	31	31	30	35	54
1979	55	50	51	53	50	39	34	32	31	50	43	42
1980	35	39	42	44	48	39	39	27	32	30	33	35
1981	36	42	40	39	44	40	34	30	32	33	33	32
1982	34	36	37	37	49	35	27	28	24	25	32	32
1983	29	35	.	32	38	33	25	21	26	27	28	29
1984	32	34	25	34	41	48	32	34	21	36	41	38
1985	40	40	41	39	35	35	22	23	26	27	31	32
1986	31	35	34	41	31	31	29	27	24	25	27	30
1987	32	30	31	32	30	26	32	24	23	27	28	30

Note: Prices are inflated using the Urban Consumer Price Index as published in International Financial Statistics.

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Multiple Regression Analysis of Sorghum, Bean and Kilocalories Per Capita Production

Regression on Factors Affecting Decision to Produce Sorghum

Dependent Variable: DUMSOR

Multiple R .52229
 R Square .27278
 Adjusted R Square .26471
 Standard Error .37595

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	11	52.53870	4.77625
Residual	991	140.06349	.14134

F = 33.79367 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
CONSECH	-.09653	.03155	-.10567	-3.060	.0023
MTIME	-1.03203E-03	4.15414E-04	-.07114	-2.484	.0131
RUMPERS	.06691	.02058	.09453	3.252	.0012
DUMZ03	-.20490	.03165	-.20034	-6.473	.0000
CONMAIN	-.07075	.03386	-.06917	-2.089	.0369
REVVVIV	.08698	.02602	.09671	3.343	.0009
DUMZ01	-.49459	.03858	-.40689	-12.822	.0000
ROOTX	-3.86386E-03	1.52236E-03	-.07651	-2.538	.0113
CONSUF	-.16509	.02848	-.18660	-5.796	.0000
DUMZ02	-.39037	.03701	-.32702	-10.547	.0000
CONFERT	-.04958	.02910	-.05649	-1.704	.0888
(Constant)	1.13797	.05206		21.860	.0000

Definitions of Variables:

DUMSOR Dummy for sorghum production
 DUMZ01 Dummy for zone 1--northwest
 DUMZ02 Dummy for zone 2--southwest
 DUMZ03 Dummy for zone 3--north central
 CONSUF Dummy for surface area constraint
 CONSECH Dummy for drought constraint
 CONMAIN Dummy for labor constraint
 CONFERT Dummy for soil fertility constraint
 REVBIE Dummy for beer revenue
 REVVVIV Dummy for food sales revenue
 RUMPERS Small ruminants per person
 MTIME Average time (in minutes) to bean and sorghum
 markets for family
 ROOTX Square root total kcal (1000s) produced per person except for
 sorghum and beer bananas

Determinants of Sorghum Production per Household Member

ZONE 1--NORTHWEST

Multiple R .78061
 R Square .60935
 Adjusted R Square .58879
 Standard Error 29.99090

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	79972.50302	26657.50101
Residual	57	51268.88591	899.45414

F = 29.63742 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
MTIME	-.32943	.08446	-.35137	-3.900	.0003
DEPMAIN	121.49981	14.46629	.71855	8.399	.0000
ROOTX	.96407	.50663	.17491	1.903	.0621
(Constant)	19.06454	10.26437		1.857	.0684

Variable definitions:

SPROPER = Sorghum production per person, 1986 agricultural year
 DEPMAIN = Dummy for labor expenditures
 ROOTX = Square root of total kilocalorie (1000s) production,
 excluding sorghum and beer bananas
 MTIME = Average time travelled to bean and sorghum markets.

Determinants of Sorghum Production per Household Member

Dependent Variable.. SPROPER

ZONE 2--SOUTHWEST

Multiple R .59858
 R Square .35829
 Adjusted R Square .34283
 Standard Error 13.57565

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	8540.82893	4270.41446
Residual	83	15296.75092	184.29820

F = 23.17122 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ROOTX	1.07351	.19643	.48159	5.465	.0000
DEPMAIN	21.23644	5.75900	.32495	3.688	.0004
(Constant)	-9.67892	4.56683		-2.119	.0370

Variable Definitions:

SPROPER = Sorghum production per person, 1986 agricultural year
 DEPMAIN = Dummy for labor expenditures
 ROOTX = Square root of total kilocalorie (1000s) production,
 excluding sorghum and beer bananas

Determinants of Sorghum Production per Household Member

Dependent Variable.. SPROPER

ZONE 3--NORTH CENTRAL

Multiple R .47910
 R Square .22953
 Adjusted R Square .20727
 Standard Error 28.00701

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	40427.15825	8085.43165
Residual	173	135699.94966	784.39277

F = 10.30789 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
BOVPERS	31.07000	8.40933	.25334	3.695	.0003
ROOTX	1.23359	.30789	.27523	4.007	.0001
DEPVETE	9.16086	4.41448	.14591	2.075	.0394
REVMAN	-10.74226	4.84518	-.15171	-2.217	.0279
DEPINPU	14.90682	5.89899	.18209	2.527	.0124
(Constant)	-2.93837	7.00240		-.420	.6753

Variable definitions:

SPROPER = Sorghum production per person, 1986 agricultural year
 DEPINPU = Expenditures for inputs
 REVMAN = Dummy for labor revenues (field hand)
 BOVPERS = Cows per person in the household
 ROOTX = Square root of total kilocalorie (1000s) production,
 excluding sorghum and beer bananas
 DEPVETE = Expenditures on clothing

Determinants of Sorghum Production per Household Member

Dependent Variable.. SPROPER

ZONE 4--SOUTH CENTRAL

Multiple R .44740
 R Square .20016
 Adjusted R Square .18733
 Standard Error 74.57919

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	260290.65653	86763.55218
Residual	187	1040104.39437	5562.05558

F = 15.59919 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ROOTX	4.03671	.82173	.33912	4.912	.0000
DEPMAIN	28.45281	17.41488	.10787	1.634	.1040
SUPTPER	8.286268E-03	3.40315E-03	.16955	2.435	.0158
(Constant)	-63.84190	16.29496		-3.918	.0001

Definition of Variables:

SPROPER = Sorghum production per person, 1986 agricultural year
 ROOTX = Square root of total kilocalorie (1000s) production,
 excluding sorghum and beer bananas
 DEPMAIN = Dummy for labor expenses
 SUPTPER = Surface area per household member

Determinants of Sorghum Production per Household Member

Dependent Variable.. SPROPER

ZONE 5--EAST

Multiple R .61115
 R Square .37350
 Adjusted R Square .35375
 Standard Error 76.84012

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	7	781459.35890	111637.05127
Residual	222	1310777.64524	5904.40381

F = 18.90742 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
CONSECH	31.76607	10.70492	.16622	2.967	.0033
RUMPERS	17.77024	8.21736	.12662	2.163	.0316
DEPFOOD	-30.09095	10.46410	-.15775	-2.876	.0044
BOVPERS	-41.19503	22.07033	-.10234	-1.867	.0633
DEPMAIN	39.88588	13.78253	.15851	2.894	.0042
CONMAIN	-22.83079	10.74238	-.11786	-2.125	.0347
ROOTX	3.85730	.53535	.42665	7.205	.0000
(Constant)	-12.04834	14.46146		-.833	.4057

Definition of Variables:

SPROPER = Sorghum production per person, 1986 agricultural year
 ROOTX = Square root of total kilocalorie (1000s) production,
 excluding sorghum and beer bananas
 DEPMAIN = Dummy for labor expenses
 CONSECH = Dummy for drought constraint
 RUMPERS = Small ruminants per person
 DEPFOOD = Dummy for food expenses
 BOVPERS = Cows per person
 CONMAIN = Dummy for labor constraint

Determinants of Sorghum Production per Household Member

Dependent Variable.. SPROPER

ALL 5 ZONES

Multiple R .52106
 R Square .27150
 Adjusted R Square .26388
 Standard Error 57.74171

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	11	1307176.80111	118834.25465
Residual	1052	3507478.98085	3334.10550

F = 35.64202 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
DUMZ04	-26.61747	5.39370	-.15916	-4.935	.0000
DEPMAIN	25.97093	5.76542	.12257	4.505	.0000
ACTPERS	22.08823	8.30198	.07253	2.661	.0079
REVVVIV	10.81297	3.86484	.07816	2.798	.0052
RUMPERS	5.70777	3.15343	.05158	1.810	.0706
CONSECH	10.23804	3.87201	.07357	2.644	.0083
MTIME	-.14278	.06284	-.06317	-2.272	.0233
DUMZ02	-46.15250	6.00940	-.24773	-7.680	.0000
DUMZ01	-47.81824	5.90939	-.25603	-8.092	.0000
ROOTXSBB	2.19094	.26641	.25357	8.224	.0000
DUMZ03	-33.53564	5.30972	-.21107	-6.316	.0000
(Constant)	-10.32504	8.22004		-1.256	.2094

Definition of Variables:

SPROPER = Sorghum production per person, 1986 agricultural year
 ROOTXSBB = Square root of total kilocalorie (1000s) production, excluding sorghum and beer bananas
 RUMPERS = Small ruminants per person
 ACTPERS = Number of 15 to 64 year olds per person
 DEPMAIN = Dummy for labor expenses
 CONSECH = Dummy for drought constraint
 MTIME = Average time travelled to bean and sorghum markets.
 REVVVIV = Dummy for food sales revenue

DUMZ01 through DUMZ04 Dummies for geographical zone.

Determinants of Bean Production per Household Member

Dependent Variable.. BPROPER

ZONE 1--NORTHWEST

Multiple R .68405
 R Square .46792
 Adjusted R Square .44389
 Standard Error 37.49454

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	7	191630.66483	27375.80926
Residual	155	217905.32830	1405.84083

F = 19.47291 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
BOVPERS	-30.72682	14.05039	-.13033	-2.187	.0302
MTIME	-.24665	.07165	-.20555	-3.442	.0007
DEPINCI	-21.06211	8.65928	-.20038	-2.432	.0161
DEPMAIN	61.04556	10.74475	.35204	5.681	.0000
SUPTPER	.01051	1.53165E-03	.41325	6.861	.0000
DEPINPU	-19.51616	9.77489	-.14890	-1.997	.0476
DEPVETE	-21.06512	8.63894	-.20869	-2.438	.0159
(Constant)	58.49907	9.67672		6.045	.0000

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 BOVPERS = Cows per person
 MTIME = Average time spent getting to bean and sorghum markets
 in minutes
 DEPINCI = Dummy for expenses on incidentals
 DEPMAIN = Dummy for expenses on labor
 SUPTPER = Surface area (centiares) per person
 DEPINPU = Dummy for expenses on seed, field rent or tools
 DEPVETE = Dummy for expenses on clothing

Determinants of Bean Production per Household Member

Number 1 Dependent Variable.. BPROPER

ZONE 2--SOUTHWEST

Multiple R .67788
 R Square .45952
 Adjusted R Square .43900
 Standard Error 21.03283

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	59427.05115	9904.50853
Residual	158	69896.00989	442.37981

F = 22.38915 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
BOVPERS	-9.54635	5.83715	-.10473	-1.635	.1039
DEPFOOD	-9.29554	3.86632	-.14986	-2.404	.0174
RUMPERS	7.77269	3.33496	.15009	2.331	.0210
SUPTPER	2.040691E-03	7.81596E-04	.18397	2.611	.0099
DEPMAIN	17.61988	6.84891	.16956	2.573	.0110
ROOTEXB	1.67942	.26452	.44775	6.349	.0000
(Constant)	-5.23304	5.87579		-.891	.3745

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 BOVPERS = Cows per person
 DEPFOOD = Dummy for expenses on food
 RUMPERS = Small ruminants per person
 SUPTPER = Surface area (centiares) per person
 DEPMAIN = Dummy for expenses on labor
 ROOTEXB = Square root of total kilocalorie (1000s) production
 excluding beans

Determinants of Bean Production per Household Member

Dependent Variable.. BPROPER

ZONE 3--NORTH CENTRAL

Multiple R .62276
 R Square .38783
 Adjusted R Square .37779
 Standard Error 29.05233

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	130471.80346	32617.95087
Residual	244	205945.17693	844.03761

F = 38.64514 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ROOTEXB	3.52762	.29757	.60116	11.855	.0000
MTIME	-.24890	.07022	-.17891	-3.545	.0005
REVN FAR	-10.70243	4.68867	-.11918	-2.283	.0233
REVB IER	-7.90658	4.05029	-.10283	-1.952	.0521
(Constant)	-13.29324	7.77610		-1.710	.0886

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 ROOTEXB = Square root of total kilocalorie (1000s) production
 excluding beans
 MTIME = Average distance in minutes to bean and sorghum markets
 REVN FAR = Dummy for non-cropping revenue
 REVB IER = Dummy for beer revenue

Determinants of Bean Production per Household Member

Equation Number 1 Dependent Variable.. BPROPER

ZONE 4--SOUTH CENTRAL

Multiple R .76604
 R Square .58681
 Adjusted R Square .57099
 Standard Error 31.52023

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	294899.06045	36862.38256
Residual	209	207646.72074	993.52498

F = 37.10262 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
DEPINPU	17.92270	5.59848	.16309	3.201	.0016
DEPMAIN	15.48937	7.39864	.10098	2.094	.0375
REVCIND	-10.40158	4.89404	-.09725	-2.125	.0347
ROOTEXB	4.85085	.33540	.67051	14.463	.0000
DEPVETE	15.16758	5.56885	.15771	2.724	.0070
REVN FAR	12.97487	7.11890	.08458	1.823	.0698
CONMAIN	9.96531	4.71863	.09828	2.112	.0359
DEPINCI	18.40723	5.89890	.18699	3.120	.0021
(Constant)	-83.87334	9.58664		-8.749	.0000

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 ROOTEXB = Square root of total kilocalorie (1000s) production
 DEPINPU = Dummy for expenses on seed, field rent, or tools
 DEPMAIN = Dummy for expenses on labor
 REVCIND = Dummy for revenue from industrial crops
 DEPVETE = Dummy for clothing expenses
 REVN FAR = Dummy for non-cropping revenue
 CONMAIN = Dummy for labor constraint
 DEPINCI = Dummy for incidental expenses

Determinants of Bean Production per Household Member

Equation Number 1 Dependent Variable.. BPROPER

ZONE 5--EAST

Multiple R .78527
 R Square .61664
 Adjusted R Square .60954
 Standard Error 52.04503

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	1176391.51236	235278.30247
Residual	270	731345.08600	2708.68550

F = 86.86069 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
CONMAIN	-24.74663	6.46170	-.14709	-3.830	.0002
REVVVIV	14.55330	6.49097	.08750	2.242	.0258
SUPTPER	4.782508E-03	6.92797E-04	.29978	6.903	.0000
RUMPERS	17.40838	5.44962	.13620	3.194	.0016
ROOTEXB	4.25180	.39533	.50777	10.755	.0000
(Constant)	-61.59328	10.41567		-5.914	.0000

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 ROOTEXB = Square root of total kilocalorie (1000s) production
 CONMAIN = Dummy for labor constraint
 REVVVIV = Dummy for food sales revenue
 SUPTPER = Surface area (centiares) per person
 RUMPERS = Small ruminants per person

Determinants of Bean Production per Household Member

ALL 5 ZONES Dependent Variable.. BPROPER

Multiple R .71641
 R Square .51325
 Adjusted R Square .50628
 Standard Error 40.30885

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	15	1795490.01638	119699.33443
Residual	1048	1702793.78345	1624.80323
F =	73.67005	Signif F = 0.0	

----- Variables in the Equation -----					
Variable	B	SE B	Beta	T	Sig T
DUMZ04	-7.18851	3.86999	-.05043	-1.858	.0635
DEPMAIN	14.39120	4.20890	.07968	3.419	.0007
ACTPERS	20.51743	5.80476	.07903	3.535	.0004
CONFERT	-6.32115	2.68779	-.05506	-2.352	.0189
RUMPERS	4.92887	2.22051	.05225	2.220	.0267
BOVPERS	-8.04219	4.49591	-.04069	-1.789	.0739
MTIME	-.27198	.04401	-.14117	-6.180	.0000
CONSUPF	6.02364	2.80215	.05185	2.150	.0318
DUMZ02	-18.63353	4.27567	-.11734	-4.358	.0000
DEPFOOD	-8.99762	2.85633	-.07388	-3.150	.0017
SUPTPER	4.932138E-03	4.56275E-04	.27779	10.810	.0000
CONMAIN	-6.34459	3.25939	-.04773	-1.947	.0519
DUMZ01	-10.30467	4.39498	-.06473	-2.345	.0192
ROOTXBEA	2.92122	.18764	.43664	15.568	.0000
DUMZ03	-5.28811	3.84167	-.03905	-1.377	.1690
(Constant)	-14.29079	6.71713		-2.128	.0336

Definitions of Variables:

BPROPER = Bean production per person, 1986 agricultural year
 ACTPERS = Number of 15 to 64 year olds per person
 ROOTXBEA = Square root of total kilocalorie (1000s) production, excluding beans
 CONFERT = Dummy for soil fertility constraint
 CONSUPF = Dummy for surface area constraint
 RUMPERS = Small ruminants per person
 DEPMAIN = Dummy for labor expenses
 MTIME = Average time travelled to bean and sorghum markets.
 DEPFOOD = Dummy for food expenses
 BOVPERS = Cows per person
 SUPTPER = Surface area (centiares) per person
 REVBIER = Dummy for beer revenue

DUMZ01 through DUMZ04 Dummies for geographic zone. A joint F-test for the zonal dummies showed them to be significant at >99%.

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

Zone 1--Northwest

Multiple R .74088
 R Square .54890
 Adjusted R Square .53453
 Standard Error 401.31351

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	30767279.31531	6153455.86306
Residual	157	25285248.20479	161052.53634

F = 38.20776 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
RUMPERS	234.91193	49.64703	.28580	4.732	.0000
MTIME	2.16378	.76024	.15413	2.846	.0050
DEPMAIN	535.30319	110.11462	.26387	4.861	.0000
REVVVIV	204.70029	64.69472	.17380	3.164	.0019
SUPTPER	.11587	.01790	.38948	6.471	.0000
(Constant)	144.81188	64.25693		2.254	.0256

Definitions of Variables:

CALPERS = Kilocalories produced per person, 1986 agricultural year
 RUMPERS = Small ruminants per person
 MTIME = Average time travelled to bean and sorghum markets
 DEPMAIN = Dummy for labor expenses
 REVVVIV = Dummy for revenue from food sales
 SUPTPER = Farm size (centiares) per person

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

Zone 2--Southwest

Multiple R .62036
 R Square .38484
 Adjusted R Square .36550
 Standard Error 357.48875

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	12712079.69796	2542415.93959
Residual	159	20319914.79261	127798.20624

F = 19.89399 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ACTPERS	429.75384	125.61778	.21811	3.421	.0008
SUPTPER	.08387	.01133	.47311	7.404	.0000
REVMAN	-124.66373	73.00433	-.10746	-1.708	.0897
REVBIE	118.50600	57.51001	.13243	2.061	.0410
PROPTUB	-484.78339	161.43399	-.19333	-3.003	.0031
(Constant)	472.06597	121.59986		3.882	.0002

Definitions of Variables:

CALPERS = Kilocalories (1000s) produced per person,
 1986 agricultural year
 SUPTPER = Farm size (centiares) per person
 ACTPERS = Number of 15 to 64 year olds per person
 REVMAN = Dummy for revenue from selling labor
 REVBIE = Dummy for revenue from selling beer/wine.
 PROPTUB = Proportion of kilocalorie output from tubers and bananas

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

Zone 3--North Central

Multiple R .62444
 R Square .38992
 Adjusted R Square .37486
 Standard Error 312.49616

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	15166407.50396	2527734.58399
Residual	243	23729885.88106	97653.85136

F = 25.88464 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
RUMPERS	108.64481	34.19265	.16638	3.177	.0017
PROPTUB	-494.39871	127.96032	-.19746	-3.864	.0001
DEPINPU	228.80246	54.31384	.21266	4.213	.0000
REVVVIV	215.42337	47.63580	.23835	4.522	.0000
REVBIER	105.06401	43.75329	.12721	2.401	.0171
SUPTPER	.07672	.01135	.36192	6.761	.0000
(Constant)	602.58879	88.98971		6.771	.0000

Definitions of Variables:

CALPERS = Kilocalories (1000s) produced per person,
 1986 agricultural year
 RUMPERS = Small ruminants per person
 REVVVIV = Dummy for revenue from food sales
 SUPTPER = Farm size (centiares) per person
 REVBIER = Dummy for revenue from selling beer/wine.
 PROPTUB = Proportion of kilocalorie output from tubers and bananas
 DEPINPU = Dummy for expenses on seed, field rent, or tools

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

Zone 4--Southcentral

Multiple R .59605
 R Square .35527
 Adjusted R Square .34000
 Standard Error 437.62823

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	22268087.13271	4453617.42654
Residual	211	40410396.81435	191518.46831

F = 23.25425 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ACTPERS	240.21527	126.52971	.10552	1.898	.0590
BOVPERS	150.78074	78.76843	.11048	1.914	.0569
MTIME	-2.80601	1.45857	-.10715	-1.924	.0557
PROPTUB	-1245.95118	215.30081	-.32269	-5.787	.0000
SUPTPER	.12451	.01905	.38050	6.537	.0000
(Constant)	1187.48867	164.91136		7.201	.0000

Definitions of Variables:

CALPERS = Kilocalories (1000s) produced per person,
 1986 agricultural year
 MTIME = Average time travelled to bean and sorghum markets
 SUPTPER = Farm size (centiares) per person
 ACTPERS = Number of 15 to 64 year olds per person
 PROPTUB = Proportion of kilocalorie output from tubers and bananas
 BOVPERS = Number of cows per person

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

Zone 5--East

Multiple R .74567
 R Square .55602
 Adjusted R Square .54442
 Standard Error 617.77938

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	7	128092885.29516	18298983.61359
Residual	268	102282563.70648	381651.35711

F = 47.94686 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
ACTPERS	1057.83987	190.37181	.24147	5.557	.0000
REVVVIV	261.92471	83.64711	.14331	3.131	.0019
CONSECH	237.94608	79.66121	.13017	2.987	.0031
SUPTPER	.06425	7.62735E-03	.36650	8.424	.0000
RUMPERS	392.03709	61.65438	.27911	6.359	.0000
REVBIER	334.28022	96.08747	.15357	3.479	.0006
PROPTUB	-767.64694	236.18599	-.14789	-3.250	.0013
(Constant)	144.34063	203.62915		.709	.4790

Definitions of Variables:

CALPERS = Kilocalories (1000s) produced per person,
 1986 agricultural year
 RUMPERS = Small ruminants per person
 REVVVIV = Dummy for revenue from food sales
 SUPTPER = Farm size (centiares) per person
 ACTPERS = Number of 15 to 64 year olds per person
 REVBIER = Dummy for revenue from selling beer/wine.
 PROPTUB = Proportion of kilocalorie output from tubers and bananas
 CONSECH = Dummy for drought constraint

Determinants of Kilocalorie per Person Production

Dependent Variable.. CALPERS

ALL 5 ZONES

Multiple R .69957
 R Square .48940
 Adjusted R Square .48265
 Standard Error 477.25106

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	14	230978044.11284	16498431.72235
Residual	1058	240979149.34109	227768.57216

F = 72.43507 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
DUMZ04	-167.72872	51.14064	-.10176	-3.280	.0011
DEPMAIN	233.20041	47.25598	.11122	4.935	.0000
ACTPERS	440.93338	66.65747	.14819	6.615	.0000
REVCIND	74.94914	34.59757	.05122	2.166	.0305
RUMPERS	224.33845	24.95301	.20645	8.990	.0000
REVBIER	163.23852	35.65725	.11998	4.578	.0000
DEPINPU	123.88526	39.52924	.07010	3.134	.0018
DUMZ02	-262.80646	52.45677	-.14295	-5.010	.0000
SUPTPER	.07690	4.88539E-03	.37341	15.740	.0000
DUMZ03	-221.01785	47.59789	-.14088	-4.643	.0000
REVVVIV	242.10795	34.42950	.17754	7.032	.0000
PROPBAN	-449.23883	115.60054	-.11178	-3.886	.0001
PROPTUB	-679.78966	97.56299	-.19684	-6.968	.0000
DUMZ01	-230.22916	54.44377	-.12491	-4.229	.0000
(Constant)	548.04693	75.88964		7.222	.0000

Definitions of Variables:

CALPERS = Kilocalories (1000s) produced per person,
 1986 agricultural year
 ACTPERS = Number of 15 to 64 year olds per person
 PROPTUB = Proportion of kilocalorie output from tubers and bananas
 REVVVIV = Dummy for food sales revenue
 RUMPERS = Small ruminants per person
 DEPMAIN = Dummy for labor expenses
 DEPFOOD = Dummy for food expenses
 SUPTPER = Surface area (centiares) per household member
 REVBIER = Dummy for beer revenue
 REVCIND = Dummy for revenue from industrial crops

DUMZ01 through DUMZ04 Dummies for geographic zone

Determinants of Kilocalorie per Centiare Production

Dependent Variable.. CALARE

ZONE 1--Northwest

Multiple R .62679
 R Square .39286
 Adjusted R Square .36152
 Standard Error .38909

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	15.18422	1.89803
Residual	155	23.46617	.15139

F = 12.53695 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPPODT	.64397	.15335	.28339	4.199	.0000
CONSUPF	-.23699	.07547	-.23340	-3.140	.0020
BOVARE	-302.32926	156.76565	-.12460	-1.929	.0556
ACTPERS	.33773	.14932	.14649	2.262	.0251
MTIME	2.697328E-03	7.68521E-04	.23160	3.510	.0006
RUMARE	126.81993	60.29979	.14926	2.103	.0371
CONSECH	-.13637	.07100	-.14042	-1.921	.0566
PERSUPT	172.22463	28.89691	.44085	5.960	.0000
(Constant)	.19049	.10162		1.875	.0627

Definitions of variables:

CALARE = Kilocalorie (1000s) output per centiare
 ACTPERS = Number of 15 to 64 year olds per person
 PROPPODT = Proportion of kilocalorie output from irish potatoes
 RUMARE = Small ruminants per centiare
 PERSUPT = Household members per centiare
 MTIME = Average time travelled to bean and sorghum markets
 BOVARE = Number of cows per centiare
 CONSUPF = Dummy for land constraint
 CONSECH = Dummy for drought constraint

Determinants of Kilocalorie per Centiare Production

Equation Number 1 Dependent Variable.. CALARE

ZONE 2--Southwest

Multiple R .61041
 R Square .37260
 Adjusted R Square .35691
 Standard Error .33683

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	10.78022	2.69506
Residual	160	18.15239	.11345

F = 23.75495 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPPATD	-.41811	.15392	-.17960	-2.716	.0073
BOVARE	794.61171	164.85924	.30246	4.820	.0000
PERSUPT	307.93046	39.61727	.49764	7.773	.0000
REVCIND	-.15645	.05946	-.17357	-2.631	.0093
(Constant)	.30444	.07387		4.121	.0001

Definitions of variables:

CALARE = Kilocalorie (1000s) output per centiare
 PERSUPT = Household members per centiare
 BOVARE = Number of cows per centiare
 PROPPATD = Proportion of kilocalorie output from sweet potatoes
 REVCIND = Dummy for revenue from industrial crops

Determinants of Kilocalorie per Centiare Production

Dependent Variable.. CALARE

ZONE 3--North-central

Beginning Block Number 1. Method: Enter

Multiple R .74105
 R Square .54915
 Adjusted R Square .53029
 Standard Error .17426

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	10	8.83968	.88397
Residual	239	7.25722	.03036

F = 29.11150 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPP00T	1.85469	.71556	.12176	2.592	.0101
REVBIER	.03672	.02482	.06912	1.480	.1402
REVCIND	.04210	.02679	.07632	1.571	.1174
DEPVETE	-.06358	.02320	-.12489	-2.741	.0066
BOVARE	234.27107	98.36123	.10621	2.382	.0180
CONSECH	-.04728	.02618	-.08046	-1.806	.0722
PERSUPT	335.80408	20.96539	.73731	16.017	.0000
PROPMANI	-.29112	.12640	-.11260	-2.303	.0221
REVVVIV	.15357	.02869	.26413	5.352	.0000
PROPPATD	-.31099	.08034	-.19502	-3.871	.0001
(Constant)	.24078	.04955		4.860	.0000

Definitions of variables:

CALARE = Kilocalorie (1000s) output per centiare
 PROPP00T = Proportion of kilocalorie output from irish potatoes
 PERSUPT = Household members per centiare
 BOVARE = Number of cows per centiare
 CONSECH = Dummy for drought constraint
 PROPPATD = Proportion of kilocalorie output from sweet potatoes
 PROPMANI = Proportion of kilocalorie output from manioc
 REVCIND = Dummy for revenue from industrial crops
 REVBIER = Dummy for beer revenue
 REVVVIV = Dummy for food sales revenue
 DEPVETE = Dummy for clothing expenses

Determinants of Kilocalorie per Centiare Production

Dependent Variable.. CALARE

ZONE 4--South-central

Multiple R .71634
 R Square .51314
 Adjusted R Square .49432
 Standard Error .15814

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	5.45631	.68204
Residual	207	5.17692	.02501

F = 27.27140 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPPATD	-.37893	.07802	-.24751	-4.857	.0000
ACTPERS	.13641	.04639	.14539	2.941	.0036
CONSUPF	.04230	.02498	.09182	1.693	.0919
DEPVETE	-.05726	.02203	-.12884	-2.599	.0100
REVVVIV	.05924	.02372	.12825	2.498	.0133
MTIME	-1.30680E-03	5.36979E-04	-.12113	-2.434	.0158
REVCIND	-.05308	.02548	-.10715	-2.083	.0385
PERSUPT	303.16518	27.94743	.62632	10.848	.0000
(Constant)	.31865	.04695		6.787	.0000

Definitions of variables:

CALARE = Kilocalorie output per centiare
 ACTPERS = Number of 15 to 64 year olds per person
 PERSUPT = Household members per centiare
 MTIME = Average time travelled to bean and sorghum markets
 CONSUPF = Dummy for land constraint
 PROPPATD = Proportion of kilocalorie output from sweet potatoes
 REVVVIV = Dummy for food sales revenue
 REVCIND = Dummy for revenue from industrial crops
 DEPVETE = Dummy for clothing expenses

Determinants of Kilocalorie per Centiare Production

Dependent Variable.. CALARE

ZONE 5--East

Beginning Block Number 1. Method: Enter

Multiple R .62998
 R Square .39688
 Adjusted R Square .38343
 Standard Error .20329

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	7.31568	1.21928
Residual	269	11.11737	.04133

F = 29.50217 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPPATD	-.44893	.13991	-.15914	-3.209	.0015
RUMARE	212.35220	42.24088	.24289	5.027	.0000
REVBIER	.06124	.02930	.09946	2.090	.0376
CONFERT	-.05328	.02521	-.10247	-2.113	.0355
PERSUPT	212.25024	25.68121	.42980	8.265	.0000
CONSUF	.10102	.02917	.18104	3.463	.0006
(Constant)	.30012	.03471		8.647	.0000

Definitions of variables:

CALARE = Kilocalorie (1000s) output per centiare
 RUMARE = Small ruminants per centiare
 PERSUPT = Household members per centiare
 CONSUF = Dummy for land constraint
 PROPPATD = Proportion of kilocalorie output from sweet potatoes
 REVBIER = Dummy for beer revenue
 CONFERT = Dummy for soil fertility constraint

Determinants of Kilocalorie per Centiare Production

Dependent Variable.. CALARE

ALL FIVE ZONES

Beginning Block Number 1. Method: Enter

Multiple R .57924
 R Square .33552
 Adjusted R Square .33115
 Standard Error .27248

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	7	39.92714	5.70388
Residual	1065	79.07402	.07425

F = 76.82207 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPPODT	.45750	.09461	.13856	4.835	.0000
DEPINPU	.05691	.02228	.06414	2.554	.0108
ACTPERS	.09370	.03797	.06271	2.468	.0137
RUMARE	91.30916	23.34675	.10448	3.911	.0001
REVBIER	.04295	.01812	.06287	2.371	.0179
PROPPATD	-.30956	.05094	-.16278	-6.076	.0000
PERSUPT	211.21793	12.24332	.46898	17.252	.0000
(Constant)	.25214	.03062		8.233	.0000

Definitions of variables:

CALARE = Kilocalorie (1000s) output per centiare
 ACTPERS = Number of 15 to 64 year olds per person
 PROPPATD = Proportion of kilocalorie output from sweet potatoes
 PROPPODT = Proportion of kilocalorie output from irish potatoes
 RUMARE = Small ruminants per centiare
 PERSUPT = Household members per centiare
 REVBIER = Dummy for beer revenue
 DEPINPU = Dummy for expenses on seed, field rent, or tools

Multiple Regression Analysis of Bean and Sorghum Transactions Per Capita

Regression Results for Bean Sales

Zone 1--Northwest: No significant variables.

Zone 2--Southwest

Dependent Variable.. BEAVPER

Variable(s) Entered on Step Number

1.. RUMPERS

Multiple R .75771
R Square .57412
Adjusted R Square .56081
Standard Error 8.49806

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	3115.33668	3115.33668
Residual	32	2310.94705	72.21710

F = 43.13849 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
RUMPERS	15.77645	2.40202	.75771	6.568	.0000
(Constant)	-.32630	1.92061		-.170	.8662

Definitions of Variables:

BEAVPER = Bean sales per household member (gifts included)
RUMPERS = Small ruminants per household member

Regression Results for Bean Sales

Zone 3--Northcentral: No significant variables

Zone 4--Southcentral

Dependent Variable.. BEAVPER

Multiple R .60295
 R Square .36355
 Adjusted R Square .34397
 Standard Error 12.39977

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	5708.84443	2854.42221
Residual	65	9994.03684	153.75441

F = 18.56481 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	3.493020E-03	9.30582E-04	.38092	3.754	.0004
PROPTUB	-45.36834	11.79182	-.39045	-3.847	.0003
(Constant)	26.19385	7.53002		3.479	.0009

Definitions of Variables:

BEAVPER = Bean sales per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers

Regression Results for Bean Sales

Zone 5--East

Dependent Variable.. BEAVPER

Multiple R .38784
 R Square .15042
 Adjusted R Square .13735
 Standard Error 45.34153

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	47317.86938	23658.93469
Residual	130	267261.11093	2055.85470

F = 11.50808 Signif F = .0000

Equation Number 1 Dependent Variable.. BEAVPER

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	3.117267E-03	1.03779E-03	.24297	3.004	.0032
PROPTUB	-84.70311	22.03942	-.31088	-3.843	.0002
(Constant)	51.90019	11.72775		4.425	.0000

Definitions of Variables:

BEAVPER = Bean sales per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers

Regression Results for Bean Purchases

Zone 1--Northwest

Dependent Variable.. BEAVPER

Multiple R .36985
 R Square .13679
 Adjusted R Square .11829
 Standard Error 11.86215

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	3121.76816	1040.58939
Residual	140	19699.46822	140.71049

F = 7.39525 Signif F = .0001

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	-1.435064E-03	6.36907E-04	.18093	2.253	.0258
CONMAIN	11.04711	4.12756	-.21242	-2.676	.0083
PROPTUB	14.27159	4.63162	-.24499	-3.081	.0025
(Constant)	9.37692	2.41094		-3.889	.0002

Definitions of Variables:

BEAVPER = Bean purchases per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers
 CONMAIN = Dummy for labor constraint

Regression Results for Bean Purchases

Zone 2--Southwest

Dependent Variable.. BEAVPER

Multiple R .41080
 R Square .16876
 Adjusted R Square .15577
 Standard Error 10.81847

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	3041.38340	1520.69170
Residual	128	14981.02074	117.03922

F = 12.99301 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	1.50615E-03	3.76148E-04	-.32268	-4.004	.0001
ACTPERS	12.93056	4.09919	-.25420	-3.154	.0020
(Constant)	1.64619	2.50818		-.656	.5128

Definitions of Variables:

BEAVPER = Bean purchases per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 ACTPERS = Persons 15 to 64 years old per household member

Regression Results for Bean Purchases

Zone 3--Northcentral

Dependent Variable.. BEAVPER

Multiple R .27190
 R Square .07393
 Adjusted R Square .06077
 Standard Error 17.48491

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	5149.92154	1716.64051
Residual	211	64507.36137	305.72209

F = 5.61504 Signif F = .0010

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
DEPMAIN	-11.47337	5.42525	.14044	2.115	.0356
RUMPERS	3.87642	1.88111	-.13653	-2.061	.0406
ACTPERS	13.98097	5.22516	-.17767	-2.676	.0080
(Constant)	11.84438	3.10560		-3.814	.0002

Definitions of Variables:

BEAVPER = Bean purchases per household member (gifts included)
 RUMPERS = Small ruminants per household member
 ACTPERS = Persons 15 to 64 years old per household member
 DEPMAIN = Dummy for labor expenses

Regression Results for Bean Purchases

Zone 4--Southcentral

Dependent Variable.. BEAVPER

Multiple R .37329
 R Square .13935
 Adjusted R Square .12178
 Standard Error 9.60930

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	2197.67772	732.55924
Residual	147	13573.78291	92.33866

F = 7.93340 Signif F = .0001

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
PROPTUB	26.78508	6.11769	-.33779	-4.378	.0000
ACTPERS	6.87133	3.46093	-.15354	-1.985	.0490
BOVPERS	-5.72626	2.80693	.15843	2.040	.0431
(Constant)	-8.98829	4.51565		1.990	.0484

Definitions of Variables:

BEAVPER = Bean purchases per household member (gifts included)
 PROPTUB = Proportion of kilocalorie production in bananas and tubers
 ACTPERS = Persons 15 to 64 years old per household member
 BOVPERS = Cows per household member

Regression Results for Bean Purchases

Zone 5--East

Dependent Variable.. BEAVPER

Multiple R .31075
 R Square .09656
 Adjusted R Square .08366
 Standard Error 11.08560

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	1838.93632	919.46816
Residual	140	17204.66094	122.89044

F = 7.48202 Signif F = .0008

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
DEPINCI	-6.44017	1.85519	.27887	3.471	.0007
SUPTPER	2.57571E-04	1.49818E-04	-.13811	-1.719	.0878
(Constant)	13.20325	1.36240		-9.691	.0000

Definitions of Variables:

BEAVPER = Bean purchases per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 DEPINCI = Dummy for expenses on incidentals

Regression Results for Sorghum Sales

Zone 1--Northwest Not Enough Observations For Regression

Zone 2--Southwest Not Enough Observations For Regression

Zone 3--Northcentral No Significant Variables

Zone 4--Southcentral

Dependent Variable.. SOAVPER

Multiple R	.63615
R Square	.40469
Adjusted R Square	.35707
Standard Error	5.66713

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	1091.63606	272.90902
Residual	50	1605.81849	32.11637

F = 8.49751 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
REVMAN	-3.40297	2.02231	-.18742	-1.683	.0987
PROPTUB	-19.56135	5.25759	-.41036	-3.721	.0005
DEPINPU	4.01426	1.70416	.26489	2.356	.0225
SUPTPER	1.102233E-03	4.54883E-04	.27472	2.423	.0191
(Constant)	12.63710	3.30401		3.825	.0004

Definitions of Variables:

SOAVPER = Sorghum sales per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers
 REVMAN = Dummy for income from working in other's fields
 DEPINPU = Dummy for expenses on seed, field rent, or tools

Regression Results for Sorghum Sales

Zone 5--East

Dependent Variable.. SOAVPER

Multiple R .48940
 R Square .23951
 Adjusted R Square .21950
 Standard Error 45.06853

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	97236.23279	24309.05820
Residual	152	308738.18991	2031.17230

F = 11.96799 Signif F = 0.0

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
RUMPERS	16.94095	5.54354	.21623	3.056	.0027
PROPTUB	-128.49031	23.03254	-.39986	-5.579	.0000
CONFERT	-19.43001	7.46365	-.18506	-2.603	.0101
DEPVETE	-14.42257	7.35724	-.14116	-1.960	.0518
(Constant)	100.17304	12.91820		7.754	.0000

Definitions of Variables:

SOAVPER = Sorghum sales per household member (gifts included)
 RUMPERS = Small ruminants per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers
 DEPVETE = Dummy for expenses on clothing
 CONFERT = Dummy for soil fertility constraint

Regression Results for Sorghum Purchases

Zone 1--Northwest

Dependent Variable.. SOAVPER

Multiple R .57545
 R Square .33115
 Adjusted R Square .30288
 Standard Error 28.30131

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	6	56310.37596	9385.06266
Residual	142	113736.93299	800.96432

F = 11.71720 Signif F = 0.0

Equation Number 1 Dependent Variable.. SOAVPER

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	-4.83214E-03	1.32676E-03	-.29195	-3.642	.0004
MTIME	.10476	.05463	.13385	1.918	.0572
DEPFOOD	-14.35144	5.32314	-.19379	-2.696	.0079
REVVVIV	-14.53758	4.94494	-.21407	-2.940	.0038
RUMPERS	-6.91656	3.54230	-.15080	-1.953	.0528
CONSUPF	12.54329	5.61422	.17443	2.234	.0270
(Constant)	-6.24280	7.31493		-.853	.3949

Definitions of Variables:

SOAVPER = Sorghum purchases per household member (gifts included)
 RUMPERS = Small ruminants per household member
 SUPTPER = Farm surface area (ha) per household member
 MTIME = Average time (minutes) to bean and sorghum markets
 DEPFOOD = Dummy for food expenses
 REVVVIV = Dummy for income from food sales
 CONSUPF = Dummy for land constraint

Regression Results for Sorghum Purchases

Zone 2--Southwest

Dependent Variable.. SOAVPER

Multiple R .37174
 R Square .13819
 Adjusted R Square .12118
 Standard Error 52.04978

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	3	66031.72996	22010.57665
Residual	152	411795.28804	2709.17953

F = 8.12444 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
SUPTPER	-3.89471E-03	1.78537E-03	-.17814	-2.181	.0307
ACTPERS	-62.38509	18.12185	-.25935	-3.443	.0007
BOVPERS	-27.53215	16.46985	-.13647	-1.672	.0966
(Constant)	20.76725	11.14513		1.863	.0643

Definitions of Variables:

SOAVPER = Sorghum purchases per household member (gifts included)
 SUPTPER = Farm surface area (ha) per household member
 BOVPERS = Cows per household member
 ACTPERS = Persons 15 to 64 years old per household member

Regression Results for Sorghum Purchases

Zone 3--Northcentral

Dependent Variable.. SOAVPER

Multiple R .44261
 R Square .19590
 Adjusted R Square .17452
 Standard Error 25.68325

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	5	30213.08195	6042.61639
Residual	188	124010.31505	659.62934

F = 9.16062 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
CONSECH	-7.67875	4.27332	-.11912	-1.797	.0740
MTIME	-.20801	.07127	-.19601	-2.919	.0039
RUMPERS	-11.97501	3.04903	-.26099	-3.927	.0001
CONMAIN	-10.68401	5.28447	-.13511	-2.022	.0446
PROPTUB	44.31613	12.25656	.24212	3.616	.0004
(Constant)	-22.85766	8.37159		-2.730	.0069

Definitions of Variables:

SOAVPER = Sorghum purchases per household member (gifts included)
 RUMPERS = Small ruminants per household member
 PROPTUB = Proportion of kilocalorie production in bananas and tubers
 MTIME = Average time (minutes) to bean and sorghum markets
 CONSECH = Dummy for drought constraint

Regression Results for Sorghum Purchases

Zone 4--Southcentral

Dependent Variable.. SOAVPER

Multiple R .24814
 R Square .06157
 Adjusted R Square .04984
 Standard Error 21.66236

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	4926.23876	2463.11938
Residual	160	75081.23852	469.25774

F = 5.24897 Signif F = .0062

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
REVCIND	-8.34481	3.66133	-.17464	-2.279	.0240
RUMPERS	-8.25605	3.70741	-.17064	-2.227	.0273
(Constant)	-6.95144	2.46629		-2.819	.0054

Definitions of Variables:

SOAVPER = Sorghum purchases per household member (gifts included)
 RUMPERS = Small ruminants per household member
 REVCIND = Dummy for income from industrial crops

Regression Results for Sorghum Purchases

Zone 5--East

Dependent Variable.. SOAVPER

Multiple R .23457
 R Square .05502
 Adjusted R Square .03873
 Standard Error 27.59015

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	5141.45265	2570.72633
Residual	116	88301.09758	761.21636

F = 3.37713 Signif F = .0375

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
CONMAIN	10.24521	5.27043	.18202	1.944	.0543
DEPFOOD	11.62456	5.33154	.20416	2.180	.0313
(Constant)	-23.35302	5.09384		-4.585	.0000

Definitions of Variables:

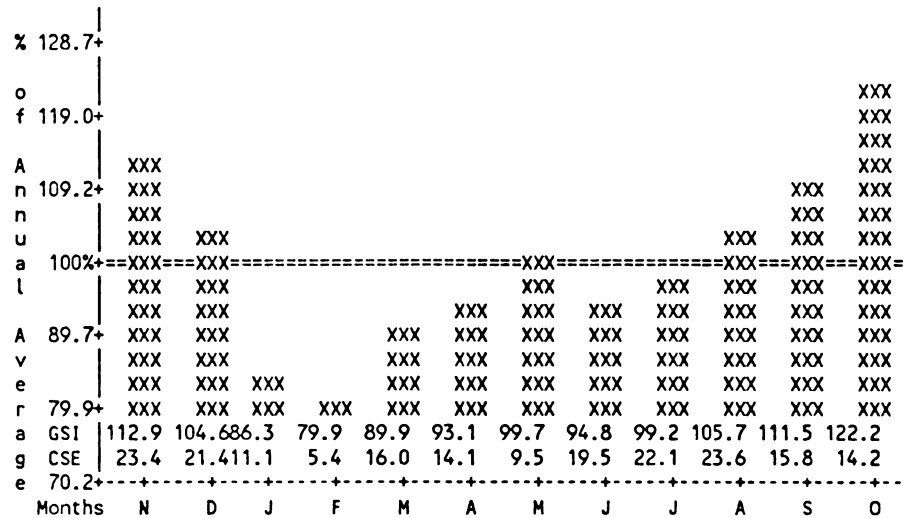
SOAVPER = Sorghum purchases per household member (gifts included)
 DEPFOOD = Dummy for food expenses
 CONMAIN = Dummy for labor constraint

Annex III: Grand Seasonal Indexes for Retail Food Prices

Calculating the Grand Seasonal Index.

In order to generate the grand seasonal index, a "Twelve Month Moving Average" is first calculated for each month. A twelve month moving average is the average price during the six months prior to, and the six months after the month in question. After calculating the twelve month moving average, the observation for the month is divided by its twelve month moving average to calculate a monthly "Seasonal Index". According to Goetz and Weber in their publication, "Fundamentals of Price Analysis in Developing Countries Food Systems: A Training Manual to Accompany the Microcomputer Software Program 'MSTAT'", the grand seasonal index is calculated by "...finding the average seasonal index for each month over the period of the analysis, and then adjusting those averages so that they sum to 1200." They go on to note that "...because of this averaging procedure the GSI should in principle be purged of all random variations in the time series data."

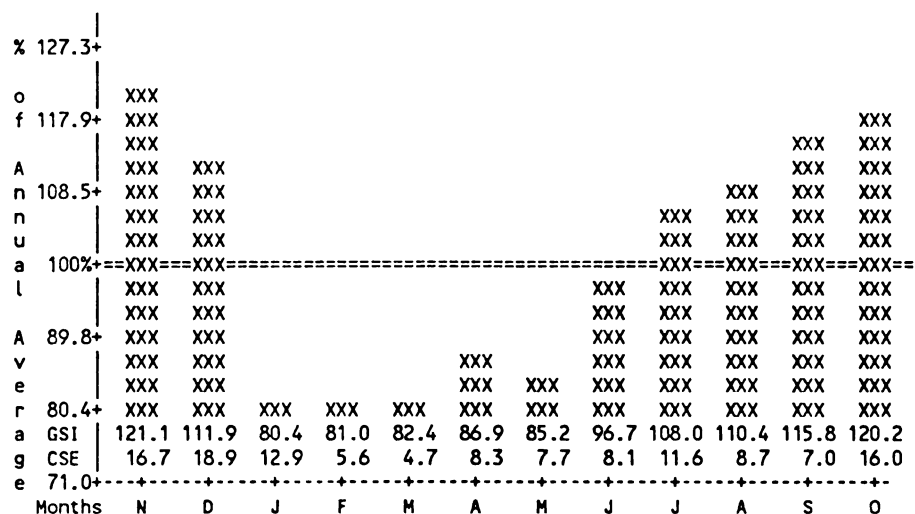
Figure A3.1
Graph of the Grand Seasonal Index
for
Gitarama Bean Prices, Jan 1980 - Nov 1987



GSI is the grand seasonal index
CSE represents the corrected standard error

The 100% line in the barchart represents the average of 31.627 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 11.1 for January indicates that the January value will lie within plus or minus 11.1 percentage points of its mean in 7 out of 10 years

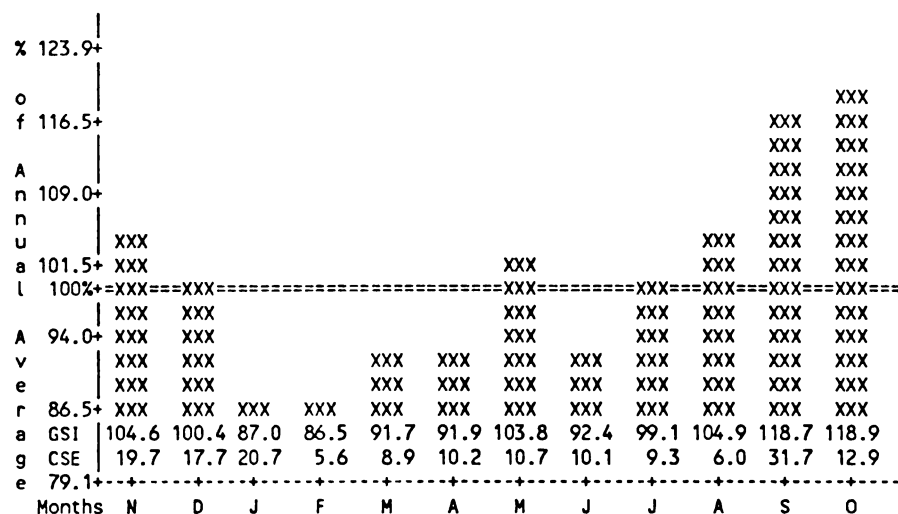
Figure A3.2
Graph of the Grand Seasonal Index
for
Kigali Bean Prices, Jan 1980 - Nov 1987



GSI is the grand seasonal index
CSE represents the corrected standard error

The 100% line in the barchart represents the average of 33.458 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 12.9 for January indicates that the January value will lie within plus or minus 12.9 percentage points of its mean in 7 out of 10 years

Figure A3.3
Graph of the Grand Seasonal Index
for
Ruhengeri Bean Prices, Jan 1980 - Nov 1987

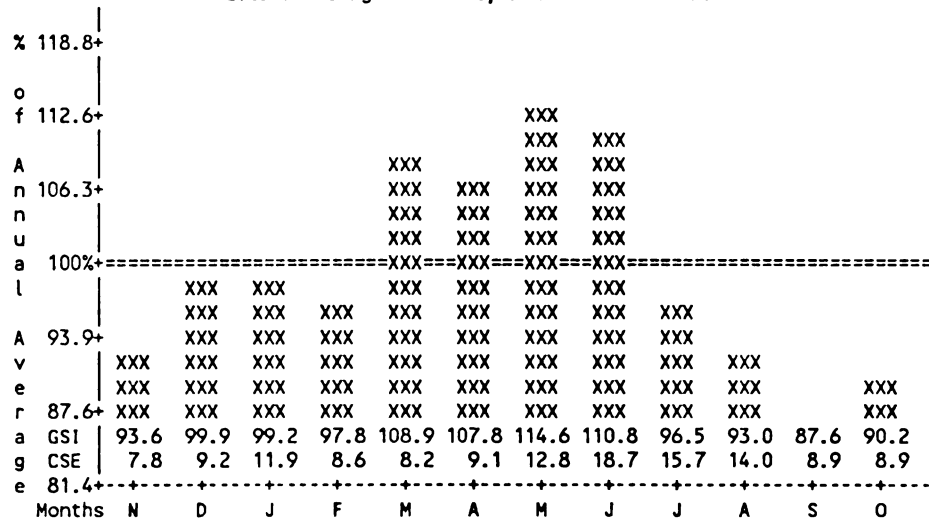


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 31.976 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 20.7 for January indicates that the January value will lie within plus or minus 20.7 percentage points of its mean in 7 out of 10 years

Figure A3.4
Graph of the Grand Seasonal Index
for
Gitarama Sorghum Prices, Jan 1980 - Nov 1987

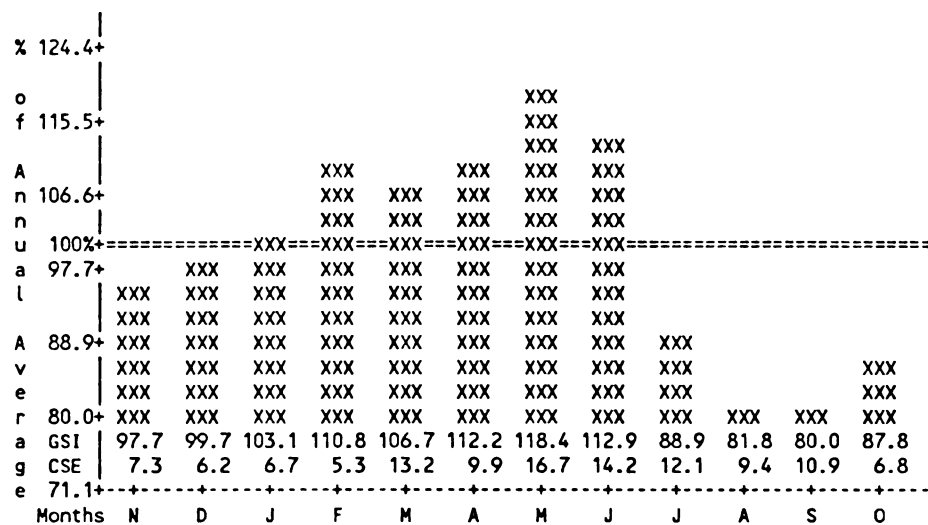


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 23.759 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 11.9 for January indicates that the January value will lie within plus or minus 11.9 percentage points of its mean in 7 out of 10 years.

Figure A3.5
Graph of the Grand Seasonal Index
for
Kigali Sorghum Prices, Jan 1980 - Nov 1987

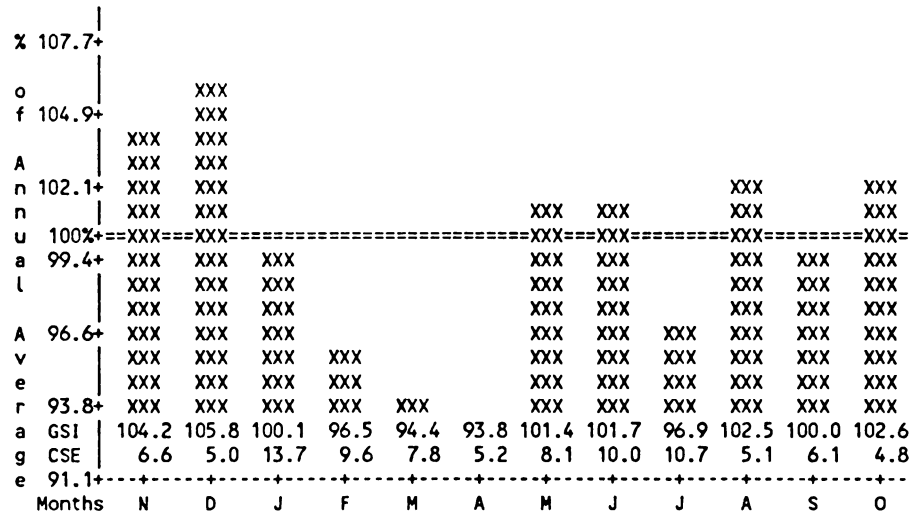


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 28.361 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 6.7 for January indicates that the January value will lie within plus or minus 6.7 percentage points of its mean in 7 out of 10 years.

Figure A3.6
Graph of the Grand Seasonal Index
for
Ruhengeri Sorghum Prices, Jan 1980 - Nov 1987

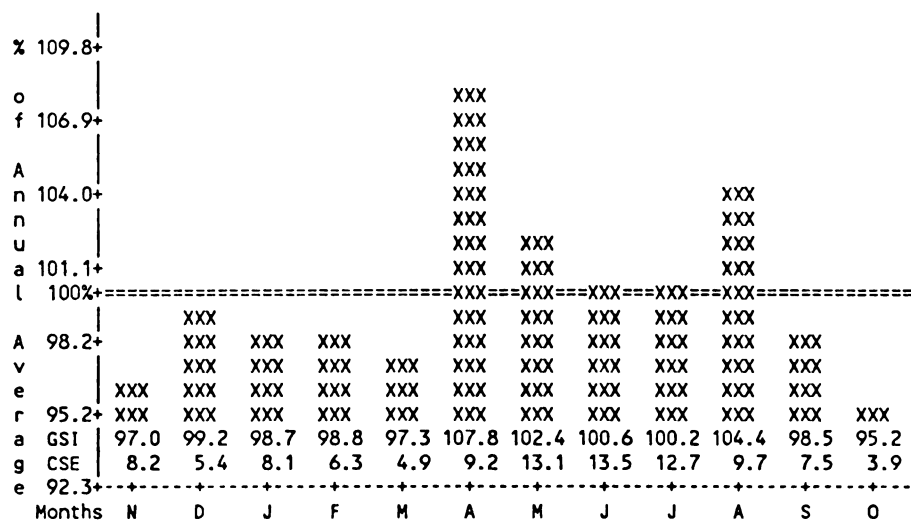


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 25.506 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 13.7 for January indicates that the January value will lie within plus or minus 13.7 percentage points of its mean in 7 out of 10 years.

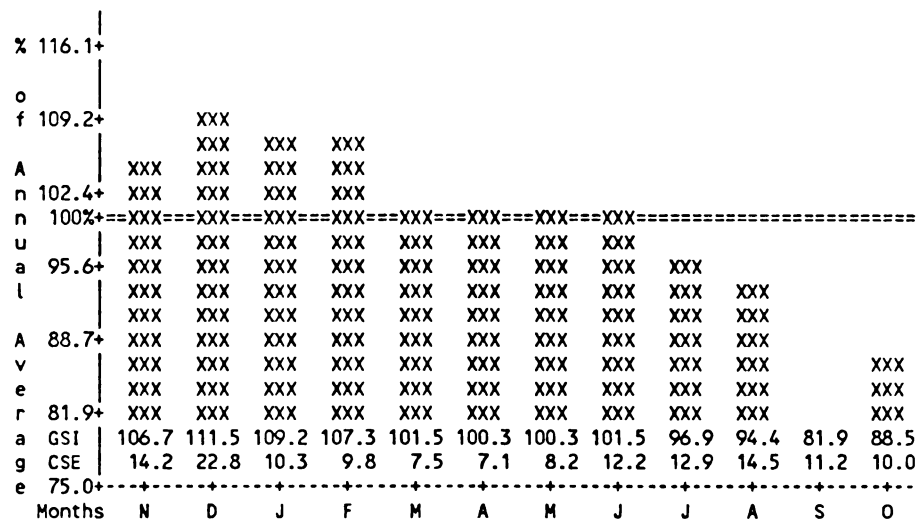
Figure A3.7
Graph of the Grand Seasonal Index
for
Gitarama Banana Prices, Jan 1980 - Nov 1987



GSI is the grand seasonal index
CSE represents the corrected standard error

The 100% line in the barchart represents the average of 16.446 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 8.1 for January indicates that the January value will lie within plus or minus 8.1 percentage points of its mean in 7 out of 10 years.

Figure A3.8
Graph of the Grand Seasonal Index
for
Kigali Banana Prices, Jan 1980 - Nov 1987

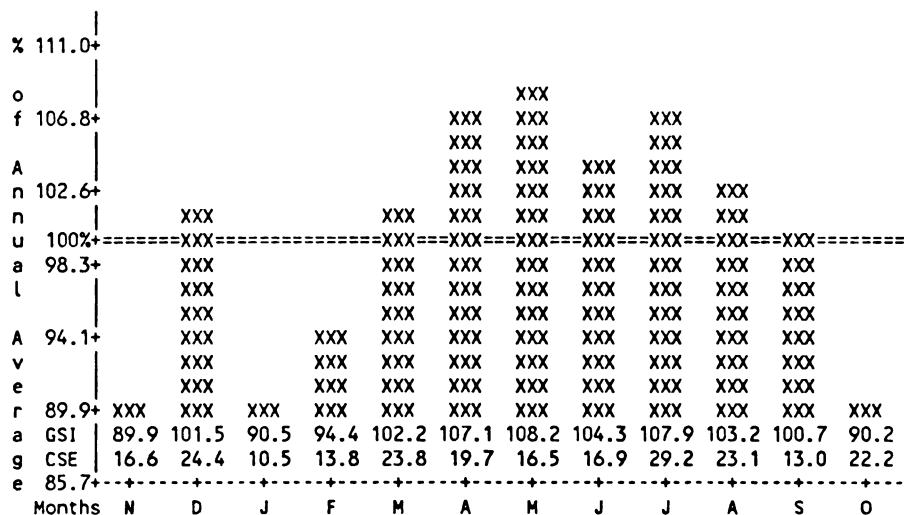


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 16.566 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 10.3 for January indicates that the January value will lie within plus or minus 10.3 percentage points of its mean in 7 out of 10 years.

Figure A3.9
Graph of the Grand Seasonal Index
for
Ruhengeri Banana Prices, Jan 1980 - Nov 1987

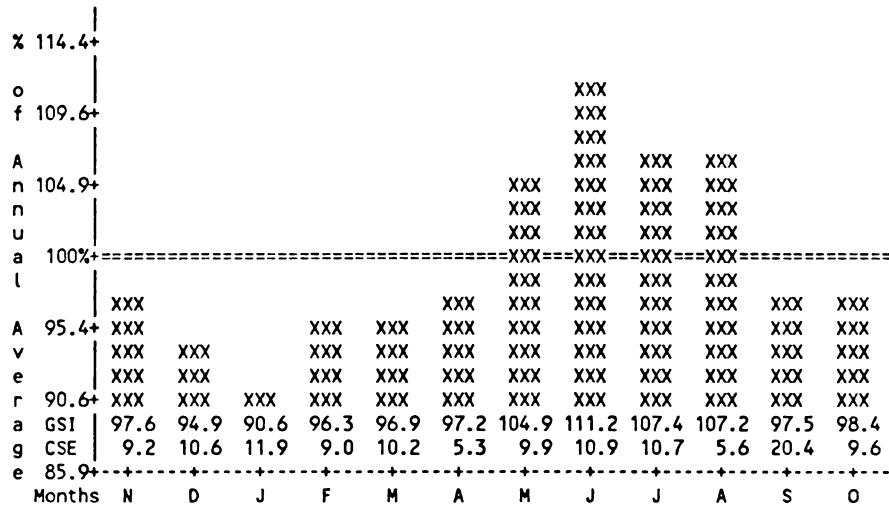


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 12.506 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 10.5 for January indicates that the January value will lie within plus or minus 10.5 percentage points of its mean in 7 out of 10 years.

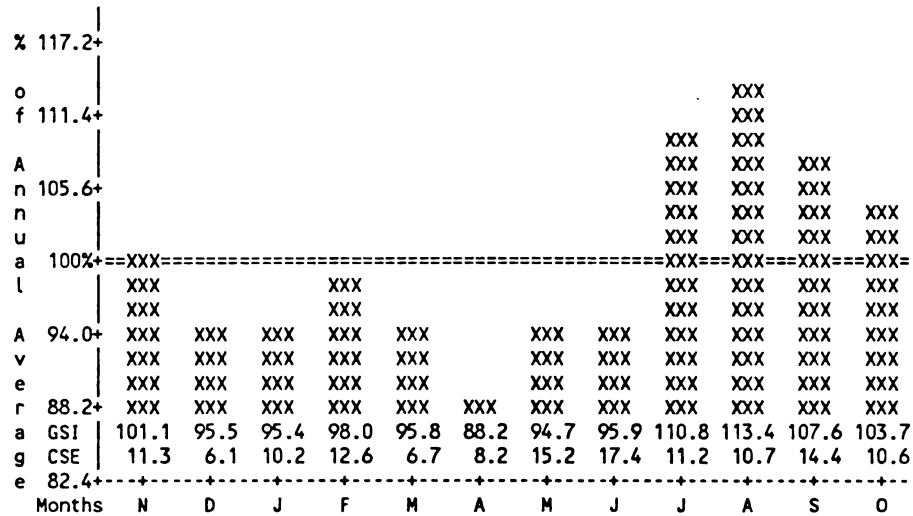
Figure A3.10
Graph of the Grand Seasonal Index
for
Gitarama Irish Potato Prices, Jan 1980 - Nov 1987



GSI is the grand seasonal index
CSE represents the corrected standard error

The 100% line in the barchart represents the average of 15.217 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 11.9 for January indicates that the January value will lie within plus or minus 11.9 percentage points of its mean in 7 out of 10 years.

Figure A3.11
Graph of the Grand Seasonal Index
for
Kigali Irish Potato Prices, Jan 1980 - Nov 1987

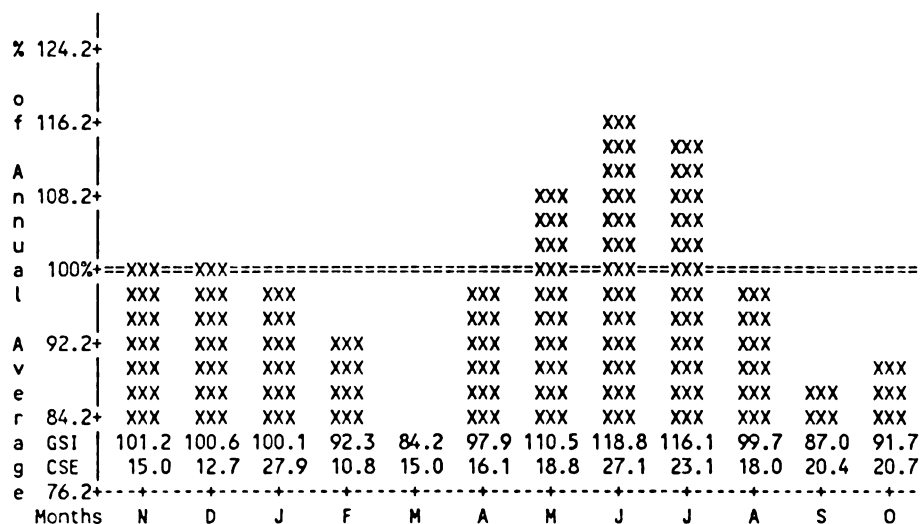


GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 14.410 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 10.2 for January indicates that the January value will lie within plus or minus 10.2 percentage points of its mean in 7 out of 10 years.

Figure A3.12
Graph of the Grand Seasonal Index
for
Ruhengeri Irish Potato Prices, Jan 1980 - Nov 1987



GSI is the grand seasonal index

CSE represents the corrected standard error

The 100% line in the barchart represents the average of 10.699 currency units over the 8 year period of analysis of commodity price data. The month index value indicates by how many percentage points each month's value lies above or below the annual average. The standard error of 27.9 for January indicates that the January value will lie within plus or minus 27.9 percentage points of its mean in 7 out of 10 years.

Figure A3.13

Monthly Rural Dry Bean Production
in Gitarama Prefecture
1986 Agricultural Year

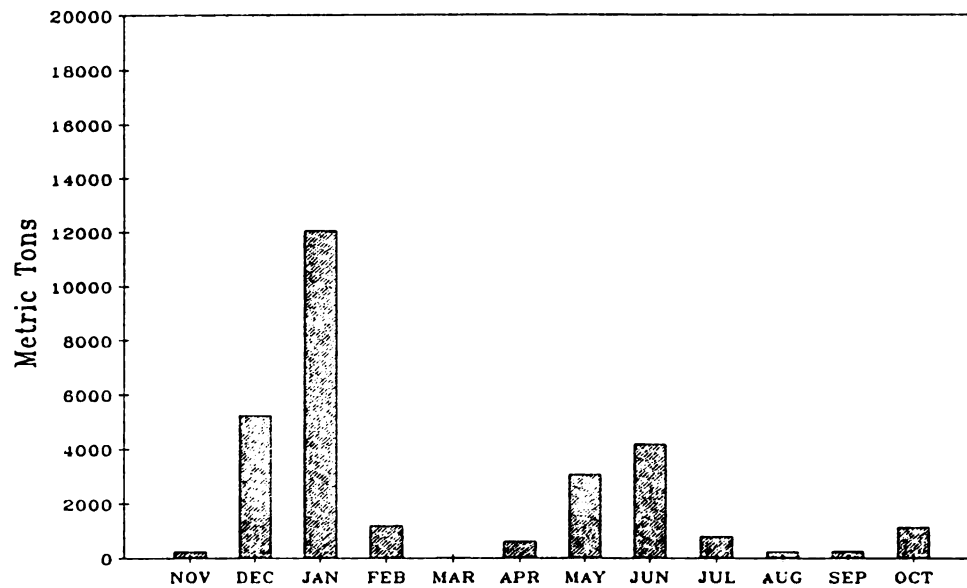


Figure A3.14

Monthly Dry Bean Production
in Kigali Prefecture
1986 Agricultural Year

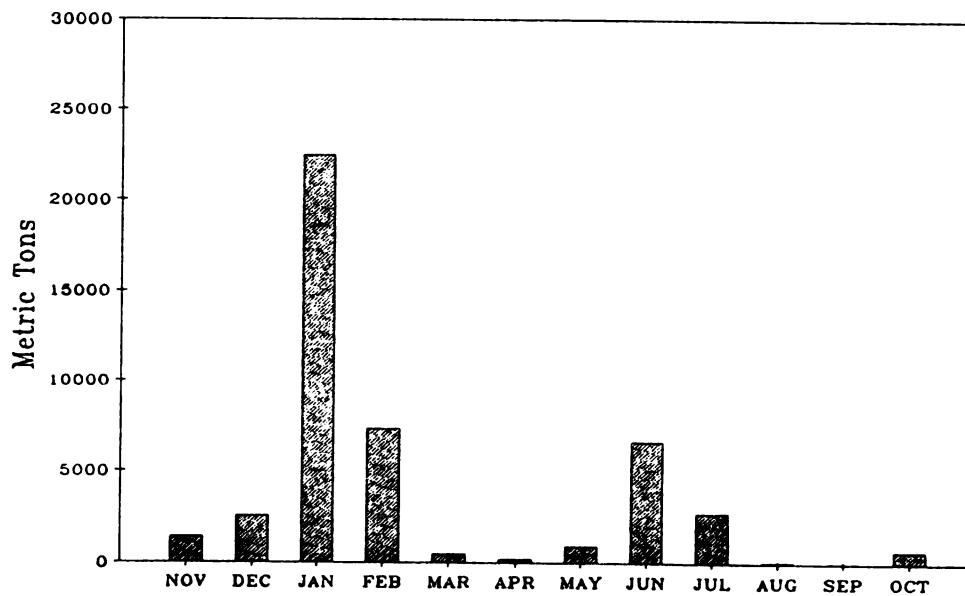


Figure A3.15

Monthly Rural Dry Bean Production
in Ruhengeri Prefecture
1986 Agricultural Year

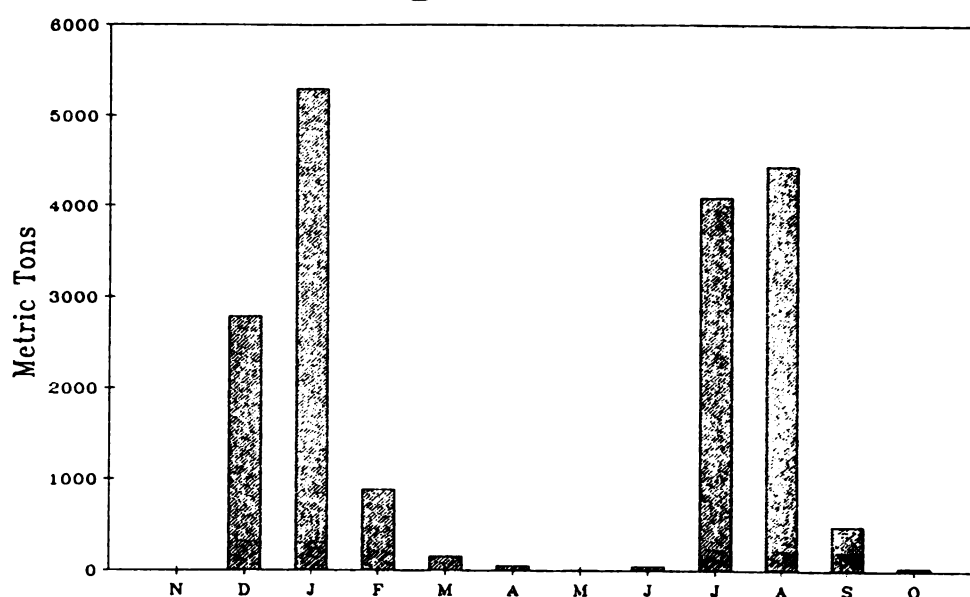


Figure A3.16

Monthly Rural Sorghum Production
in Gitarama Prefecture
1986 Agricultural Year

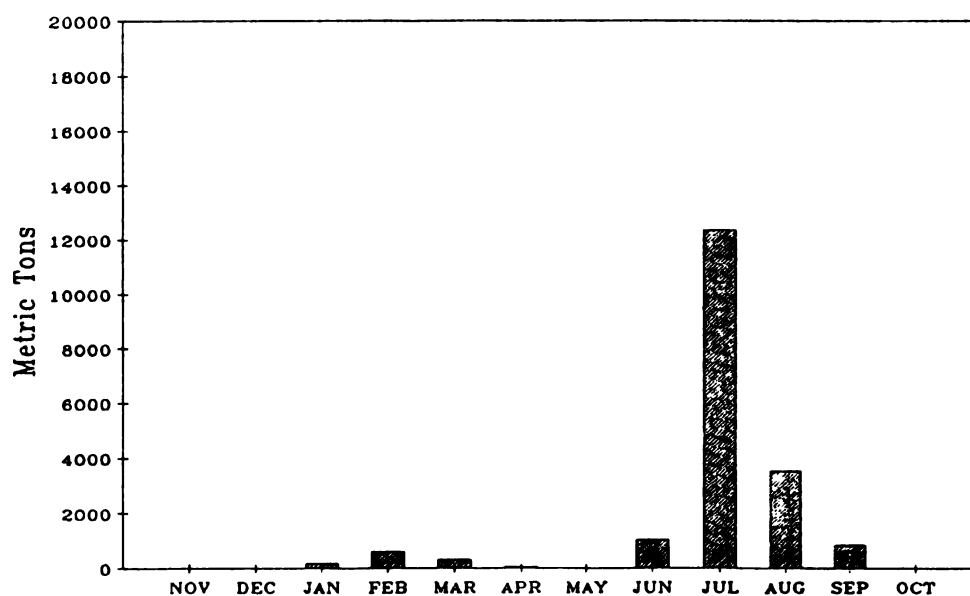


Figure A3.17

Monthly Rural Sorghum Production
in Kigali Prefecture
1986 Agricultural Year

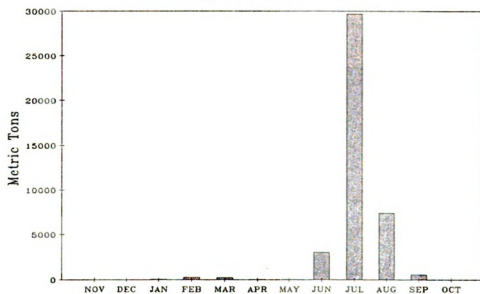


Figure A3.18

Monthly Rural Sorghum Production
in Ruhengeri Prefecture
1986 Agricultural Year

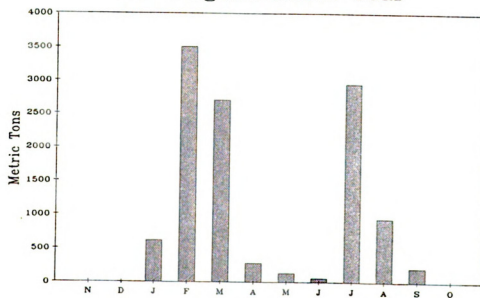


Figure A3.19
Monthly Rural Cooking Banana
Production in Gitarama Prefecture
1986 Agricultural Year

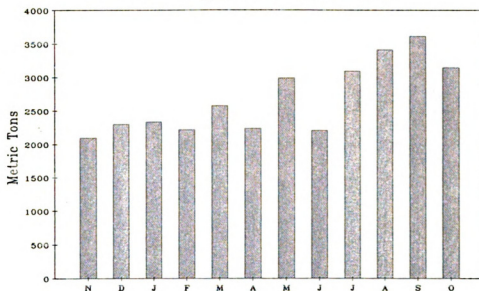


Figure A3.20
Monthly Rural Cooking Banana
Production in Kigali Prefecture
1986 Agricultural Year

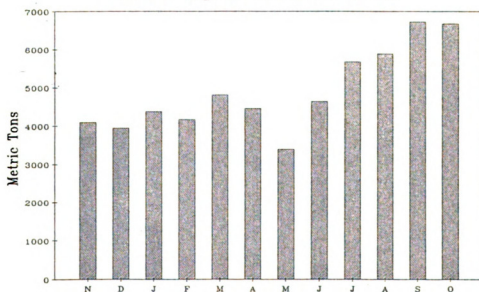


Figure A3.21

Monthly Rural Cooking Banana
Production in Ruhengeri Prefecture
1986 Agricultural Year

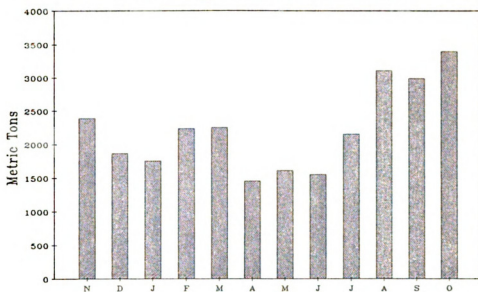


Figure A3.22

Monthly Rural Irish Potato Production
in Gitarama Prefecture
1986 Agricultural Year

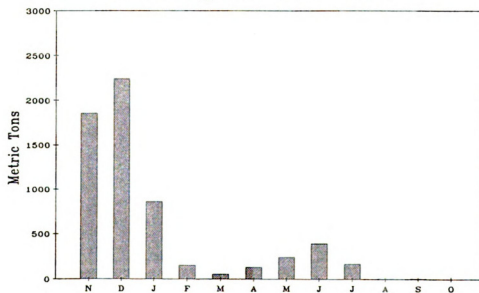


Figure A3.23

**Monthly Rural Irish Potato Production
in Kigali Prefecture
1986 Agricultural Year**

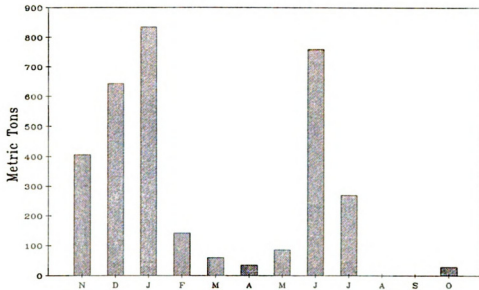


Figure A3.24

**Monthly Rural Irish Potato Production
in Ruhengeri Prefecture
1986 Agricultural Year**

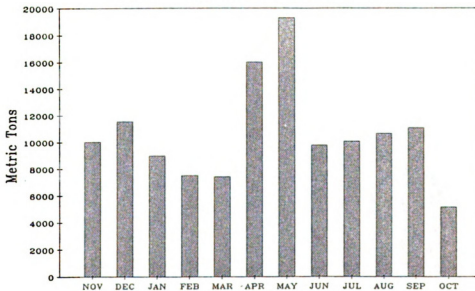


Figure A3.25

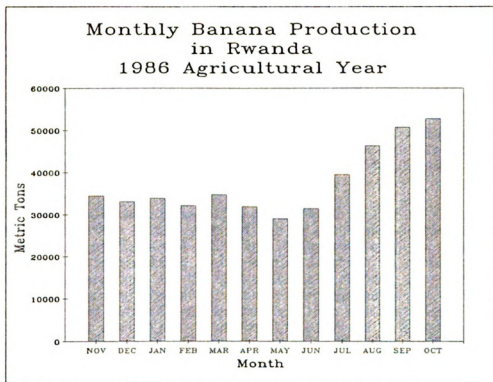
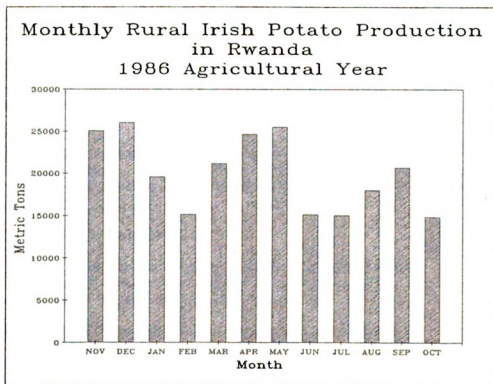


Figure A3.26



Annex IV:

A Brief Overview of the Method Used to Draw the SESA Sample

SESA obtained technical assistance from the U.S. Bureau of Census in drawing its sample. This annex provides a summary of two papers written by Bureau of Census staff to describe sample selection methods, calculation of weights, and variance estimation procedures.

The sample frame used in the collection SESA's 1986 data was developed using a subset of SESA's 1984 sample. In order to explain the 1986 sample it is therefore necessary to describe the 1984 sample first.

The 1984 sample was drawn using a two-stage stratified cluster design. Thirty-five strata were defined by geographical areas: 10 administrative (prefectural) units and 12 agro-ecological regions. Each stratum was represented in the sample in order to allow production estimates by prefecture and by agro-ecological region. For the first stage of the sampling procedure, a pre-determined number of secteurs from each stratum were chosen randomly and then districts within each secteur selected randomly. The number of districts selected per stratum was determined by population estimates from the 1978 census. In total, 150 districts were selected. In the second stage, households in each selected district were listed in serpentine fashion by enumerators, and grouped into clusters of ten households. Two clusters of ten households per district were randomly selected from the listings. Seven households per cluster were used in the sample, with three households per cluster as replacements.

After the 1984 survey, budgetary constraints mandated a 50% reduction in the staff of 150 enumerators. Using results from the 1984 survey, the SESA staff developed a five zone classification scheme for Rwanda as an alternative to the twelve agro-ecological regions¹. The 35 strata from the 1984 survey were collapsed² into 21 strata following prefectural and agricultural region lines.

Districts were then chosen by sampling from the districts included in the 1984 survey³. In total 78 districts were selected. The number of districts per stratum was determined by population estimates from

¹See Clay and DeJaegher.

²That is, the strata were collapsed in all prefectures except for Kibuye, where four new strata were formed to replace the three strata in the 1984 survey.

³Except in Kibuye, where new secteurs were chosen.

the 1978 census. The household listings in each district were updated, and new clusters of households chosen randomly, using the same method as in the 1984 survey.

The weighting factors applied to both the 1984 and the 1986 data are based upon probability of selection. This was calculated by using the 1978 population census results and the district listings established by SESA enumerators.

Readers wishing more detailed information on this topic are referred to:

1. "Sample Design for the Rwanda National Agricultural Survey", by Karen Stanecki and Rita Petroni, International Statistical Programs Center, Bureau of the Census, August 1984.
2. "Sample Design and Variance Estimation Procedures for the Rwanda Crop Forecasting Survey", by Karen Stanecki, Bureau of the Census, April 1985.

Annex V

A Discussion of Recently Proposed Tests of Market Integration

Recent developments in the literature on testing market integration are worth reviewing briefly here in light of what this research has uncovered about farmer marketing behavior in Rwanda.

Ravallion and Timmer have both proposed alternatives to the bivariate correlation test of market integration. Ravallion's model and Timmer's model¹ resemble each other. Ravallion used the following theoretical formulation:

$$P_1 = f_1(P_2, P_3, \dots, P_N, X_1) \quad (3)$$

$$P_i = f_i(P_1, X_i) \quad (i = 2, \dots, N) \quad (4)$$

Where P_1 = Price in the central (urban) market
 P_i = Price in the i^{th} (rural) market
 X_i = Other influences on local markets

In practice, Ravallion ignores equation 3, and uses equation 4 to estimate the effect of lagged dependent and independent variables on prices in the i^{th} market. The length and strength of the lagged effect is then the determinant of market integration. This "radial model" may be useful in situations where rural market surplus is being vented in a central urban setting but cannot be adapted to Rwanda because, as was shown in section V, Rwanda is concurrently a producer and a net bean and sorghum importer. As a net importer, Rwanda's central market prices must depend as much on foreign prices as rural prices closer to home. Rural prices must also depend on local supplies, transfer costs, and cost of foreign supplies. The direction of product flow may change from month to month depending on the location of sources of supply. Timmer's own (1974) work shows that central market prices in some countries may be higher than rural prices most of the year but lower than rural prices in the hungry period just prior to harvest--and plots of the data from Rwanda exhibit this phenomenon. The radial formulation could be useful in African countries where the rural areas never acquire food supplies via outside sources such as the central market or informal imports, but evidence is mounting (see forthcoming MSU studies on Mali, Somalia, and Senegal) that in many countries, a large proportion of farmers are net food buyers. Where many farmers are net food buyers, the region may be importing food from other areas. The radial model should not be used unless the direction of product flow is well understood.

¹As described in Goetz and Weber.

Delgado has also attempted to construct a model to test market integration which builds on Jones' work while correcting for the flaws highlighted by Harriss. Delgado's "variance components" approach uses the following formulation:

$$p_{it}(s) = m(s) + v_i(s) + u_t(s) + z_{it}(s) \quad (6)$$

Where $p_{it}(s)$ = Price in market i at time t in season s
 $m(s)$ = Sample mean price in season s
 $v_i(s)$ = Village effect--village i in season s
 $u_t(s)$ = Constant weekly time effect in season s
 $z_{it}(s)$ = Stochastic interaction term in season s

In applying this model, Delgado runs separate regressions on "harvest" and "postharvest" seasons because he found that variance of prices in his data is not constant between seasons. Delgado subtracts the season mean price in each village from each observation to remove the sample mean and village price effects, resulting in observations combining the time (seasonal) effect and the error term. He then runs regressions on sixth order polynomials constructed with powers of time to differentiate between the seasonal effect and the error term. The regressions are run on individual villages and on the pooled sample. The test for integration then becomes an F-statistic testing the hypothesis that the seasonal effect is the same in individual villages as it is in the pooled sample.

The advantages of Delgado's approach are that it allows for a joint, rather than pair-wise test of market integration, and that seasonality and inflation are accounted for in the model. Unfortunately, there is an assumption at the very heart of the model which makes it of little use in practical tests of market integration in Rwanda and many other African countries: homogeneity of the geographic regions under study. This homogeneity assumption is critical to the model because market integration is tested by looking for equivalence of seasonality. But the discussion of figure 3 showed that there are significant geographical differences in levels of net imports in Rwanda. These arise *inter alia* from differences in altitude, rainfall, soil type, consumption habits and population density--all of which influence seasonality of production and prices.

Consider a hypothetical example. Population density alone could cause significant differences in seasonality of prices in two areas producing a given commodity. As the more densely populated area runs out of locally produced supplies, it is forced to incur transfer costs necessary to bring product from other areas. Meanwhile, the less densely populated area has adequate local supplies, and does not pay transfer costs. Therefore prices rise more in the densely populated

area than they do in the low population density area even though the markets are integrated.

To give an example specific to Rwanda, sorghum production in the northwest of the country peaks in February, while in the rest of the country, July is the peak sorghum production period. This reversal of seasonality is due to differences in altitude and soil type. The existence of a reversal of seasonality renders the Delgado model useless for Rwanda.

When geographical regions are extremely homogeneous, it may not be interesting to study market integration. According to trade theory, trade arises as a result of different factor endowments or because of product differentiation. Why would two homogeneous regions trade in an undifferentiated commodity like millet or sorghum? The presence of homogeneous regions in Delgado's study suggests that prices in these regions may be jointly affected by some exogenous variable (i.e. prices in a heterogeneous region), and that a radial model might have been more appropriate.

Annex VI

A Summary of Results from the Merchant I Survey

Survey Method

Each interview lasted approximately thirty minutes, depending on the number of times the interview was interrupted to allow the merchant to serve clients. The questions were asked on an open ended basis, and coded immediately by the enumerator. As there was only one enumerator, who had participated in the conception and design of the survey, a formal translation of the interview schedule into Kinyarwanda was not made.

Summary of Survey Results for Bean Merchants.

Thirty-three merchants were interviewed in the five prefectures. All but two of the interviewees market beans year round. Seventy-six percent of the merchants interviewed said they acquire beans throughout the year. Others concentrate their purchases around harvest times. All but four of the interviewees said their sales strategy was to sell continuously. Four merchants said they hold off selling until prices rise. Twenty-one percent of those interviewed said they buy beans from farmers bringing them beans. Merchants engaging in this type of assembly operation tend to have smaller stocks than other types of merchants.

Fifty-eight percent of the interviewees mentioned truckers as a source of their beans. Businessmen buying from truckers tend to have larger stocks than those buying from farmers. Thirty-three percent of the bean sellers own trucks. Not all them use their trucks to in the process of buying beans. Twenty-four percent of the bean merchants interviewed said they use trucks to buy beans from assemblers. These merchants tend to have the largest stocks. All of the truck owners said their trucks are most frequently loaded on the return trip only.

Stocks on hand for bean merchants ranged from 100 to 800,000 kilos, with an average of 31,773 kilos. Average estimated turnover time for beans was 39 calendar days, with a maximum of 150 calendar days, a minimum of one day, and a mode of 30 calendar days.

Bean merchants in the sample are open for business an average of only three days per week. Many of the merchants who are open very few days per week are assemblers. Some retailers also fall into this category.

Nine of the bean merchants interviewed use a family member to help them in the business. Five use hired workers and family members to

help them, and four use hired workers only. The other fourteen interviewees work alone in their stores.

Three of the thirty-three interviewees have stores in more than one location. Twelve of the interviewees own their own store. Storage capacities of bean merchants range from zero (merchants with no enclosed storage area) to 2,000 metric tons.

Average reported storage capacity was 86 tons. Fourteen merchants reported their storage capacity to be less than ten tons. Fourteen businessmen said their storage capacity is between 10 and 65 tons. Five persons claimed to have 100 or more tons of storage space.

Only four interviewees engage in any kind of contracting for bean purchases and sales. These merchants tend to be medium to large scale merchants.

Fifty-six percent of the bean merchants said that they base their pricing decisions on their perception of the product's availability on the market. Thirty-three percent of the interviewees said they used information from their suppliers in making pricing decisions.

Sixty percent of the merchants make wholesale purchases. Fifty-eight percent of the interviewees buy small quantities of beans. Eighty-two percent of the bean sellers sell retail quantities, while forty-five percent sell wholesale quantities. Margins for bean merchants ranged from negative fifteen frw/kg to positive 13 frw/kg. The most frequently quoted margin was one frw/kg.

The mean number of years bean merchants said they have been in business was three, with fifty-eight percent of the merchants stating that they had started their businesses in 1985 or 1986.

Summary of Survey Results for Sorghum Merchants.

Twenty interviews with sorghum merchants were conducted in the five prefectures. All of the sorghum merchants interviewed market the product year round. Thirty percent of the interviewees said they concentrate their purchases around harvest time. The remaining 70% said they buy progressively throughout the year. Four merchants said they hold off sales until sorghum prices rise, while the rest of the group said they sell continuously. Twenty-five percent of the interviewees said they buy sorghum from farmers bringing the product to them. Seventy percent of the merchants get sorghum from truckers who bring it to them. Thirty percent of the sorghum merchants own trucks. Not all of them use their trucks to obtain sorghum. Twenty percent of those interviewed said they use trucks to buy sorghum from assemblers, and 10% go to the farmgate to buy sorghum.

Estimated quantities on hand for sorghum merchants ranged from zero to 30,000 kilos, with an average of 2060 kilos. Average estimated turnover rate for the thirteen merchants who had stocks and could

respond to the question was 27 days. The most frequent response among this group to the question of estimated turnover time was 30 days.

Sorghum merchants in the sample are open an average of four days per week. Three of the five merchants who buy sorghum from farmers that bring the sorghum to them are open only one or two days per week.

Four sorghum merchants use a family member to help them in the business. Three use workers and family members to help them, one uses workers and no family members in the store, while the other twelve work alone in their business.

Nine of the twenty interviewees own their own store. One of them has another store in another location. Merchants' estimated storage capacities ranged from zero (merchants with no enclosed storage) to 150 metric tons. Average reported storage capacity was 33 tons. Seven merchants reported the total storage capacity to be less than ten tons. Nine merchants said they could store between ten and sixty-five tons. Three firms claimed their storage capacity was 100 tons or more.

Only four of the interviewees engage in any kind of contracting with either buyers or sellers. As with beans, these merchants had medium to large scale businesses.

Sixty percent of the merchants interviewed said they base their pricing decisions on their perception of the availability of sorghum on the market. Twenty-five percent of the interviewees claim they make their pricing decisions based on the price they pay to their suppliers.

Forty-two percent of the respondents purchase large quantities of sorghum. Sixty-six percent buy sorghum in small quantities. Eighty-six percent of the respondents who answered a question regarding the frequency of retail sales said they performed this type of operation. Thirty-seven percent of those answering questions on the frequency of wholesale sales said they had this type of operation. Margins ranged from one to twelve frw/kg, with one and two frw/kg being the most frequently cited margins.

The mean number of years sorghum merchants claimed to have been in business was six. Ten sorghum merchants stated that they had started their businesses in 1985 or 1986.

The Modal Merchant

The largest number of merchants interviewed carry two products: beans and either sorghum or potatoes. Truckers who bring the product to the merchant were mentioned most frequently as suppliers. Zero and 1,000 kilos were the most frequent estimated quantities in stock (all products). The mode estimated turnover time for potato merchants was seven days. For other types of merchants, the most frequently cited turnover time was thirty days.

The largest number of merchants are open six or seven days per week, do not own a means of transport, and work alone in their stores. Most merchants do not own their own store. The most frequently cited storage capacity was between eight and nine tons. The majority of the merchants interviewed purchase their products all year round, not just at harvest time. Similarly, most merchants' sales strategy is to sell continuously. Most merchants do not engage in verbal or written contracting with either suppliers or buyers, and most make their pricing decisions based on their perception of the changes in supplies in the market.

The modal merchant makes wholesale purchases and also purchases small quantities of products. The majority of the interviewees make retail sales, and do not sell wholesale. A large majority of merchants interviewed claimed to have started their businesses in either 1985 or 1986. This is probably due to a combination of factors. First, merchants who have not paid their taxes in prior years may be hesitant to give the true number of years they have been in business. Second, the failure rate in such small, poorly capitalized businesses with inexperienced and uneducated managers is bound to be high.

Annex VII

Main Body of the Text From a Working Paper Entitled:

"Relationships Between Bean Marketings and Bean Production Techniques: A Study of Fifteen Farms in the Prefecture of Kigali"

by Scott Loveridge with Krista C. Dessert.

Executive Summary

A multiple visit survey was conducted on fifteen farms. The purpose of the survey was to explore bean cultural practices in farms that buy beans, farms have few transactions in beans, and farms that sell beans, and to provide some insights useful in suggesting hypotheses and questions to be asked by survey researchers in the future. The fifteen farm sample was divided evenly between net buyers of beans, farms which have few transactions in beans, and net sellers of beans.

Clear patterns of land and labor use differences between bean buyers, bean self-sufficient farms, and bean sellers appear to exist in the sample. Methods of planting, seed selection criteria, and farmers' perceived production constraints also appear to be related to family net position in beans. Bean yields seem to be higher on farms where the family is a net bean buyer.

There is some indication that bean yields may be declining for the farms in the sample, which may be one reason that almost all of the interviewees had recently adopted new soil fertility maintenance techniques. The majority of farms reported having no bean storage losses.

Given the restricted sample used in the course of the study, it is suggested that the relationships highlighted in this document be explored with a larger sample, to enable formulation of more statistically valid statements, which could in turn be used to redirect ongoing bean production research.

Survey Participants and Survey Foundation

This section describes results of a survey conducted jointly by SESA and CIAT researchers. The purpose of the survey was to provide some insights useful in suggesting hypotheses and questions to be asked in further survey research.

The International Center for Tropical Agriculture (CIAT), based in Cali, Colombia South America, initiated a regional bean improvement program in the Great Lakes region of Africa in October 1983. The objective of CIAT's regional bean improvement program is to work with

national scientists and organizations to increase average bean (*phaseolus vulgaris*) yields in the Great Lakes region of Central Africa. This region encompasses the countries of Rwanda, Burundi, and the Kivu region of Zaire. The program's principal strategy is helping national bean research programs introduce more productive bean varieties and more efficient cultural practices into farmers' cropping systems. The target group is the small farmer, and emphasis is placed on minimal input technology. In the Great Lakes Region, CIAT is working together with PNL, Zaire (Programme Nationale Legumineuse), ISABU (Institut des Sciences Agronomiques du Burundi), and ISAR (Institut des Sciences Agronomiques du Rwanda).

As analysis of the data from SESA's transactions survey began, it became apparent that trade in beans is important in the rural Rwandan economy, with three basic types of households emerging:

1. Net Bean Buyers. Almost all of these households produce beans, but not enough to satisfy family consumption requirements, so they purchase beans to supplement their own production.
2. Bean Self-Sufficient Households. Households which rarely buy or sell beans.
3. Net Bean Sellers. This type of household produces enough for family needs, and earns supplemental income by selling its surplus beans.

It was felt that these three types of households might differ not only in terms of their net position in bean purchases, but also in their bean production methods. SESA and CIAT researchers decided to work together to develop and field a survey of fifteen farms, which would allow them to test in a limited way some preliminary hypotheses about differences in cultural practices between net bean buyers, self-sufficient, and net bean sellers. This section reports the results of that survey.

Readers should interpret these results carefully, as the sample size and the fact that the sample was drawn from one agro- ecological zone do not permit extrapolation of the data to the farm population as a whole.

The rest of this annex is laid out as follows: the methods section lays out the schedule of surveys and their content, as well as outlining basic household characteristics which were used to draw the sample. The methods sub-section is followed by a description of the results obtained by the various surveys. Finally, a conclusions sub-section formulates hypotheses which the authors recommend be tested on a larger, more representative sample of farm households.

Methods

A multiple-visit approach was devised. Researchers made three field visits. In addition, SESA enumerators visited the farms to collect supplementary data. Table A7.1 below describes the data collected on each visit.

Table A7.1
Schedule of Field Activities CIAT/SESA Joint Research

Visit One (Researchers)

A. Cultural Practices Interview Schedule, Part One

- Crops which compete with beans
- Soil conservation practices
- Bean production constraints
- Agronomic practices
- Importance of pests and diseases

B. Family Labor and Budget Characteristics Interview Schedule

- Number of hours worked by each family member in preceding week
- Number of hours worked by hired labor in preceding week
- Food items purchased and sold in preceding week

C. Bean Field Identification and Observation

- Seed types by field
- Field distance from home
- Intercropping
- Rotation
- Soil fertility

Visit Two (Researchers)

A. Cultural Practices Interview Schedule, Part Two

- Changes in cropping patterns over past five years
- Bean seed sources
- Bean storage methods

B. Bean Field Observation.

- Bean plant densities
- Disease/insect observations
- Soil sampling

Visit Three (Researchers)

A. Cultural Practices Interview Schedule, Part Three

- Agronomic Practices
- Bean Storage Practices

B. Family Labor and Budget Characteristics Interview Schedule

Other Visits (SESA Enumerators)

- A. Measurement of Surface Area Planted in Beans
- B. Measurement of Production

All fifteen farms chosen for the sample are part of SESA's Crop Production, Forecasting, and Transactions survey sample. It was necessary to choose respondents who were already a part of SESA's sample in order to be able to classify them according to their net transaction position in beans.

1. Basic Characteristics of Farms Surveyed

Drawing the Sample

The sample was divided equally among farms that were deficit, self-sufficient, and surplus in beans according to November 1985 through July 1986 data from SESA's transactions survey. It should be noted here that this method of classifying farms is not 100% foolproof. Family net position in beans may change from one year (or season) to the next due to changes in land and labor available to the family unit, or to changes in the number of persons consuming beans in the household.

In order to minimize the amount of field time required to mount the survey, all fifteen farms were drawn from two sectors in Kigali: Gikomero Sha (four farms), and Gikoro Mununu (eleven farms).

Table A7.2

Selected Characteristics of Farms Surveyed,
Joint CIAT/SESA Research

Farm Number	Net Bean Purchases (kilos)	Dry Bean Production (85b + 86a) kilos	Number of Actives	Number of Actives per Person
Bean Buyers				
40901	153	274	1	.25
40907	132	225	2	.40
50501	71	147	2	.25
50505	50	470	3	.38
50504	23	657	4	.36
Self-sufficient				
40911	5	78	2	.33
40904	0	59	2	.40
50502	0	236	1	1.00
50503	0	323	5	.50
50513	-1	500	4	.57
Bean Sellers				
50514	-26	676	7	.58
50511	-29	431	4	.36
50506	-49	833	6	.60
50518	-93	392	4	.40
50515	-105	951	6	.75

Notes: 1. Negative net purchases indicate net sales. Farm numbers correspond to SESA's identification system to facilitate future inquiries. 2. Actives are defined as persons living in the household between the ages of 15 and 64.

Farm Bean Production, Bean Purchases, and Family Size

Table A7.2 summarizes some characteristics of the households that were known from previous SESA surveys at the time the sample was drawn. The data in this table reflect a general pattern in SESA's national data: farm bean production is related to, but is not the only explanatory variable in determining a farm family's net position in beans. The number of active household members in relation to the total number of people in the household may also be an important explanatory variable.

Surface Area Planted in Beans.

Table A7.3 shows the total surface area planted in beans by farm. In interpreting this table, several points should be taken into consideration. First, total surface area in beans was measured regardless of bean plant density or type of association in the field. Second, the bean surface area data reflect the more important September to January (1987A) season, while farm position in beans was determined with data from the period November 1985 to July 1986. Farm size, family size, and relative importance of various crops may have changed between seasons. For example, farm family number 40901, the most deficit in the sample for the period November 1985 to July 1986, stated that some family members had moved off the farm in the middle of 1986. The amount of mobility between bean transaction classes one would find on a national scale is difficult to estimate, given the dearth of longitudinal studies of the Rwandan economy.

Surface area planted in beans is obviously related to production class, but farm numbers 40901 (buyer), 40907 (buyer), 50502 (self-sufficient), and 50506 (seller) do not seem to fit the general pattern. Differences in soil fertility, in plant densities, in bean consumption habits, or changes in family situation are all possible explanations for these outliers. For example, farm number 50502's plant density was the highest of any farm observed in the survey. Since farmers plant more densely on soil that is infertile, this may be an indication that this farmer's soil is very infertile.

All but one farmer harvested much less beans in 1987a than in 1986a, with the total harvest in dry beans down 64% from the previous year because of the late planting rains. Thus, yields presented in this table may be unrepresentative, although some of this difference in quantity harvested is evidently due to decreases in acreage planted, as farmers attempted to substitute drought resistant crops for beans. It should also be noted that these yields were calculated without respect to intercropping. Still, some patterns are evident in the data, with bean buyers and bean self-sufficient farms showing higher yields than bean sellers. The high value presented for farm number 50501 is probably due to an error in measurement, but even without this farm, average yields for bean buyers and bean self-sufficient farms were over 100 kg/ha higher than average yields for farms selling beans.

Table A7.3

Surface Area Planted in Beans, Yield,
and Average Bean Plant Density
First Season, 1987

Farm Number:	Farm Size (86b) (ha)	Square Meters Planted in Beans	Yield kg/ha	% of Farm in Beans	Average Bean Plant Density (unweighted)
Buyers					
40901	0.4	2001	599	50%	270
40907	0.4	2182	334	54%	290
50501	3.1	378	4074	1%	245
50505	1.9	229	699	1%	230
50504	3.3	882	1292	3%	260
Self-sufficient					
40911	0.9	487	657	5%	290
40904	0.1	676	1198	67%	255
50502	7.2	888	495	1%	510
50503	4.3	1159	276	3%	250
50513	4.1	1519	967	4%	260
Sellers					
50514	3.2	4761	399	15%	230
50511	4.1	3668	262	9%	290
50506	1.6	1193	1685	7%	250
50518	1.2	3117	122	26%	395
50515	3.6	6263	494	17%	295

N.B.: Farm numbers correspond to SESA's identification system in order to facilitate future inquiries.

Table A7.3 also shows another interesting trend: bean purchasers and farms self-sufficient in beans either devote a very large or a very small proportion of their total surface area to beans, while the percent of the farm occupied by beans in farms which sell beans tends to be in the mid-range. This may mean that some farms which purchase beans (particularly those very small total farm size) have specialized in beans to reduce purchases, while others (those with somewhat larger farms) have moved away from beans in favor of other crops.

2. Crop Competition for Farm Resources.

Farmers were asked to name the most important crops they grew to feed their families. Up to four responses were recorded, with some families naming only two crops. Beans were identified most frequently as an important crop by all three bean transaction classes, as shown in Table A7.4. The data in Table A7.4 indicate that bean sellers may be more diversified in their selection of crops than the bean buyers, as sellers tended to mention more crops as important (19 responses total) than either families which buy or self-sufficient families (15 and 16 responses respectively).

Table A7.4
Crops Mentioned
as Important in Feeding Respondents' Families
by Bean Transaction Class

Crop	Bean Transaction Class (15 respondents, 5 per class)			
	Buyers	Self-suff.	Sellers	All Farms
Beans	4	5	5	14
Manioc	5	3	5	13
Sw. Potatoes	4	4	5	13
Sorghum	2	2	2	6
Bananas	0	2	1	3
Potatoes	0	0	1	1
Total Responses Obtained	15	16	19	50

In order to get a picture of the costs and constraints facing each family if they wanted to increase production of important crops, for each crop mentioned as important in response to the prior question, families were asked: "If you planted more of this crop, would you have had enough beans this year?"; and further, "If yes, why didn't you plant more beans this year?" In cases where beans were the crop mentioned as important to feeding the family, the question "Why didn't you plant more beans this year?" was asked.

The planting rains were very late for the 1987a season in the sample area. Many responses of "I would have had enough of crop X if I had planted more beans, but I didn't plant more beans because the rains were late" were recorded for each class. Due to the irregular rainfall

problem present in this season, other constraints on other farm resources such as insufficient land, labor, or seed were overshadowed.

Negative responses to the question "Would you have enough of crop X if you had planted more beans?" did show an interesting pattern. Four out of five families which purchase beans answered "no" for at least one crop, three out of five self-sufficient families answered "no" for at least one crop, and only two out of five families which sell beans answered "no" for at least one crop. Thus we see that increased bean production may be more likely to come at the expense of other crops in bean purchasers than in other types of families.

Another interesting pattern in the "No, I wouldn't have enough of crop X if I had planted more beans" responses is that of the twelve responses of where the family felt they wouldn't have enough of another important crop if they increased bean production, sorghum was mentioned three times, while the other nine times either sweet potatoes or manioc production would have been insufficient given increased bean production. This is an indication that beans may compete more with root crops than they do with other types of crops.

3. Soil Fertility Maintenance Methods.

Composting and Rotation

Farmers were asked how they used compost to maintain their soil fertility. Vegetable and animal compost were mentioned with roughly equal frequency with respect to the entire sample. Some differences in bean transactions classes are to be noted: animal compost may be less important among self-sufficient farmers than it is for the other two classes. It is also interesting to note that fallow was only mentioned once, by a farmer in the bean surplus category.

More bean buyers in the sample planted their beans in the same plot in succeeding seasons than those who did not buy beans. All the respondents who rotated their crops followed their beans with sorghum.

Table A7.5
Treatment of Bean Plant Material After Harvest
By Bean Transaction Class

Method	Bean Transaction Class			
	Buyers	Self-suff.	Sellers	All Families
Coffee Field	2	2	4	8
Compost Pit	3	3	1	7
Leave in Field	2	1	0	3
Fodder	1	0	1	2
Banana Field	0	1	1	2
Total Number of Responses	8	7	7	22

Treatment of Bean Plant Waste After Harvest

Table A7.5 shows that some differences in bean plant debris usage between transaction classes are evident. More bean sellers used bean plant debris as mulch under their coffee trees, while net buyers and self-sufficient farms used the debris for composting. Few families that sold beans composted the plant debris. In contrast to bean buyers and families self-sufficient in beans, no bean sellers buried uncomposted plant debris in the field.

The practice of burying uncomposted bean plant debris combined with no crop rotation may provide a source of inoculum for plant diseases. The benefits of introduction of organic material into the soil through the plant debris may therefore be negated by loss of yield through diseases.

4. Evolution of Cultural Practices.

A series of retrospective questions were asked which attempted to determine whether farmers' methods of bean production had changed over the past few years.

There were no clear cut differences between responses of farmers in the three transactions classes concerning changes in the quantity of beans harvested over the past five years. Across the whole sample, four farmers (27%) said they harvest more beans now, two (13%) harvest the same quantity now as they did five years ago, four (27%) harvest less beans, and five (33%) said the quantity harvested varies from year to year. Among farmers who reported a change in the size of the harvest, surface area, rainfall, and labor were most frequently mentioned as reasons for the change. Only one farmer (a net bean seller) cited a technological consideration (compost) as a reason for increased harvest size.

All of the farmers interviewed reported that they planted beans in association with the same crops now as they had five years ago, and that their planting methods had remained unchanged during that period. All but one farmer (buyer) said they changed their soil fertility maintenance methods over the past five years by the recent adoption of anti-erosion ditches and composting.

Table A7.6
Changes in Surface Area Planted in Beans Over Last
Five Years

Type of Change:	Bean Transaction Class (n=5 per class)			
	Deficit	Self-Suff.	Surplus	Total
Larger Area Now	3	1	3	7
Same Area Now	2	2	2	6
Smaller Area Now	0	2	0	2

Table A7.7
Reasons for Change in Surface Area
Planted in Beans

Reason:	Farmers Which:	
	Plant More Now (n=7)	Plant Less Now (n=2)
Adopted Hoe With Teeth	1	0
Labor	0	1
Change in Surface Area Available	2	1
Change in Land Use Pattern	4	0

Over half of the farmers which buy beans reported planting a larger surface area in beans currently than they did five years ago (Table A7.6), as did surplus farmers. If one looks at the entire fifteen farm sample in Table A7.6, it appears that the tendency over the last five years is towards more surface area being planted in beans, with 87% of the farms reporting the same or a larger surface area planted in beans. Over half of the farms which had increased surface area planted in beans said they planted more due to changes in land use pattern (Table A7.7). Changes in land use pattern cited were: reduced fallow, reduced manioc fields, and increased association with bananas. The two farmers who mentioned having a larger surface area available to plant were both bean sellers.

Note that while thirteen out of fifteen farmers claim they plant the same or a larger surface area than they did five years ago, only 40% indicated that they harvested the same amount or more beans in comparison with five years ago. This may indicate that bean yields have declined over the last five years.

5. Factors Affecting Farmers' Net Bean Supply.

Bean Production Constraints

Drought was the most frequently mentioned constraint to increased bean production (Table A7.8). This is true not only for the total sample, but within each bean transaction class as well. Responses to this question were influenced by the fact that the planting rains came late in the first season of 1987.

Next to drought, soil fertility was the most frequently mentioned bean production constraint, with this response coming in greater proportions from self-sufficient and seller farmers than from buyer farms. Conversely, lack of land was seen to be a problem more frequently by farms buying beans than by net sellers or self-sufficient farms. Lack of labor was listed as a bean production constraint in roughly equal proportions across the three classes. Insects and pests came up much more often as a problem among net sellers, with four out of five families mentioning this problem. When asked directly if they had insect problems, 100% of the farmers in all classes responded affirmatively. However, the relative importance of insect and pest compared to other constraints appears to be greater for families selling beans than for other transaction classes.

Table A7.8
Farmer Opinions on Principle Constraints
To Increased Bean Production

Constraint	Bean Transaction Class (n=5 per class)			
	Buyers	Self-suff.	Sellers	All Families
Soil Fertility	2	2	3	7
Drought*	4	4	4	12
Too Much Rain	2	1	1	4
Lack of Labor	2	1	2	5
Lack of Land	3	1	0	4
Insects/Pests	1	0	3	4
Other	1	1	1	3
Total Number of Responses	15	10	14	39

* Responses to this question may have been influenced by the fact that the planting rains were late in the first season of 1987.

Methods of Increasing Bean Production

Table A7.9 shows that farmers' perceptions on how they could increase their bean harvest did not vary much between bean transaction classes, with most farmers mentioning both compost and increased surface area.

Table A7.9

Farmers' Opinions as to How They Could
Increase the Size of Their Bean Harvest

Method:	Bean Transaction Class (n=5 per class)			
	Buyers	Self-Suff.	Sellers	All Families
Compost	4	3	4	11
Increase Area in Beans	4	4	5	13
Anti-Erosion Ditches	0	0	1	1
Insecticides	0	1	0	1
Don't Know	1	0	0	1
Total Responses Obtained	9	8	10	27

Care of Bean Plants

When a bean plant first emerges, two leaves generally appear out of the stalk. These first leaves are called primary leaves. As the plant matures, the stalk grows, and larger leaves grow out from the stalk. The larger, mature leaves are called trifoliate. Some farmers pluck the primary leaves off of the plant after the appearance of the trifoliate. The utility of this practice is not yet fully understood, but it has been hypothesized that primary leaves may be detrimental to the mature plant, perhaps by increasing the disease population. Table A7.10 (below) shows that 53% of all the farmers interviewed remove the primary leaves, but that only one of the five bean surplus farms interviewed engages in this practice. This is interesting, particularly when considered together with the data in table A7.8, which show that bean sellers mentioned insects and pests much more frequently as a constraint to production than did the other categories

of farms. Note also that bean buyers tended to have higher yields than bean sellers. It may be that farms which grow more beans lack the labor inputs necessary to be able to perform prophylactic tasks on their beans.

Table A7.10

Number of Farmers in Sample Who Remove Primary Leaves
as the Bean Plant Matures

Transaction Class	Number (n=5 per class)
Buyers	4
Self-sufficient	3
Sellers	1
All Families	8

Farmers who remove the primary leaves after plant maturation gave varied reasons for doing so. Four said the process makes the plant bigger or stronger, two said it encouraged budding, one said it prevented leaves from yellowing, and one didn't know why they removed the primary leaves. All of those that remove primary do so at the same stage in the plant cycle: before flowering.

When asked directly if they had problems with insects and pests in their fields (as opposed to the open ended question reported on in Table A7.8 where farmers were asked to list their principle constraints to production), all the interviewees said "yes". Table A7.11 gives frequencies of farmer estimates of the degree of their problems with insects and pests.

Table A7.11

Farmers' Degree of Problems with
Insects and Pests

Extent of Problem	Bean Transaction Class (n=5 per class)			
	Buyers	Self-Suff.	Sellers	All Fam.
Small	3	0	3	6
Medium	0	0	1	1
Large	2	5	1	8

Planting Methods and Season

Three basic methods of planting beans have been observed in Rwanda. One consists of placing the bean seed in the ground by hand and covering the seed immediately. The second involves broadcasting the seed over a large area, and then turning over the earth with a hoe to bury the seed. The third, not practiced by any of the farmers interviewed in this study, involves placing the seed in the farmers' mouth, spitting it into the ground, and then covering the seed immediately. Farmers were asked to describe their planting methods in both the A and the B bean season. With one exception, farmers planted in exactly the same fashion in the A and in the B season. Bean buyers and self-sufficient farmers were roughly evenly divided between those who place the seed in the ground, and those who broadcast, while all of the bean sellers practiced the broadcasting method at least some of the time. Broadcasting is probably not very efficient in terms of seed use, so farmers who are low on seed are less likely to use the method.

Sources of New Varieties of Beans.

Roughly half of the families interviewed had tried new varieties of beans at some time. The percentage of families who had tried new bean varieties does not appear to vary much according to bean transaction class.

The seven farmers who said they had tried new varieties were asked where they obtained the new varieties. The responses are summarized in Table A7.12.

Table A7.12
Sources of New Varieties of Bean Seed

Response	Times Recorded	% of Total Responses
Family	2	17
Neighbors	2	17
Merchant	3	25
Open air market	5	42

Families which bought beans were the only ones to mention family and neighbors as sources of new bean varieties. Farmers in all three transaction categories mentioned merchants and markets as sources of new bean varieties. Thus it may be that bean purchasers are more likely to be late adopters of new seed varieties, because they are less likely to obtain seed from outside the community.

Farmer Opinions on Seed

All but two of the farmers interviewed thought they could increase their bean harvest with improved seed. None of them used improved seed, because they had never had the opportunity to acquire such seed. All but one of the farmers interviewed said they thought they could improve their harvest by multiplying bean seed in a small fertile plot, but only two of them actually practiced this method of seed multiplication.

Farmers were asked if they could improve their bean harvest by choosing their seed from plants with many pods and few black marks on the leaves and pods. Half of the net buyers and self-sufficient farms said they thought this technique would improve yields, while all of the farmers which sell beans thought the method would increase their harvest. Further, all of the net bean sellers use number of pods on the plant and degree of black marks in seed selection, while only 40% of the net buyers and 0% of the self-sufficient farms use these criteria in seed selection.

Bean Storage Practices.

Table A7.13
Farmers' Evaluation of
Bean Storage Losses

	Bean Transaction Class			All Families
	Buyers	Self-suff. Sellers		
Lose a lot	1	1	0	2
Lose a little	3	1	1	5
Don't lose any	2	3	4	9

Nine of the fifteen farms reported no bean storage losses. More farms which buy or which are self-sufficient in beans reported losses than did farms which sell beans. Lack of more concrete empirical data makes interpretation of this finding difficult, as farms which buy beans may be more sensitive to storage losses than other types of farms. All farmers who reported storage losses said these losses were caused by insects.

Table A7.14 indicates that chemicals are the most popular bean storage treatment regardless of transaction class. Other storage treatments varied according to production class. Only farms which buy beans reported using cow urine and pili-pili as a seed treatment. Both buyers and self-sufficient farmers used ash, but only bean sellers used kaolin. Effectiveness against bruchid attack of seed storage with kaolin versus ash, pili-pili, and cow urine needs to be examined, although information reported in other sections of this document indicates that storage is not a very high priority research area in Rwanda.

Table A7.14
Farmers' Methods of Treating Beans
For Storage

Treatment:	Bean Transaction Class (n=5 per class)			
	Buyers	Self-Suff.	Sellers	All Families
Chemicals	4	4	3	11
Ash	1	2	0	3
Kaolin	0	0	2	2
Pili Pili	1	0	0	1
Cow Urine	2	0	0	2
Total Responses Obtained:	8	6	5	19

Farmers were asked if they stored seed separate from their stocks destined for consumption. Nine of the fifteen (60%) store seed separately from food stocks, and the rest (40%) do not keep their seed in a different place/container. More bean sellers store their seed stock separately than do bean buyers or self-sufficient farms. Table A7.15 below summarizes the types of containers farmers used to store their beans. The most common storage container for both food and seed stock in the families interviewed is a basket lined with manure. If food and seed stocks are stored separately, a clay pot is used more frequently for seed storage, whereas a sack is used more frequently for food storage.

Table A7.15
Farmer Bean Storage Containers

Storage Containers for Farmers that:			
	Do Not Store Seed Separately	Do Store Seed Separately	
		Seed	Food
Basket Lined w/Manure	5	6	7
Clay Pot	1	4	1
Sack	1	4	5
Total Responses Obtained:	7	14	13

Labor and General Household Transactions

Labor Use

To get some perspective on use of labor at different times of the season, two visits were made in which households were asked to list all persons working on their fields in the previous week, and the number of hours worked per person. The first visit occurred in mid-December 1986, while the second took place at the end of February 1987. Most farmers were in the process of weeding their fields during the mid-December visit. Planting was taking place at the time of the February visit. There were no remarkable differences in labor use between the two reference periods. Bean sellers in the sample made much more extensive use of hired labor during both periods than did farms in the other two transaction classes. Family adult labor use was also higher on a per household basis for bean sellers than for the other two classes. This tendency is probably related to the larger total farm size of the households which sell beans.

Household Transactions

During two separate visits, respondents were asked what they had purchased and sold during the previous week. Patterns exhibited by the responses to these questions were weak. One point of interest is that farmers from all three transaction categories bought beans during the December visit (one or two months before the major bean harvest). This serves to underline that the categories used in the survey are net categories, and that some families are selling at certain periods of

the year, and buying back at other times of the year. Family behavior with respect to bean purchases may also have been influenced by the exceptionally late planting rains and the poor harvest prospects for the 1987a crop.

Annex VIII

Estimated Gross Returns To Storage Of Bananas, Potatoes, Dry Beans And Sorghum

A. Method Used in Calculating Gross Returns to Storage.

The raw data come from the MINIPLAN price series as reported by Muhezangango (1980 through 1986) and Zalla (1987). The MINIPLAN data were inflated to 1987 levels using the CPI published by the BNR. Optimal storage patterns were determined by examination of the seasonal price index produced by MSTAT for the same series (see Annex III).

The the optimal storage pattern was chosen to maximize the difference between acquisition price and liquidation price. For beans and sorghum optimal storage and release times were constrained to be less than twelve months apart on the grounds that stock must be rotated and because the point of the exercise is to determine whether returns to interseasonal (not interannual) storage are significant. For bananas and potatoes, the number of months between the optimal storage month and the optimal release time was constrained by the shelf life of the product.

Estimated losses for beans and sorghum were taken from OPROVIA¹. Estimated losses of potatoes and bananas were made by personal communications with other researchers. For potatoes and bananas, an "improved technology" storage scenario is included. The feasibility of improved potato storage technology in Rwanda has been investigated by both the EEC and Technoserve. According to PNAP plant breeder Dr. Pierre Tegera², optimal storage of potatoes can increase their shelf life to six months, and requires the following treatment:

1. After harvest, the potatoes must be kept at 10-15 °C for 15 days.
2. After the initial 15 day storage period, the potatoes must be sorted. All potatoes with bad spots or cuts from harvesting must be removed.
3. There must be adequate ventilation. This usually requires a fan to circulate the air. The temperature is critical. The storage area must remain at 5 °C.
4. A humidifier must be used to keep the humidity level at 80%

¹Clarke

²Personal communication.

5. An anti-germinant must be applied to keep buds from forming on the potatoes.
6. The potatoes must be well packed.

The requirements for extended storage of bananas have not been studied for Rwanda. It is probable that improved banana storage technology is also quite capital intensive.

The formula used for calculating estimated gross returns to storage is as follows:

$$(REL - (AQU / (1 - (LOS * MON)))) / AQU / 100 = RET$$

Where: REL=Release price inflated to 1987 levels
 AQU=Acquisition price inflated to 1987 levels
 LOS=Estimate of probable storage losses per month
 MON=Number of months between acquisition and release of stocks
 RET=Estimated percentage gross returns to storage

The estimated gross returns presented in this annex therefore do not account for the following costs: handling, physical plant, the opportunity cost of capital invested in the product, or risks associated with storage.

B. Estimated Gross Returns to Short Term and Long Term Storage for Bananas in Gitarama, Kigali and Ruhengeri.

Assumptions:

- [illegible]

Table A8.1
Estimated Percentage Gross Returns to Short and
Long Term Banana Storage, by Year

Year	Short Term Storage			Long Term Storage		
	Git	Kig	Ruh	Git	Kig	Ruh
1980	-11%	10%	66%	n/a	34%	0%
1981	8%	-11%	22%	11%	-22%	-24%
1982	10%	25%	-11%	1%	-19%	51%
1983	-22%	0%	11%	-19%	71%	6%
1984	24%	22%	-35%	7%	112%	25%
1985	-11%	22%	-24%	3%	44%	10%
1986	-4%	14%	22%	-25%	39%	8%
1987	-5%	39%	n/a	-7%	n/a	7%
Mean	-1.3%	15.1%	7.4%	-4.1%	36.9%	10.3%
Std Dev	14.6%	15.6%	34.0%	13.8%	47.4%	21.4%

Notes: Estimated gross returns do not account for the following costs: handling, physical plant, the opportunity cost of capital invested in the product, or risks associated with storage. "n/a" indicates the storage period extends beyond the data under consideration.

C. Estimated Gross Returns to Short Term and Long Term Storage for Irish Potatoes in Gitarama, Kigali and Ruhengeri.

Assumptions:

- [illegible]

Table A8.2
Estimated Percentage Gross Returns to Short and
Long Term Irish Potato Storage, by Year

Year	Short Term Storage			Long Term Storage		
	Git	Kig	Ruh	Git	Kig	Ruh
1980	-28%	-25%	-6%	-14%	5%	12%
1981	-8%	-15%	15%	6%	19%	44%
1982	-19%	-35%	20%	1%	-9%	27%
1983	-19%	-13%	6%	-21%	4%	35%
1984	-30%	8%	-17%	0%	34%	38%
1985	-8%	-31%	-44%	6%	-2%	-6%
1986	20%	75%	-11%	49%	69%	27%
1987	48%	-39%	65%	125%	41%	131%
Mean	-5.6%	9.4%	3.6%	18.8%	20.2%	38.5%
Std Dev	26.9%	37.3%	31.9%	47.8%	26.4%	40.7%

Estimated gross returns do not account for the following costs: handling, physical plant, the opportunity cost of capital invested in the product, or risks associated with storage.

D. Estimated Gross Returns to Storage of Sorghum in Gitarama, Kigali and Ruhengeri.

Assumptions:

1. Storage losses: 1% Loss/mo.
2. Optimal storage period
Git: Sep-Mar
Kig: Sep-Mar
Ruh: Apr-Dec

Table A8.3
Estimated Percentage Gross Returns to Sorghum Storage,
by Year

Year	Git	Kig	Ruh
1980	4%	19%	-16%
1981	12%	9%	-14%
1982	36%	35%	-18%
1983	34%	-10%	3%
1984	-17%	89%	22%
1985	28%	24%	3%
1986	22%	23%	13%
Mean	16.9%	27.0%	1.0%
Std Dev	18.9%	30.8%	15.6%

Estimated gross returns do not account for the following costs: handling, physical plant, the opportunity cost of capital invested in the product, or risks associated with storage.

E. Estimated Gross Returns to Short Term and Long Term Storage for Dry Beans in Gitarama, Kigali and Ruhengeri.

Assumptions:

- [illegible]

Table A8.4
Estimated Percentage Gross Returns to Short and Long Term
Dry Bean Storage, by Year

Year	Short Term Storage			Long Term Storage		
	Git	Kig	Ruh	Git	Kig	Ruh
1980	-15%	1%	20%	-26%	16%	-7%
1981	67%	22%	2%	20%	5%	-9%
1982	-9%	41%	9%	30%	61%	40%
1983	65%	30%	7%	121%	32%	-5%
1984	69%	127%	61%	141%	178%	108%
1985	-8%	-8%	22%	-15%	-13%	-1%
1986	4%	18%	35%	-1%	-2%	10%
1987	44%	43%	0%	130%	88%	72%
Mean	27.2%	34.4%	19.5%	50.1%	45.6%	26.0%
Std Dev	37.9%	41.5%	20.4%	69.4%	63.2%	43.7%

Estimated gross returns do not account for the following costs: handling, physical plant, the opportunity cost of capital invested in the product, or risks associated with storage.

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