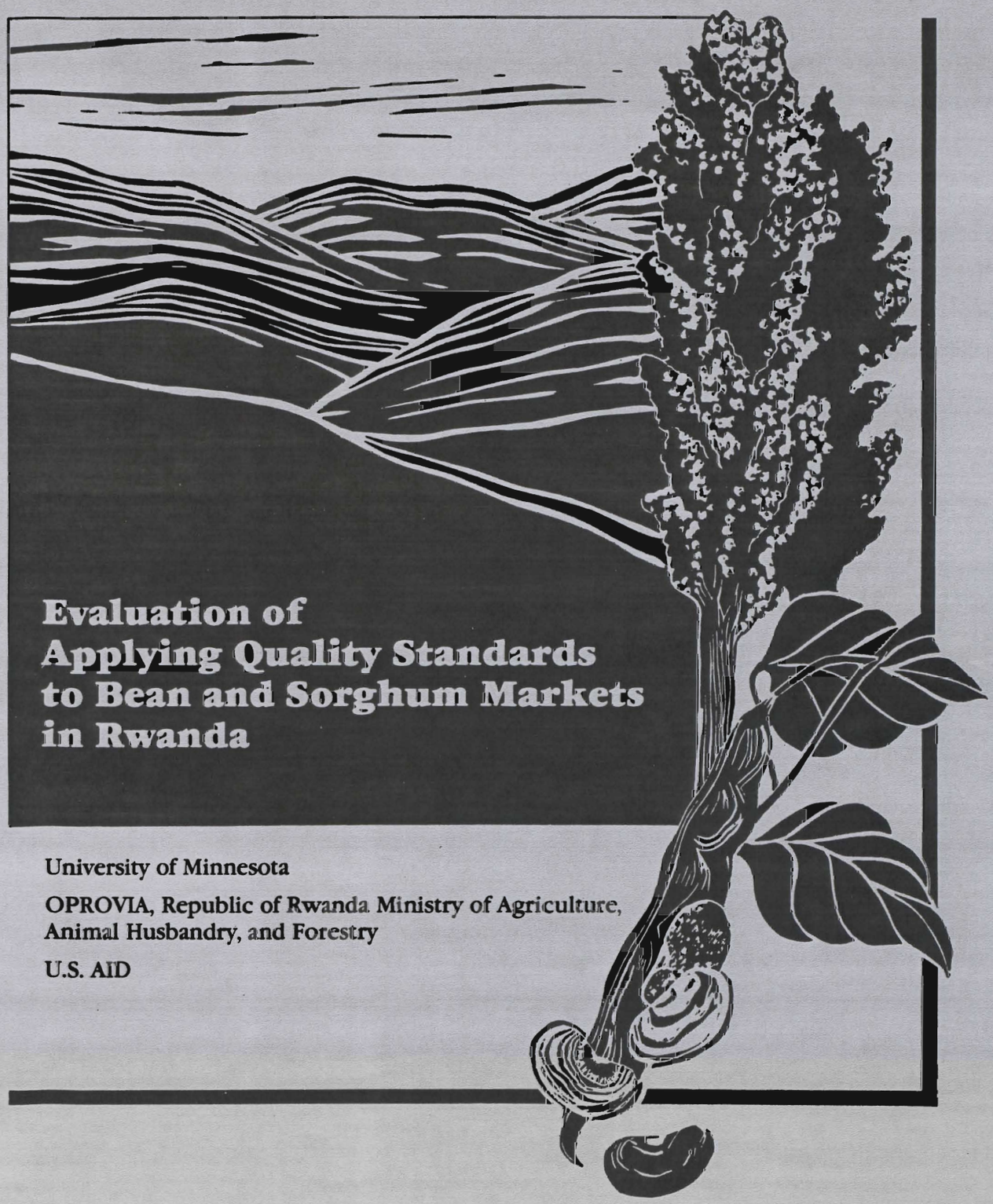

Evaluation of Applying Quality Standards to Bean and Sorghum Markets in Rwanda

University of Minnesota

OPROVIA, Republic of Rwanda Ministry of Agriculture, Animal Husbandry, and Forestry

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PREFACE

This report describes the research conducted in Rwanda, East Central Africa, by the component entitled "Development of a System of Quality Standards for Beans and Sorghum" of the Local Crop Storage/Food Storage and Marketing-Phase II (FSM II) Project jointly financed by the Rwandan and American governments (USAID).

The research work was carried out during 1986-1987 in cooperation with the National Office for the Development and Marketing of Food and Livestock Products (OPROVIA), a semi-autonomous agency of the Rwandan Ministry of Agriculture, Animal Husbandry, and Forestry (MINAGRI). Technical assistance was provided by the University of Minnesota (USA) through USAID contract No. AFR-0107-C-00-4001-00.

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BACKGROUND INFORMATION ON RWANDA

Geographical Aspects

Rwanda is located in east-central Africa at a latitude of 1 to 3° south of the equator. It is bordered by Uganda, Tanzania, Burundi, and Zaire. Rwanda covers an area of 26,338 square kilometers. The topography is hilly to mountainous with altitudes ranging from 950 meters above sea level (masl) in the southern part of the country up to 2,500 masl (for arable land) and 4,500 masl (highest peaks) in the volcanic regions of the northwest. The native vegetation ranges from the savannah to the highland tropical forests which are already largely cleared and now devoted to farming. About 90% of the soils are basic pre-Cambrian type. Five percent are alluvial and are found in the marshy areas between the hills. The remaining 5% are rich volcanic soils which are found in regions characterized by high population densities. Streams, rivers, and lakes are well distributed throughout the country. The rainfall pattern is bimodal, with the rainy seasons occurring between February and May, and again between October and December. Total annual rainfall varies from 800 to 2,000 millimeters. Average temperatures range from 16° to 24°C depending on the altitude.

Demographic Situation

The population of Rwanda was 5.5 million in 1983 with an annual growth rate of 3.5%, which is among the highest in all of Africa. The mean population density of the entire country is 200 inhabitants per square kilometer, but rises to 400 inhabitants per square kilometer when calculated on the basis of arable land area. The population is still largely rural; only 5% of the people live in urban areas. Rural organization is characterized by small, scattered farmsteads rather than by organized villages. Continued population growth constitutes the greatest threat to the further development of Rwanda.

Administrative Divisions

The Capitol of Rwanda is the City of Kigali. The country is divided into ten prefectures, each with a town designated as the center or seat of government. Prefectures are divided into sub-prefectures, which are composed of communes whose number now totals 143. The communes are divided into sectors, which in turn are divided into cells. It is these cells which constitute the smallest political and administrative units of the country.

Agriculture

A total of 1,229,600 hectares of arable land is available in Rwanda according to data collected in 1980 by the Agricultural Surveys and Statistics Service (SESA). Agriculture in Rwanda is predominantly one of subsistence. Farming is the principle occupation of 95% of the country's population. Family farmsteads average about 1 hectare in size (1980) and generally consist of small scattered plots. Most of Rwandan agriculture is

characterized by a lack of mechanization, intercropping, mixed crop and livestock farming, and the production of a diverse array of food crops. Food crops contribute more than 30% to the Gross National Product (GNP).

Crops are grown during two distinct growing seasons, but a third is possible in the lowland and marshy areas between the hills. The most important crops in terms of the area harvested are beans (Phaseolus vulgaris), bananas, sorghum, sweet potatoes, maize, peas, cassava, and (Irish) potatoes. Other crops such as soybeans, groundnuts (peanuts), yams, coco yams (taro), and wheat are of a lesser importance. Vegetable crops found with some frequency include cabbage, eggplant, tomato, leeks, and onions. Fruits grown in Rwanda include avocados, papaya, pineapple, and custard apple. The main industrial crops are coffee, tea and pyrethrum. The livestock raised in the country include cattle, goats, sheep, pigs, chickens and rabbits. The country has been divided into twelve agroclimatic zones based on elevation, rainfall, soils and the types of agricultural production (Figure 1).

Demographic growth, the limited possibilities for productive employment, and the absence of land resource elasticity define the essential problems for the future of Rwanda. Despite the labor and discipline of its 1.2 million small farms, the development of new technologies is necessary to enable Rwanda to feed its population in the future. This effort is directly related to the development of agricultural research institutions.

Agricultural Research

The Rwandan Institute of Agricultural Sciences (ISAR) has primary responsibility for all agricultural research conducted in Rwanda. Seven satellite or branch stations are located in various regions of the country (Figure 1). ISAR's research stations contain laboratories and experimental fields for research on crop improvement, plant protection, soil and plant chemistry, and microbiology. Currently ISAR is pursuing research on food and industrial crops, cropping and farming systems, forestry and animal husbandry, but to date has not placed much emphasis on the post-harvest area. In addition, research is carried out by faculty in the College of Agriculture of the National University of Rwanda (UNR). In general, their research is enscribed within the training programs for students.

In 1984, research on post-harvest problems was initiated at OPROVIA (National Office for the Development and Marketing of Food Crops and Animal Products) through the GRENARWA II-Research Project, which was given the responsibility of conducting research on the storage of beans and sorghum.

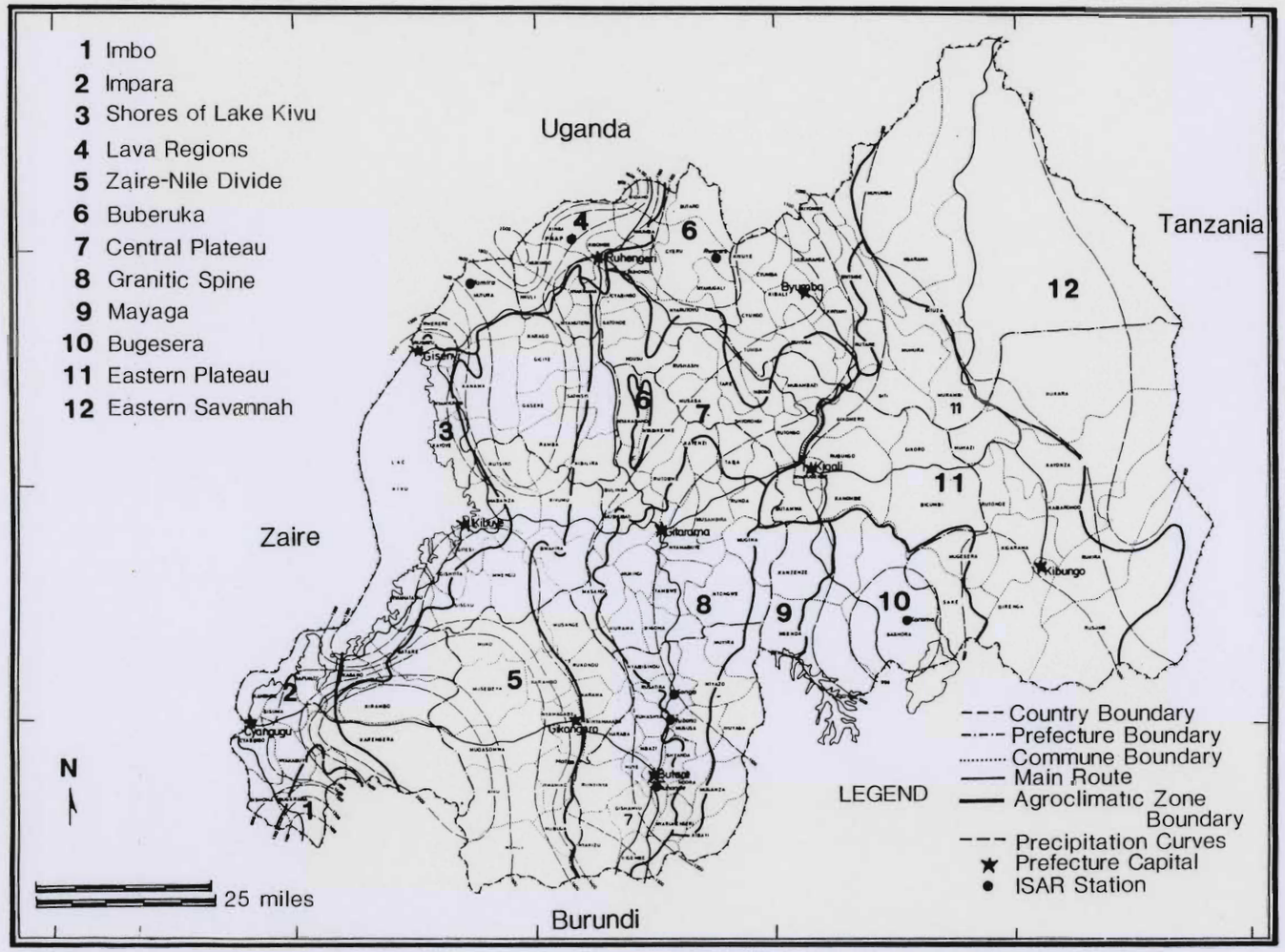


FIGURE 1: MAP OF RWANDA

I. INTRODUCTION

Research in several developing countries shows that the quality of government grain stocks is frequently lower than quality at other market levels (Steinke and Pfost, 1978). Suppliers take advantage of the rigid pricing schedules usually associated with government grain purchasing which allow poor quality lots to be sold for the same price as high quality lots. This situation exists in Rwanda's bean market. Data collected over the last two years show that the quality of beans that OPROVIA (National Office for the Development and Marketing of Food Crops and Animal Products) buys is lower than for other buyers in the marketing system. The research results indicate that the quality of OPROVIA's stocks could be significantly improved by: a) reducing the amount of damaged grain in purchases; b) reducing the amount of foreign material in purchases; and c) buying beans which have lower moisture content.

Grading is the sorting of products into various categories established by standards for quality. In grain markets, the purpose of grades is to make trading more convenient by informing sellers about the price to be received for different levels of quality and by informing buyers about the exact quality to be received prior to a transaction. In industrialized countries, grades in grain trading originated with the use of various forms of specification buying by different merchants and trading boards. The eventual development of several different classification systems within the same grain market caused difficulties for sellers. Government involvement in grain standards became necessary because the benefits of a system for describing quality cannot usually be fully captured by one buyer who tries to implement such a system. The payoffs affect all buyers as well as sellers. For example, the most important payoff is lower transaction costs due to the possibility of trading without personal inspection. Government involvement in establishing standards is a way to distribute the costs of the system among all market participants (Steinke and Pfost, 1978).

A national system of grain inspection and quality standards can benefit a grain marketing system where there are bottlenecks in large-scale distribution arrangements due to: 1) numerous long distance transactions which prohibit personal inspection; 2) traders taking advantage of less than thorough inspection procedures which create higher transaction costs for buyers; or 3) numerous specification systems within one grain market which create higher transaction costs for sellers. A government installed and administered grading system provides uniform criteria for all market participants to follow.

The quality standards component of the Food Storage and Marketing (FSM II) Project represents the final stage of much of the work that has been completed on the project. The overall objective of this component is to develop and recommend standards for beans and sorghum, adaptable to Rwanda, which will promote orderly marketing, expand commercialization of these products, and improve product quality and value. Such a system of standards should also facilitate and encourage improved management of grain in long-term storage, such as the food security stocks; provide specific information on quality of beans and sorghum purchased or sold under contract; and stabilize and provide uniformity for the national program of commercialization of beans and sorghum in Rwanda.

Specific objectives of the quality standards component are to:

a) examine some of the important issues that need to be considered in developing and operating a system of quality standards and associated price differentials for beans and sorghum in Rwanda;

b) suggest the appropriate quality attributes to be included in the standards;

c) specify the necessary procedures for measuring and reporting quality;

d) assess the technical difficulties in applying the standards; and

e) assess how market participants for these products would respond in their marketing activities to quality standards and price variations based on quality.

The results of these analyses will be used to make recommendations to OPROVIA on the applicability and viability of installing a formalized quality standards system for its bean and sorghum marketing activities in Rwanda. The aim is to propose a system which can improve the performance of OPROVIA's market stabilization activities and reduce costs of maintaining the food security stocks. The analyses will also permit us to draw implications for an industry-wide program of quality standards in Rwanda.

II. THE MARKET SETTING

A. The Structure of Commercial Market Channels.

Less than half of most food products in Rwanda move into commercial market channels, Table 1. It was estimated that only 31% and 32% of beans in 1980 and 1981, respectively, entered commercial market channels. The corresponding figures for sorghum were 35% and 36%. This is hardly surprising since much of agriculture is subsistence based, and farming represents the economic activity of more than 90% of Rwanda's population.

The market channels for bean and sorghum are illustrated in Figure 2. Several types of assemblers buy beans and sorghum from producers, small assemblers, local merchants, cooperatives, and OPROVIA. All of these firms resell beans and sorghum to producers for consumption, but they also sell to non-producing consumers in the region. OPROVIA, along with merchant-transporters, are important agents in moving product from surplus to deficit regions of the country. They are also the suppliers to the military, prisons, schools, hospitals, and to the World Food Program.

OPROVIA's share of the total commercial market is relatively small. For 1981 and 1982, it accounted for 8.2% of commercialized beans in 1981, and 2.4% of commercialized sorghum, Table 2. In terms of total production, this comprised 2.66% and 0.86% respectively, of beans and sorghum. OPROVIA's activities are described in more detail in subsequent sections of this report.

B. Quality of Beans and Sorghum in Rwanda

The first step in evaluating the feasibility of quality standards was to examine the quality at various points in the marketing system. OPROVIA researchers collected bean and sorghum samples at four market levels (producer, cooperative, merchant, and OPROVIA) at approximately the same time of year. Results of laboratory analysis of beans showed that the percentage of low quality beans, specifically those defined under the general heading of "damaged beans" (including shrunken or shriveled, insect or rodent damaged, mold, germinated, and broken beans), are lowest at the producer level, successively higher at the cooperative and merchant levels, and highest at OPROVIA warehouses, Table 3. Shrunken/shrivelled seeds accounted for at least half of the percentage of "damaged beans" for four types of market participants. These are seeds which, for biological reasons, were malformed or immature. In general, the results indicate that quality in Rwanda's bean market is poorest within OPROVIA's stocks. The evidence indicates, however, that for the most part this is not due to poor storage practices at OPROVIA but rather the lower quality of grain delivered to OPROVIA.

Evidence that pre-storage damage is more of a problem within OPROVIA's bean stocks than storage damage was revealed in the results of quality testing of two bean piles (totalling 450 tons) in OPROVIA's Kicukiro warehouse, Table 4. Though the quality testing was originally undertaken to monitor differences in stock losses between aerated and non-aerated piles, the data show that storage damage is low in both cases. The categories "inedible" and "unplantable" shown in Table 4 are necessarily subjective, but are based on the results of a farmer

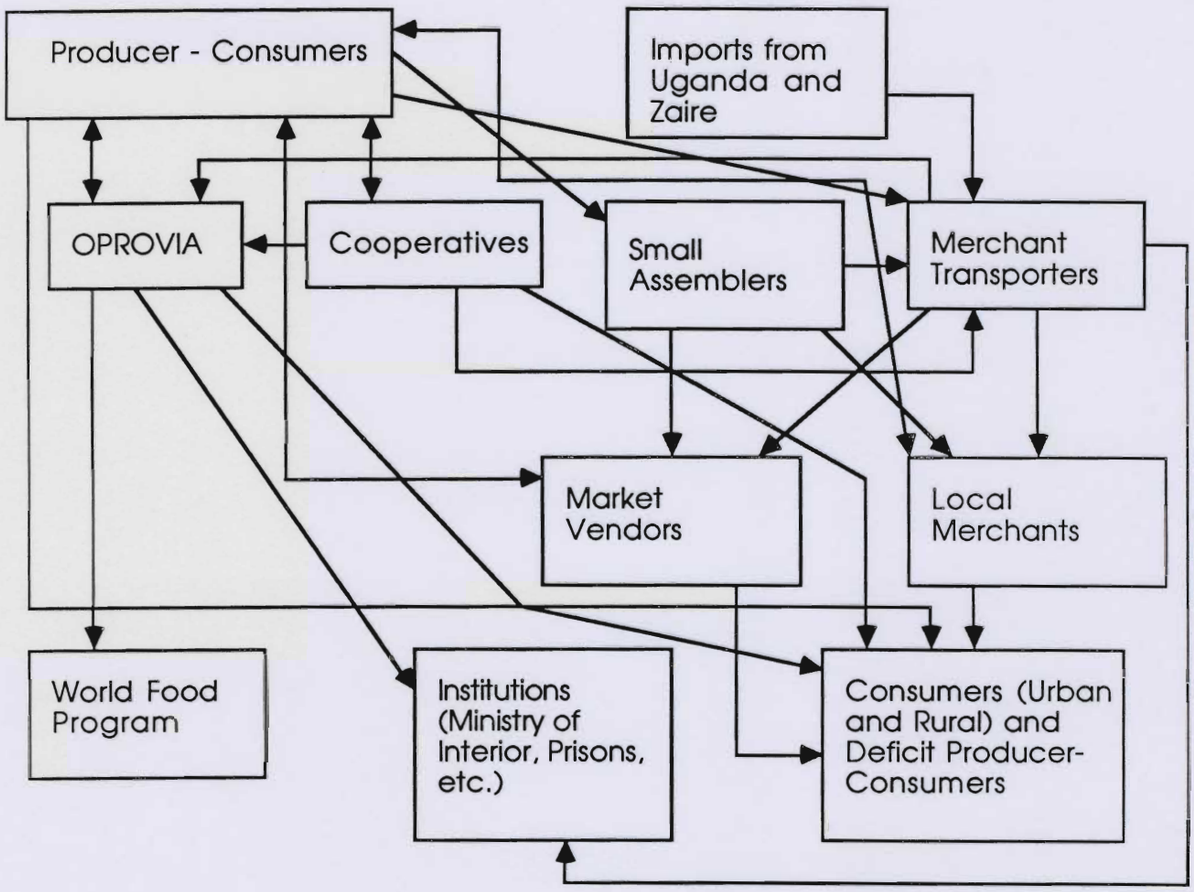
Table 1.

Percentage of Total Crop Production Entering Commercial Market Channels in Rwanda 1980-1981.

Product	1980 %	1980 Tonnage	1981 %	1981 Tonnage
Bananas	56	1,155,317	60	1,392,643
Dry Beans	31	56,161	32	61,323
Peas	23	8,020	24	8,617
Peanuts	42	6,554	34	5,981
Soybeans	36	1,916	38	2,419
Sorghum	35	62,616	36	69,330
Maize	27	22,966	26	22,049
Eleusine Millet	14	281	13	272
Wheat	29	631	25	260
Rice	92	4,076	87	5,008
Sweet Potatoes	33	287,383	31	296,875
Potatoes	39	84,653	42	106,727
Cassava	38	205,999	41	220,112
Cocoyam (Taro)	24	7,097	26	2,117
Yams	19	947	24	1,446
Legumes	60	20,873	50	19,261
Fruits	65	24,208	60	19,450

Source: OPROVIA, "Plan de Commercialisation des Denrees Alimentaires, 1984 a 1986", Republique Rwandaise, Ministere de l'Agriculture, de l'Elevage, et des Forets, Siege Social, Kigali.

Figure 2. Market Channels for Beans and Sorghum in Rwanda



Source: Based on discussions with and information supplied by OPROVIA and SESA (Service des Enquetes et Statistiques Agricoles) and Scott Loveridge (University of Michigan AID Project in Rwanda) in 1986.

Table 2

OPROVIA's Share of the Total Market for Beans and Sorghum in Rwanda, 1981

Product	OPROVIA Volume (tons)	Percent of Total Commercialization	Percent of Total Production
Beans	5,039	8.21	2.66
Sorghum	1,656	2.39	.86

Source: Based on figures published in OPROVIA, "Plan de Commercialisation des Denrees Alimentaires, 1984 a 1986", Republique Rwandaise, Ministere de l'Agriculture, de l'Elevage et des Forets, Siege Social, Kigali.

Table 3

Physical quality data of bean stocks sampled throughout the marketing system in Rwanda

Market Level	# of Samples	Moisture Content %	# of Insects (per kg)	Percent by weight: Foreign material	Percent by weight: Damaged beans (shrunken, broken etc.)	Percent by weight: Total Defects
Producer	48	15.0	1	1	4	4
Cooperative	9	14.8	4	1	6	7
Merchant	14	15.1	79	1	6	7
OPROVIA	11	15.2	42	1	9	10

Sources: Producer and cooperative data were compiled from the "National Storage Survey of Beans and Sorghum in Rwanda," GRENARWA II Research Project and represent first samples taken just after the beans were placed in storage following the January 1985 harvest.

Merchant data were compiled from samples taken in early June, 1986, from stocks offered by merchants who participated in open bidding for immediate GRENARWA purchase.

OPROVIA samples were taken in March 1985 just after purchase in the Kicukiro warehouse. The samples were representatively selected from two piles totalling 450 tons.

Table 4

Physical quality data of beans stocks sampled throughout storage at OPROVIA's Kicukiro Warehouse in 1985 (middle altitude)

	Non-aerated Pile 1		Aerated Pile 2	
Quality Category	At Purchase	After 9 months	At Purchase	After 11 months
% Inedible	11	14	8	12
% Unplantable	20	20	19	19

survey of damage perception and cleaning practices with regard to intended use of bean stocks conducted by another component of the Project (Projet GRENARWA II-Recherches, 1987a).

The results of laboratory quality analysis of sorghum samples taken throughout the marketing system are shown in Table 5. General levels of quality were good at all levels in the marketing chain, including the quality of OPROVIA's stocks just after purchase. Unlike laboratory test results for beans, the mean values for quality do not reveal a general trend in the marketing system from producer's to OPROVIA's stocks of increasingly greater levels of damaged grain. Also, moisture levels were quite good (low) at all levels. Sorghum is Rwanda is harvested during the time of year when it is relatively easy to dry grain adequately. In contrast, most of the bean crop is harvested in December-January during a more humid period and just prior to the second shorter rainy season.

Given the results of laboratory quality testing, the hypothesis can be made that OPROVIA's present policy to pay the same price for different levels of quality results in its receiving low quality beans from its suppliers. Suppliers are evidently using their higher quality stocks for their own use (consumption and planting) or for commerce with other traders where the risk of rejection or perhaps price reductions are greater. Lower quality could be due to producers cleaning less for those lots that are intended for sale to OPROVIA and/or cooperatives. Merchants may also be blending their lowest quality lots with higher quality to create a minimally acceptable level before selling to OPROVIA. At least some sellers are exploiting OPROVIA's present buying practices to get rid of their low quality beans.

The studies also show that this pattern of behavior does not extend to sorghum marketing. One reason for this is the difference in the size of grains. Defective grains can be hand-picked or sieved out much more easily in beans than in sorghum so that lots can be more easily separated according to quality.

The assumption is that bean sellers do not presently associate a cost with the act of selling low quality. Sellers know that a discount will not be applied in cases of low quality and that rejection is rare. The function of a grading system is to change the economic incentives and make it costly for sellers to market lower quality. Sellers can only be expected to furnish high quality grain if there is an incentive for higher quality, or a disincentive for lower quality.

What constitutes quality is the subject of the next chapter. Criteria for designing quality standards and the quality factors deemed relevant in Rwandan beans and sorghum are discussed. A description and technical evaluation of proposed standards are then presented. This will serve as the basis for subsequent examination of the feasibility of implementing such a system for OPROVIA as well as the other key players in the Rwandan grain trade.

Table 5

Physical Quality Data of Sorghum Stocks Sampled throughout the Marketing System in Rwanda

Market level	Number of Samples	Moisture Content (%)	Insects (number per kg)	Foreign Material	Damaged Grain (shrunken, broken etc.)	Total Defects
				(% by weight)		
Producer	39	12.4	1	1	4	5
Cooperative	50	12.5	37	1	5	6
OPROVIA (A)	15	12.6	176	1	4	5
OPROVIA (B)	83	11.1	4	1	1	2

Sources: Producer and cooperative data were compiled from the "National Storage Survey of Beans and Sorghum in Rwanda." GRENARWA II Research Project and represent first samples taken just after sorghum was placed in storage following the June-July, 1984 harvest. The farms and cooperatives sampled were located in three different altitude levels in Rwanda.

Merchant data were not available for sorghum.

OPROVIA (A) samples were taken in October, 1984, soon after sorghum piles in 3 warehouses (representing different altitude levels) were constituted. OPROVIA purchased mostly from merchants during the August/September, 1984 sorghum buying campaign.

OPROVIA (B) samples were taken from two sources: approximately half were taken as producers delivered sorghum to the Kicukiro warehouse during the August/September, 1986 sorghum buying campaign and approximately half were taken from sampling at four OPROVIA warehouses (Kibungo, Rwamagana, Nyamata, and Gitarama) during October, 1986 shortly after piles had been constituted.

III. PROPOSED QUALITY STANDARDS

A. Criteria for designing quality standards

The proposed quality standards for Rwandan beans and sorghum (Appendix A and B, respectively) provide definitions of terminology, descriptions of the necessary equipment, the bases on which the relevant quality factors are determined, and the systematic step-by-step procedures to follow in testing. They also include quality requirements according to specified grades, Tables 6 and 7. These are expressed as the maximum permissible limits by percent weight of each of the relevant quality factors for each designated grade. Grades are a ranked set of quality levels or classifications, each with specified standards.

A major issue in developing standards is whether to use grades or simply to determine and report the amounts of each quality factor found in a given grain sample. The principal disadvantages of using the "grades" approach is that it does not describe with precision the actual quality of a given sample. Grain of quite different quality may receive the same grade designation. Grades set limits over a range, often quite wide, for a whole group of quality attributes.

Furthermore, in a system using grades, the grade of a sample is determined by that quality factor having the lowest grade. For example, a sample may be of excellent quality in all factors except one. As a result, it will receive a low grade equivalent to the grade of that one factor. This situation may potentially lead to abuses. A supplier may decide to add poorer quality grain of low value without in fact changing the overall grade.

A system which reports the exact amount of each factor provides a much more precise description of product quality. Also, if price differentials are involved, prices can be more precisely and fairly adjusted to specific quality. In addition, little or no incentive would exist to tamper with the product through blending of poorer quality lots. Because the "grades" approach has been widely used throughout the world, it was decided to begin this research using a set of grades. Other options should be considered prior to any final recommendation.

Two major questions to address in developing any system of quality standards are: 1) what grain analysis or testing methods are to be used, and 2) what kinds of grain purchasing and management decisions will be based on those test results. In other words, how do you get the information, and then what do you do with it? For the former, procedures can range from highly subjective (e.g., quick, non-quantitative, visual inspection) to highly objective (e.g., more lengthly quantitative, lab-type analysis). For the second question, options when making purchases include rejection policies, price differentials (discounts/premiums), or a combination of the two. It must be emphasized and clearly understood by all involved that standards are <u>not</u> designed to set prices; they only describe certain characteristics of a product and thereby provide the information needed for exchange of each lot of grain based on what the market determines as its value (Hill, 1985). The test results also provide information on which storage decisions can be based, such as segregation of stocks according to quality or storability, scheduling of stock rotations, types and timing of insecticide treatments, and so forth.

Table 6
Proposed Grades and Grade Requirements
for the Class Mixed Beans in Rwanda
(Version II - August 1986)

Grade	-------- Maximum limits by percent weight of: --------					
	Damaged Beans		Foreign Material		Undamaged Broken Beans	Total Defects*
	Insect & Mold	Total (D)	Total Stones	(FM)	(B)	(D+FM+B)
GOR No. 1	0.5	1.0	0.3	1.0	0.5	2.0
GOR No. 2	1.0	2.0	0.4	2.0	1.0	4.0
GOR No. 3	5.0	10.0	0.5	3.0	1.5	12.0

Substandard Grade

The substandard grade shall be beans which:

a). Do not meet the requirements for the Grades GOR Nos. 1, 2 or 3.

b) Have a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.

c) Have more than 50 insects (live plus dead) per kilogram.

*Note: The standard for Total Defects is less than the sum of the maximum limits for foreign material, damaged grains, and broken beans. Therefore, samples which are approaching the maximum limits of all three quality factors for a given grade will not meet the requirements for that grade.

Table 7
Proposed Grades and Grade Requirements
for the Class Mixed Sorghum in Rwanda
(Version I - June 1986.)

Grade	--Maximum limits by percent weight of: Damaged Kernels	Foreign Material Stones	Foreign Material Total
GOR No. 1	1.0	0.5	1.0
GOR No. 2	3.0	1.0	2.0
GOR No. 3	5.0	2.0	4.0

Substandard Grade.

The substandard grade shall be sorghum which:

a) Does not meet the requirements for the Grades GOR Nos. 1, 2, or 3.

b) Has a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.

c) Has more than 50 insects (live plus dead) per kilogram.

d) Has more than 10 smut sori per 30 grams.

The proposed quality standards and testing procedures for beans and sorghum were drafted in mid-1986 and based on three sources of information:

1) The results of quality data collected during the past two years by FSM II researchers, data which served to identify the kinds and extent of quality problems in Rwandan beans and sorghum.

2) The quality standards used in industrialized as well as other developing countries where these two commodities are important. The draft standards for the Codex Alimentarius of FAO/WHO were also consulted.

3) The long-term experience of implementing a system of quality standards in North America, especially the USA.

The aim was to develop a set of standards which were realistic, attainable, meaningful, and useful within Rwanda's marketing system. An additional aim was to develop testing procedures which were relatively simple but objective--based on precise measurements such as weights and counts; could be easily taught to potential grain analysts with minimal formal education, did not require sophisticated equipment including not being dependent on electricity; and were not time-consuming--the original goal was a test which required less than 20 minutes, excluding sampling.

In the initial proposal, it was decided to retain the concept of designating specific grades but to limit their number. The philosophy underlying the different grades is explained below.

Grade No. 1 was intended to represent what would be considered high quality in Rwandan markets. It would not be 100% free of defects such as damaged grain or foreign material, but a premium grade with minimum defects that was realistically achievable by Rwandan producers. If price differentials were instituted, the maximum limits set for Grade No. 1 would be a good threshold or starting point for discounts.

Grade No. 2 was designed to encompass what would be considered grain of good, acceptable quality by most Rwandan consumers. A reasonable threshold for rejecting grain would be the maximum limits set for Grade No. 2.

Grade No. 3 was envisioned as representing grain of lower quality though of some value for some purposes within the Rwandan market.

The Substandard Grade was intended to designate grain of highly inferior quality, perhaps still of some worth to certain users but generally of distinctly low value. Neither Grade No. 3 nor Substandard should normally be purchased, but rather are included so that at least the system accounts for such quality if it occurs.

B. Key Quality Factors

The major quality factors considered when formulating the standards were as follows:

- damaged grain
- foreign material
- broken grain
- grain moisture content
- discoloration due to aging (especially for beans)
- varietal purity
- germination
- cookability or hardness (in the case of beans)
- insects
- test weight
- odor

An explanation is presented below of how each of these factors was defined and why decisions were made to have them incorporated into or excluded from the standards.

Damaged Grain Damaged grain is defined as those seeds which have severe enough defects or injuries to be normally considered by Rwandans as inedible or highly undesirable as confirmed by consumer surveys. Of the ten damage categories identified during earlier research (Projet GRENARWA II-Recherches, 1987a), only five were retained in the proposed standards. These consisted of grain damaged by insect attack, rodent feeding, severe mold growth, germination, and abnormal maturation (severely shriveled, shrunken seeds). It was initially decided that only the total weight of all these types of damage would be measured in the case of sorghum, but for beans separate standards were established for insect and mold damage combined as well as for total damage. Moreover, for each grade, it was felt that insect and mold damage should not exceed half of the maximum limit for total damage. Because previous research indicated higher levels of damage in beans than in sorghum, standards were made less stringent for beans for Grade No. 3, 10% vs. 5%, also the cut-off for the Substandard Grade.

Foreign Material Foreign material is essentially all matter other than good seed of the crop being tested. It includes stones, dirt, insects and their frass, rodent pellets, chaff and other plant materials - all of which have no food value and detract from product appearance and cleanliness. The standard for the top two grades for both beans and sorghum was initially set at 1% and 2%, respectively. The cut-off for substandard is less stringent for beans than for sorghum.

Broken Grain Broken grain is a seed missing more than one quarter of its normal mass, and which is not damaged according to the definition above. Broken grain usually retains its food value and satisfactory processing/cooking attributes, so it has greater value than factors such as foreign material. However, broken grain is generally more susceptible to storage damage and, in large amounts, detracts from product appearance. For beans, it was decided to establish a separate quality category for brokens, whereas with sorghum it was incorporated into foreign material.

Moisture Content Moisture content (mc) is a crucial factor as it determines not only storability of grain but also the weight of product, hence its price when marketed. The maximum moisture levels for safe storage are known. To prevent mold development, beans and sorghum must not exceed 15% and 13.5% mc, respectively. To retard insect attack, moisture levels probably must be below 10%. This cannot be attained in Rwanda without artificial drying, a practice not yet used in the country. To delay the onset of hardness in beans, an mc less than 13% is necessary. Although moisture content is recognized as important, expert opinion is divided on how it should be handled within a standards system. It should be noted that moisture has recently been removed as a grade factor from the US standards for several crops.

In this initial proposal, it was decided not to include moisture as a grade-determining factor, but to make provision for its measurement if desired. It is therefore only defined in the standards and approved means for its measurement described. In addition, the proposed standards state that moisture content can be used in calculating the weight basis for determining purchase price, and specify 13% mc as the official basis for both beans and sorghum. This is an important consideration because of the obvious difference in value between dry matter and water in grain. An individual acquiring 20% mc grain is not only facing a serious storage problem but is also paying for a good deal of water which is worthless. It is dry matter, not moisture, which bestows value on grain.

The standards provide a table of conversion factors for ease in determining actual purchase weight, Table 8. To simplify the table and account for some imprecision in moisture measurements, a range of 0.4% mc has been used. The basis is thus 13.0 plus or minus 0.2% mc, or a range of 12.8% to 13.2% mc. Grain drier than this level would be considered as weighing more than the delivery weight, while wetter grain would be less. These calculations do not change the price per kg but only the grain weight used to compute total price. For example, 1,000 kgs of 18% mc beans would be equivalent to 942.5 kgs of 13% mc beans (thus containing nearly 58 kgs of unwanted water). At the official price of 35 FRW/kg, the seller would receive 32,988 FRW (942.5 kg x 35 FRW/kg) instead of 35,000 FRW for these beans.

These weight adjustments are separate from the price adjustments (discounts/premiums) which serve as an incentive to reward the supplier who provides grain of desired moisture or other quality attributes. Without such adjustments, suppliers of high moisture grain actually receive an implicit premium. Assigning more weight to the delivery weight of overdried grain (less than 13.0% mc) is likewise only equitable. This is currently not the practice in the United States, resulting in an economic incentive for suppliers to blend in higher moisture grain or to add water to low moisture grain just prior to delivery. Neither of these practices is conducive to sound management of stored grain.

Discoloration Age-induced color change or discoloration, browning or darkening of seedcoat, is an important problem in beans in Rwanda. It is not an issue in sorghum. In beans, it is the result of bio-chemical, enzymatic processes occurring over time during storage. Although influenced by initial bean moisture content, storage temperature and relative humidity, it is basically an inevitable and irreversible process at typical ambient conditions prevailing in Rwandan storage. In short, there is really no practical action which can be

Table 8
Multiplication (Conversion) Factors for Adjusting Delivered Weight of Grain to the Net Purchase Weight Equivalent to a 13% Moisture Content (mc) Basis.

Moisture content (mc) (%)	Multiplication factor	Moisture content (mc) (%)	Multiplication factor
less than 10.3	1.0345	15.3 - 15.7	0.9713
10.3 - 10.7	1.0288	15.8 - 16.2	0.9655
10.8 - 11.2	1.0230	16.3 - 16.7	0.9598
11.3 - 11.7	1.0172	16.7 - 17.2	0.9540
11.8 - 12.2	1.0115	17.3 - 17.7	0.9483
12.3 - 12.7	1.0057	17.8 - 18.2	0.9425
12.8 - 13.2	1.0000	18.3 - 18.7	0.9368
13.3 - 13.7	0.9943	18.8 - 19.2	0.9310
13.8 - 14.2	0.9885	19.3 - 19.7	0.9253
14.3 - 14.7	0.9828	19.8 - 20.2	0.9195
14.8 - 15.2	0.9770	less than 20.2	1.1495 - 0.0115 (% mc)

Note: The weight adjustment factor converts the weight of beans delivered at any moisture content to an equivalent total weight for the same amount of dry matter at 13% moisture content (mc). The delivered weight is multiplied by the adjustment factor to determine the net purchase weight. For example, 1.0 kg of beans delivered at 15% mc weighs 0.977 kg if dried (or converted) to 13% mc.

taken, short of refrigeration. Also, if discoloration were a grade factor, a high quality lot maintained in excellent condition over a long period could be downgraded from Grade No. 1 to Substandard Grade without any significant quality change other than color and for a factor beyond everyone's control. Thus, it was initially decided not to include color as a grade factor. However, this in no way precludes OPROVIA or those in the grain trade from specifying the degree of aging coloration or harvest period for purchases. For instance, one could stipulate "new beans" or "new crop" meaning fresh-looking beans from the most recent harvest, or one could specify a certain harvest period, such as "January 1986 beans".

Varietal Purity Varietal purity is another factor considered for inclusion in the standards. Beans in Rwanda are predominantly, though not exclusively, grown and stored as complex multi-colored mixtures of numerous seed types (Projet GRENARWA II-Recherches, 1986). Sorghum is also grown as varietal mixtures though the red-seeded types are by far the most common and tend to mask the less prevalent lighter-colored (white, ivory, yellow) varieties. Regional and local preferences for specific seed types or varieties seem to be much more pronounced and variable in beans (Projet GRENARWA II-Recherches, 1986 and 1987b) than in sorghum. Since the demand for specific types is negligible, separate standards for individual market classes are not currently useful as in Canada and the USA. The best way to take into account diverse preferences and varietal complexity is probably not to make variety a grade determining factor or part of a rigid set of specifications. Exclusion does not in any way detract from the standards, however, and in fact leaves the issue to be dealt with and settled in the marketplace between buyer and seller. Moreover, as with color due to aging, this does not preclude OPROVIA or those in the grain trade from specifying the kind of mixture or the predominant seed type(s) required in their purchases.

The proposed standards recognize only the class "mixed beans" and "mixed sorghum", but state that a mixture may be designated by the variety or grain type which constitutes more than 20% in beans or 80% in sorghum of the mixture. Beans or sorghum presented as a single variety or type will be subject to the same standards as the "mixed" class, though a separate set of standards could be developed later for these special cases.

Germination Germination is an important characteristic of grain intended for seed purposes. Grain for seed and grain for food and feed products are usually not traded together nor subject to the same standards. Sorghum in Rwanda is somewhat of a special case in that most of the crop is sprouted and used for making beer. Germination capacity is thus important in this use though extremely high rates are not essential. The major constraint to inclusion of germination in standards is that no rapid, accurate test exists for measuring this attribute, an essential criterion for the proposed testing methods. Standard germination tests take from four days to more than a week depending on the crop. More rapid tests, such as the Tetrazolium Test, measure viability as distinct from germinability, yet still require many hours to complete. From a practical standpoint, none of these tests could be conducted in warehouses, cooperatives, or markets.

Cookability Cookability is another important quality attribute of beans, especially in Rwanda. In the consumer's mind, it is associated with a typical coloration induced by aging as discussed above. A standardized laboratory test

has been developed for use in Rwanda (Projet GRENARWA II-Recherches, 1987b), based on a 3-hour cook without prior soaking and then measurement of bean hardness using a Chatillon texture (puncture) tester on a 100-bean sample. Though a simple procedure, altogether it is a half-day test, which is much too lengthy for the system proposed. For this reason, cookability has been excluded from the standards. However, samples can be submitted to the FSM II laboratory by any individual or organization for cookability testing on a voluntary basis, an action highly recommended for those with beans stored for periods exceeding 6-8 months.

Insects Insects in Rwanda are a major cause of weight and quality loss in stored grain. If not controlled, insects can greatly increase in numbers over time with a resultant increase in grain loss. Besides the obvious damage, holes and tunnels, due to the feeding activities of insects, severe attacks may produce objectionable odors and even lead to mold damage. In such cases, nutritional quality and germinability of the grain can also be significantly reduced.

In general, Western countries have strict standards on insects. In the United States' bean standards, for example, samples containing more than one live insect per kg are considered "weevily" and designated United States Sample Grade, a low quality classification. Even if more than one bean is found with distinct insect webbing or filth, or if live moths or live "worms" (larvae) are observed in the beans or on the containers, the lot receives the "weevily" designation.

For sorghum in the United States, samples are given the special grade "weevily", a phrase added on to the regular numerical grade, if the work sample contains more than one live weevil; e.g., Sitophilus spp., Rhyzopertha dominica or more than 14 other live insects injurious to stored grain. It should be noted that in both cases dead insects are not counted, only live ones. The standards are thus primarily intended to indicate and penalize the existence of live infestations.

Much debate occurred during the process of establishing an appropriate standard for insect numbers in Rwanda. There were two important considerations. First, the lack of visible evidence of insects is not proof that a grain lot or sample contains no insects or that an infestation is not in progress. An infestation may be in its early stages without emerged adults, or a lot could have been sieved to remove adults just prior to inspection. Second, the presence of visible but dead insects is likewise not proof that a grain lot or sample contains no live insects or that an infestation is not in progress. Adults could be dead from insecticidal treatments, environmental causes (heat or extreme cold), disease or age, while at the same time viable immature stages could be present and thriving within seeds.

In both cases, the infestation could be hidden--adults not yet emerged, larvae/pupae still within seeds. Hidden infestations are not easy to detect. They require sophisticated tests or lengthy incubations (4-6 weeks), neither of which is practical given the circumstances under which grain is currently marketed in Rwanda. Furthermore, though live insects may be more noticeable than dead ones because of their movement, they are the same from a hygienic standpoint.

For the reasons stated above, the number of insects found is not necessarily indicative of present or potential damage to grain. In any case, the damage caused by insects is already measured directly as part of a separate quality factor (damaged grain). Because infestation often begins in the field prior to harvest, it is understandable that grain being marketed in Rwanda will have some insects even with good control efforts.

The North American standards thus seem too strict for Rwanda. It is, therefore, proposed that on a preliminary basis, the standard used be 50 insects per kg, live and dead combined, determined by examining the fine material obtained from sieving. Above this level, grain would be graded Substandard. This is equivalent to 5,000 insects per 100 kg of grain, a large number from any standpoint. However, this seems more realistic given the occurrence of field infestations and the fact that the standard is not meant to indicate the point at which grain needs to be treated.

Disease Organisms Seeds which are attacked by micro-organisms such as fungi, bacteria, or viruses are generally considered of low value and undesirable. The principal examples of this are moldy grain on which fungal growth (mycelia) is clearly visible on the seedcoats. This kind of damage has already been accounted for as part of another grade factor, damaged grain.

Some fungi create special structures that are separate from the seeds of their hosts but may get mixed with the grain. For instance, a field disease of beans called white mold, caused by Sclerotinia sclerotiorum, produces hard black mats of mycelia (sclerotia). Standards exist in Canada for these scelortia but very few if any have been reported to occur in Rwandan bean samples.

Two common fungi in cereal grains are ergot and smut. A form of the latter called covered kernel smut is found in Rwandan sorghum and caused by the fungus Sporisorium sorghi (Syn. Sphacelotheca sorghi). It produces sori which are compact masses of black spores covered by a grayish membrane and which resemble elongated sorghum kernels. In large numbers, these can taint the color and odor of the stored product. Although the United States sorghum standard is 20 sori in 100 grams, it was decided to make the initial Rwandan standard slightly more tolerant: maximum of 10 sori per 30 grams of sorghum. This would be determined from material remaining after sieving and thus includes only the larger smut masses.

Test Weight Test weight is the weight of the volume of grain required to fill, level full, an official standard container. It was used initially in the United States as a measure of quality to indicate breadmaking quality in wheat and approximate moisture content (Foster, 1982), and remains a grade factor in most crops. However, it has been proven repeatedly that test weight is not correlated with any of the important chemical or product yield characteristics (Hill, personal communication). Insect-damaged beans and sorghum have lower test weight than sound grain but this quality attribute is already measured by another grade factor (damaged grain). To our knowledge, no bean standards in the world include test weight. Because of its limited usefulness, it was decided not to include test weight in the proposed standards for Rwanda.

Odor Objectionable odors in grain can be the result of molds (musty smell), fermentation (sour), insects (acrid/rancid), or contamination by other materials. They render grain unfit for consumption or normal commercial usage. Insecticides often impart a distinct odor to grain but are usually considered acceptable if they dissipate within several hours in the open air. Since odors greatly diminish product attractiveness and are often indicative of other quality problems, they are not permitted in the grain standards of most countries. In the United States' standards, samples having a "commercially objectionable foreign odor" are considered distinctly low quality and designated Sample Grade. For Rwanda, it is therefore proposed to relegate to Substandard all grain with these kinds of odors.

C. Results of Initial Standards Testing

During the second half of 1986, samples of beans and sorghum moving in the commercial trade were taken at various locations in Rwanda and tested according to the procedures and standards initially proposed, Tables 9 - 12. For beans, sampling was limited to merchants because OPROVIA's purchases from producers and cooperatives had been completed earlier in the year. Two different sets of bean stocks were sampled: 1) 14 stocks offered for sale to, and sampled by, OPROVIA in June, 1986; and 2) 31 stocks sampled by FSM II staff during a survey of grain merchants in late 1986.

Tests on sorghum were conducted on samples collected soon after the main harvest (June-July, 1986) at the five main buying points of OPROVIA. The stocks sampled were grouped into three distinct sets: 1) 39 samples taken from producers as they delivered to the OPROVIA warehouse at Kicukiro in August-September; 2) 44 samples taken from stacks in OPROVIA warehouses at Gitarama, Nyamata, Rwamagana, and Kibungo shortly after purchase from producers and cooperatives; and 3) 11 samples taken from cooperatives as they delivered to OPROVIA at Kicukiro at the same time as the producers above. The testing procedures used are those described in Appendices A and B.

1. Bean Quality

The quality of beans tested was relatively poor, especially with respect to damage levels, Table 9. One reason is that all samples were taken from stocks of merchants, a group known to have difficulties with storage. In addition, most of the beans were not "fresh". At the time of sampling, most had been in storage for many months and had time to deteriorate in quality without sound management. Specific results and conclusions are discussed below.

Damaged Grain The results show that damage levels were high, averaging nearly 6% by weight, Table 9. Most of this damage, over 90% was due to insects and molds. The range was quite variable, with some samples exceeding 25% damage by insects and molds. As a result, only 7% of these samples were good enough to meet the proposed standard for Grade No 1, Table 11. Most would have graded No. 3 or Substandard. Because total damage was largely determined by insect/mold damage and since several producer/consumer surveys conducted by another component of the Project (Projet GRENARWA II-Recherches, 1987a) indicated that the five types of damage measured here are more or less equally undesirable, we propose reducing damage to a single factor of "total damage" only and not maintaining insect/mold damage separate from the other types.

TABLE 9

Summary of Quality Data of Bean Samples Collected in 1986 From Private Merchants and Tested According to Prescribed Procedures of Proposed Rwandan Grain Quality Standards[a]

Number of Samples	Statistical Measure	Damaged Beans: Insect & Mold	Damaged Beans: Other[b]	Damaged Beans: Total (D)	Foreign Material[c]: Fine	Foreign Material[c]: Large	Foreign Material[c]: Stones	Foreign Material[c]: Total (FM)	Undamaged Broken Beans (B)	Total Defects (D+FM+B)	Moisture Content (%)	Insects (nbr/kg)
		percent by weight										
14[d]	mean	5.3	0.3	5.6	0.8	0.2	0.3	1.3	0.1	7.0	15.1	78
	S.D.	6.7	0.2	6.7	0.5	0.1	0.2	0.6	0.1	6.9	1.0	140
	range	0.5-25.4	0.0-0.6	0.8-25.7	0.1-1.5	0.0-0.3	0.0-0.8	0.2-2.3	0.0-0.5	1.1-27.3	13.5-16.4	1-543
31[e]	mean	5.3	0.6	5.9	0.6	0.2	0.2	0.9	0.3	7.1	14.5	15
	S.D.	6.5	0.3	6.4	0.3	0.3	0.3	0.5	0.2	6.4	2.0	21
	range	0.4-33.3	0.1-1.5	0.8-33.4	0.2-1.1	0.0-1.7	0.0-0.9	0.2-2.9	0.0-0.8	1.6-34.3	11.6-20.7	0-24

a Rwandan Standards for Beans (proposed), Version II, August 1986.

b Other damage is defined as rodent damaged, sprouted, and shrunken/shriveled beans.

c Fine foreign material (FM) is all matter which passes through an 8 x 3/4 oblong hole sieve. Large FM is all matter other than beans which does not pass through an 8 x 3/4 oblong sieve.

d Merchant bean stocks offered for sale to, and sampled in June 1986, by GRENARWA staff (January, 1986 harvest).

e Merchant bean stocks from various harvests of 1986 sampled in late November-early December, 1986, during "Merchant Survey" (Appendix D).

TABLE 10

Summary of Quality Data of Sorghum Samples Collected From Various Sources and Tested According to Prescribed Procedures of Proposed Rwandan Grain Quality Standards[a]

Number of Samples	Statistical Measure	Damaged Kernels[b] (D)	Foreign Material: Fine[c]	Foreign Material: Large[c]	Foreign Material: Stones	Foreign Material: Total (FM)	Total Defects (D+FM)	Moisture Content (%)	Insects (nbr/kg)	Smut Sori (nbr/50g)
			percent by weight							
39[d]	mean	1.5	0.4	0.5	0.2	1.1	2.6	11.2	3	2
	S.D.	2.3	0.5	0.4	0.3	0.6	2.3	0.7	3	2
	range	0.2-13.2	0.1-2.2	0.2-2.0	0.0-1.2	0.3-3.0	0.5-13.9	10.0-13.1	0-13	0-7
44[e]	mean	0.9	0.4	0.7	0.2	1.3	2.2	11.0	4	2
	S.D.	0.3	0.1	0.3	0.2	0.4	0.6	0.4	4	1
	range	0.2-1.4	0.1-0.8	0.2-1.4	0.0-0.8	0.5-2.2	0.8-3.2	9.7-11.9	0-21	0-7
11[f]	mean	1.0	0.4	0.8	0.3	1.5	2.5	10.8	1	1
	S.D.	0.4	0.2	0.2	0.3	0.5	0.8	0.3	1	1
	range	0.2-1.6	0.1-0.7	0.4-1.2	0.0-1.0	0.9-2.7	1.1-3.9	10.4-11.3	0-3	0-3

a Rwandan Standards for Sorghum (proposed), Version I, June 1986.

b Kernels damaged by insect/rodent feeding, molds, sprouting, or abnormal maturation (shrunken, shriveled kernels).

c Fine foreign material (FM) is all matter which passes through a 5/64 triangular hole sieve. Large FM is all matter other than whole kernels of sorghum which does not pass through a 5/64 triangular sieve.

d Producer stocks sampled as delivered to GRENARWA's warehouse at Kicukiro (Kigali) during August-September, 1986 buying campaign.

e GRENARWA stocks sampled during October and early November, 1986, at four warehouses (Gitarama, Nyamata, Rwamagana, and Kibungo) shortly after purchase from producers and cooperatives.

f Cooperative stocks sampled as delivered to GRENARWA's warehouse at Kicukiro (Kigali) during the August-September, 1986 buying campaign.

Table 11
Grade Distribution (%) by Individual Quality Factor
and Overall Grade of 45 Bean Samples Tested
According to Prescribed Procedures of
Proposed Rwandan Grain Quality Standards [1]

	----- GRADE -----			
Quality Factor	I	II	III	SUB
Insect/Mold Damaged Beans	7%	11%	49%	33%
Total Damaged Beans	11	18	56	15
Stones	76	0	6	18
Total Foreign Material	60	36	4	0
Broken Beans	96	4	0	0
Total Defects	11	36	38	15
Overall Grade [2]	2%	13%	38%	47%

1. Based on data presented in Table 9 and standards presented in Appendix A.

2. Figures for the overall grade are not the totals nor the means of the grades of the various quality factors listed above. The overall grade assigned to a sample is the lowest grade obtained for any of the quality factors tested. A sample can also be graded Substandard because of odor or high insect numbers (see Section 1.200 of Appendix A), but these factors were not taken into account in compiling this table.

Table 12
Grade Distribution (%) by Individual Quality Factor
and Overall Grade of 94 Sorghum Samples Tested
According to Prescribed Procedures of
Proposed Rwandan Grain Quality Standards[1]

	-----GRADE-----			
Quality Factor	I	II	III	SUB
Damaged Kernels	67%	29%	2%	2%
Stones	89	10	1	0
Total Foreign Material	35	57	8	0
Overall Grade [2]	25%	62%	11%	2%

1. Based on data presented in Table 10 and standards presented in Appendix B.

2. Figures for the overall grade are not the totals nor the means of the grades of the various quality factors listed above. The overall grade assigned to a sample is the lowest grade obtained for any of the quality factors tested. A sample can also be graded Substandard because of odor or high insect numbers (see Section 2.200 of Appendix B), but these factors were not taken into account in compiling this table.

Although the vast majority of merchant bean stocks did not meet the Grade No. 1 standard for total damage (1%), preliminary evidence from some producers and the Kicukiro market indicates that the standard can be met. Damage is also a factor which can be controlled; technology exists to keep damage levels to a minimum. It is a tough standard, nevertheless, but one we recommend. As a partial offset, we also propose lessening the standard for Grade No. 2 from 2 to 3%. In addition, we recommend toughening the limit for Grade No. 3 from 10 to 5%.

Foreign Material Total foreign material (FM) averaged slightly over 1%, Table 9, the maximum limit for Grade No. 1. Fifteen percent of the samples contained 0.5% or less total FM. Overall, 40% had more than 1% FM, thus 60% made Grade No. 1, Table 11. Only 4% of the samples would have been rated Grade No. 3 or worse. Standards for total FM should, therefore, not be lowered, and an argument could even be made to raise them. However, we recommend that the standards for the top three grades remain as originally proposed; 1, 2, and 3%, respectively.

As for stones, an important component of foreign material, they account for less than one quarter of total foreign material in the bean samples analyzed, Table 9. No samples contained more than 1% of stones, and the mean level was less than 0.3%, which is the level proposed for Grade No. 1. We recommend, therefore, that 0.3% be maintained. However, the current spread of 0.1% between the top three grades seems too small to be really measurable, and thus we further recommend that the standards for Grades No. 2 and 3 be changed from 0.4 and 0.5% to 0.6 and 1.0%, respectively. Because of the special undesirability of stones in beans, it seems wise to measure stones separately and impose rather stringent limits on the amounts allowed.

It is interesting to note the relative proportions of fine and large-sized foreign material. There was much more fine material than large material including stones. Fine material is all material passing through an 8 x 3/4" oblong sieve (called "dockage" in the U.S.); large material stays on top of this sieve. Although not important for grade determination, these data give an indication of what can be accomplished by cleaning, whether it be manual cleaning of small lots by producers or mechanical cleaning of large lots by OPROVIA, processing companies, grain merchants, and others. The fine material can be relatively easily sieved out because of the simple difference in physical size compared to good quality beans. Some of the large foreign material other than stones, such as pieces of pods and stems, could be removed through aspiration: hand winnowing by producers, or fans on mechanical cleaners by large operations. The remaining large foreign material including stones could be removed by hand-picking at the producer level and perhaps by using gravity separators for large-scale cleaning. The latter is generally used only in the seed business in other countries, however, and usually not in the grain trade.

Broken Beans The lots tested contained very small amounts (mean less than 0.3%) of broken beans, i.e., pieces of beans which were undamaged in other ways and which were large enough to stay on top of an 8 x 3/4" oblong sieve, Table 9. Only 4% of the samples did not make Grade No. 1. The results indicate that broken or split seed is not a significant problem in Rwandan beans, which probably reflects the use in Rwanda of non-mechanical harvesting/threshing techniques. We therefore suggest eliminating this category as a separate grade factor in the standards. However, since broken beans are still a quality defect

and more susceptible to storage damage than sound beans, we recommend that they be measured as part of damaged beans. Small pieces of beans which pass through the sieve would continue to be included as part of foreign material.

Total Defects This grade factor was intended to downgrade lots which contained levels of most or all of the individual quality factors approaching the maximum limits allowed for a particular grade. Although it does not require separate analysis, but rather only a simple calculation and hence, is not very time-consuming, it probably does not serve sufficient purpose to warrant retention in the standards. In the interests of simplicity, we therefore propose eliminating total defects as a grade factor. This makes the bean standards more like the sorghum standards from which this factor was excluded in the initial proposal. The concept is worth retaining, however, as it is the sum of total damaged grain and total foreign material, and as such represents the total percent by weight of unwanted or undesirable material in a lot. It is thus an index of overall product quality.

2. Sorghum Quality

The quality of sorghum tested was in general quite good, Table 10. One reason is certainly favorable conditions during the 1986 harvest period: warm and dry, with little or no rain. This is reflected in the low moisture contents of the sorghum with a mean of about 11% and a maximum of 13.1%, levels which are excellent for storage. Another reason is that the sorghum was sampled relatively soon after harvest when quality would be expected to be highest. A third reason is the source: the sorghum was purchased primarily from producers, either directly or indirectly through cooperatives.

Damaged Grain Damage levels were considerably lower than for beans, averaging only slightly more than 1%, Table 10. There were a few samples with substantial damage, a maximum of 13%, but two-thirds of the samples contained less than 1% and thus graded No. 1, Table 12. Most of the remainder, 30%, had less than 3% damage and graded No. 2. These data support toughening the standards. Even though 1986 may have been an exceptionally good year from the standpoint of grain quality, we propose reducing the maximum limits for Grades No. 2 and 3 from 3.0 and 5.0% to 2.0 and 4.0% respectively. The 1% level for Grade No. 1 is already quite high and is probably best maintained.

Foreign Material The mean value of total foreign material (FM) ranged from 1.1 to 1.5% for the three groups of samples, Table 10. The most FM found in any sample was 3.0%. Over one-third contained less than 1% and thus graded No. 1. Most of the remainder, 57%, had less than 2% FM and thus graded No. 2. These data support some tightening of the standards. We therefore suggest changing the limit for Grade No. 3 from 4 to 3%, but keeping the maximum limits for the top two grades at 1 and 2% respectively.

The amount of stones found in these sorghum samples was roughly the same as for the beans. They averaged under 0.3% and ranged from 0 to 1.2%, Table 10. As a result, almost 90% of the samples graded No. 1 , less than 0.5%. For the same reasons presented for beans, we propose maintaining a separate standard for stones in sorghum. We suggest making the maximum limits for the top three grades the same as for beans, namely 0.3, 0.6, and 1.0% respectively.

It is again interesting to note the ratio between fine and large-size foreign material. Large material including stones amounted to 2-3 times more than fine material. This is opposite of the situation for beans, but is most likely explained by the fact that sorghum kernels are much smaller than beans seeds; consequently, the size of the sieve holes is much smaller for removing fines which leaves much more material, including large FM, on top of the sieve. Cleaning sorghum to remove foreign material represents a somewhat different challenge than for beans. Manual methods at the producer level will require skillful use of the traditional winnowing basket coupled with considerable hand-picking. Certain basket movements should tend to aggregate the heavier large FM as well as segregate them to a certain degree from the sorghum. Skillful selection and adjustments of screens in mechanical cleaners should allow significant improvement in product quality as well. The fine material can be removed through conventional winnowing and through small-hole screens combined with air suction in cleaning machines.

Other Factors The data provide no justification for adding broken kernels to the standards as a quality factor, namely foreign material. It should be noted that, because of the floury nature of their endosperms, broken sorghum kernels tend to disintegrate much more readily than broken beans and thus probably have less value than the latter. Use of "total defects" as a distinct grading factor is also not recommended for reasons discussed earlier in the case of beans.

D. Proposed Modifications to Initial Standards

Based on the analysis of these quality test results, the proposed quality standards for beans and sorghum were again modified in March, 1987 as shown in Tables 13 and 14, respectively. The revised procedures including these modified grade requirements are in the process of being drafted. The tables of standards continue to show distinct grade levels (GOR No. 1, 2, and 3 plus Substandard), but may be used without designating specific grades. That is, users may prefer to report the actual level of particular quality factors combined, for instance, with discounts and/or a specified level below which lots are rejected. It is our intention, however, that these grade designations be the sole officially and legally recognized standards in Rwanda and that no grain be in any way considered or labelled a particular grade without an officially approved inspection.

The proposed bean standards were reduced in complexity and now closely resemble the sorghum standards. In fact, the levels allowed for both stones and total foreign material are now the same for the two crops. The standards do vary with respect to damaged grain. Grade No. 1 is the same for both (1%), but standards for Grades No. 2 and 3 are tougher for sorghum because lower damage levels are more common in sorghum than in beans. The reason for this is that, because there are many fewer seeds per unit of weight in beans than in sorghum, a single seed of beans attacked by an insect or fungi (molds) represents a much greater percent of damage in a kilogram of beans than a single kernel of sorghum.

Table 13
Proposed Grades and Grade Requirements
for the Class Mixed Beans in Rwanda
(Version III - March, 1987)

Grade	---Maximum limits by percent weight of: Damaged Beans	Foreign Material Stones	Foreign Material Total
GOR No. 1	1.0	0.3	1.0
GOR No. 2	3.0	0.6	2.0
GOR No. 3	5.0	1.0	3.0

Substandard Grade.

The substandard grade shall be beans which:

a) Do not meet the requirements for the Grades GOR Nos. 1, 2, or 3.

b) Have a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.

c) Have more than 50 insects (live plus dead) per kilogram.

Table 14
Proposed Grades and Grade Requirements
for the Class Mixed Sorghum in Rwanda
(Version II - March, 1987)

Grade	---- Maximum limits by percent weight of: Damaged Kernels	Foreign Material Stones	Foreign Material Total
GOR No. 1	1.0	0.3	1.0
GOR No. 2	2.0	0.6	2.0
GOR No. 3	4.0	1.0	3.0

Substandard Grade.

The substandard grade shall be sorghum which:

a) Does not meet the requirements for the Grades GOR Nos. 1, 2, or 3.

b) Has a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.

c) Has more than 50 insects (live plus dead) per kilogram.

d) Has more than 15 smut sori per 50 grams.

IV. FEASIBILITY OF IMPLEMENTING QUALITY STANDARDS WITHIN OPROVIA'S OPERATIONS

To assess the feasibility of using the proposed grain inspection procedures and quality standards in OPROVIA's purchasing operations, it is first necessary to understand the quality factors presently accounted for in Rwanda's bean and sorghum markets and any existing price discounts or premiums connected to these quality factors. What are the standard operating procedures that market participants use in accounting for quality in their bean commercialization activities? Of particular importance is an understanding of how OPROVIA's present purchasing system works and problems facing warehouse managers in following quality specifications. Second, it is important to know whether participants perceive a difference between the quality levels included in the proposed standards. Finally, what sampling and testing procedures would be operationally feasible within OPROVIA's operations? How are the other groups involved in grain marketing - producers, cooperatives, and merchants - likely to respond to adoption of these proposed standards?

The feasibility analysis is based on primary data collected by FSM II researchers between September, 1986 and January, 1987. The types of data collected and the manner in which they were obtained are discussed in this section. The first part focuses on the four formal surveys which were conducted. Following this is a description of the data collected from informal interviews of senior OPROVIA officials and discussions with warehouse managers.

A. Surveys of Market Participants

Five surveys were originally planned and designed for researching how Rwanda's present marketing system accounts for quality and how a quality standards system could be adapted to this system. Four of the five surveys were conducted: producers who sell to OPROVIA, cooperatives who have supply contracts with OPROVIA, merchants commercializing beans and sorghum, and institutions who purchase from OPROVIA.

The objectives of the four surveys were to determine: 1) existing cleaning, rejection, and price practices concerning quality in Rwanda's bean and sorghum markets; 2) whether market participants perceive a difference between the grades proposed by OPROVIA researchers; and 3) responses to the idea of a quality standard system. Each of the surveys contained three types of questions: short answer questions, questions requiring the respondent to inspect bean and sorghum samples shown by the interviewer, and hypothetical questions concerning reactions to possible changes in OPROVIA's purchasing procedures.

A brief description of each survey follows:

Producer survey A total of 164 producers who came to sell sorghum to OPROVIA during the 1986 buying campaign, August-October were interviewed. The survey was conducted at five OPROVIA locations: Kicukiro, Gitarama, Rwamagana, Kibungo, and Nyamata. A total of 82% of the sorghum purchased from producers in 1986 was purchased at these warehouses. The survey also

determined selling and cleaning practices concerning beans and sorghum, perceptions of quality, and possible reactions to hypothetical changes in OPROVIA buying practices with regard to quality.

Cooperative Survey Half of the cooperatives which sold beans and/or sorghum to OPROVIA in 1986 were interviewed. These 27 cooperatives supplied 50% of the sorghum sold to OPROVIA by cooperatives and were located in six different prefectures. The survey questions were designed to determine the reaction of cooperatives to the proposed quality standards and also current cooperatives practices with regard to quality. The survey was conducted between October 15 and November 4, 1986, shortly after OPROVIA's sorghum buying campaign ended.

Merchant Survey Thirty merchants were surveyed in five different prefectures between November 18 and December 3, 1986. Merchants were selected if they had fixed place operations and if they marketed beans and/or sorghum. To facilitate locating merchants once in the field, OPROVIA warehouse managers were sent a questionnaire in August, 1986 and asked to furnish the names and locations of 10 large-scale merchants in their area who had previously made sales to OPROVIA.

The merchant survey was conducted jointly by researchers from FSM II and the Agricultural Survey and Analysis Project (SESA). The survey incorporated questions from three different researchers. One section was oriented towards storage practices and problems and another attempted to determine monthly transaction schedules. The third section, which pertained to quality standards, was similar to the previously described cooperative survey. The questions focused on standard operating practices concerning quality and merchant responses to possible changes in OPROVIA's purchasing policies.

Institutional Survey The two main institutional buyers of OPROVIA's beans and sorghum are the Ministry of Finance (MINIFINECO) and the World Food Program (WFP). A total of nine interviews were conducted with individuals within these two institutions who are either responsible for contract negotiations or for the receipt, handling, and storage of bean and sorghum deliveries. The purpose of the interviews was to determine what types of problems, if any, institutions experience with bean and sorghum quality and what procedures are followed to control the quality of deliveries.

A third institution, the national brewery (BRALIRWA), was also interviewed even though it does not presently buy sorghum from OPROVIA. The survey was conducted to find out what type of quality standards this institution uses in its grain purchasing activities and its past experience with those standards.

Informal Interviews of Senior Management at OPROVIA The majority of the statistics cited in this analysis concerning OPROVIA's operations were obtained from requests made to senior management within GRENARWA, the food crop division of OPROVIA, as well as senior management within OPROVIA. These individuals also contributed information concerning policy at OPROVIA with regard to bean and sorghum quality.

Warehouse Manager Interviews During the course of the producer and cooperative surveys, OPROVIA warehouse managers were interviewed by means of an informal questionnaire. Managers were asked general questions about their

standard operating procedures for controlling quality. Six managers were interviewed.

B. Consumer Demand for Quality Standards

In September, 1986, a proposal was forwarded to OPROVIA administrators asking permission to conduct a consumer test in retail outlets. The proposed test entailed selling three qualities of beans, representing the three grades proposed by FSM II researchers, in five retail outlets during November and December, 1986, when OPROVIA sometimes sells beans at retail. The beans would be sold at prices reflecting the average market price in the area of the outlet, with specified differentials between the three qualities.

OPROVIA's internal committee on pricing rejected the proposal due to the pricing arrangement (Government of Rwanda, 1986). According to the committee, "such an operation would be dangerous to OPROVIA's reputation" given the present environment concerning official prices. The committee agreed to authorize the experiment only if the beans were sold at 45 FRW, 10 francs above the official producer price in 1986. The three types of beans also had to be sold in the market outside OPROVIA retail outlets and the local authorities were to be notified in advance of the experiment. In view of the restrictive conditions, the consumer survey was dropped.

The survey of the institutions who buy from OPROVIA, completed in January, 1987, is the main source of information about customer preferences concerning the quality standards being tested in this analysis. Given that institutions buy the bulk of OPROVIA's beans and sorghum, the lack of information at the retail level is not considered a problem within this feasibility study. It does limit, however, the kinds of generalizations which can be made about how a quality standards system, whether national in scope or implemented solely by OPROVIA, is likely to be adapted in the marketing system for beans and sorghum.

C. OPROVIA's Current Quality and Pricing Policies

1. OPROVIA's Role in Marketing

OPROVIA's stated objective is to promote the availability of basic food products within Rwanda and to perform market stabilization activities. GRENARWA, the food crop division of OPROVIA, has in the past purchased beans and sorghum at harvest at a somewhat higher than market price to put upward pressure on producer prices. They then sold throughout the year according to pre-arranged commitments. It bought at or slightly above the official price set by the government in 1986, 35 and 22 FRW/kg, respectively, for beans and sorghum.

Currently, GRENARWA has a storage capacity of 7,800 tons for storing beans and sorghum. This capacity has traditionally been viewed as separate from OPROVIA storage facilities which hold staple food products, often processed, for retail sale throughout the country. A proposal to administratively combine GRENARWA with the food products division within OPROVIA was made in 1987. In total, OPROVIA will then have 17 locations in the ten prefectures of Rwanda with a storage capacity, including GRENARWA, of 12,000 tons. Most locations have a warehouse and an associated retail outlet.

There are three locations, Butare, Ruhengeri, and Ruhango, which have a retail outlet but no warehouse. On average, each location has one warehouse manager, one warehouse foreman, one retail outlet manager, and a budget for employing temporary help for loading and unloading trucks and building the large piles of bagged grain inside the warehouse.

In addition to the 12,000 tons storage capacity, the warehouse at OPROVIA's Kicukiro administrative headquarters near Kigali features a strategic stock facility with a 3,500 ton capacity. This facility is intended to be the first of three food security warehouses which will total 8,000 tons. These facilities are planned to be an integral part of Rwanda's overall strategy of food security and self-sufficiency. It is anticipated that the three buildings will hold 6,000 tons of sorghum and 2,000 tons of beans for three year periods. Each year, one-third of the stock will be rotated out. The purpose of this storage facility is not to capitalize on seasonal price differences but rather to store reserves in anticipation of food shortages.

The first purchase of sorghum for food security purposes, 1,500 tons, was scheduled to take place in 1987 but the funds were subsequently used to buy domestic rice to promote rice production. A new plan concerning the use of the strategic stock facility is presently under consideration.

There are two growing seasons for beans in Rwanda with the principal harvest, two-thirds of the annual total, occurring in January/February and the second harvest, one-third of the annual total, occurring in June/July (Projet GRENARWA II-Recherches, 1986). OPROVIA generally purchases beans during February and March following the first harvest. In most areas of Rwanda, sorghum is harvested once a year in June/July, after the second, shorter rainy season. OPROVIA purchases sorghum in August/September. Bean and sorghum purchases are frequently shifted between warehouses throughout the year due to differences in storage capacities and production differences between prefectures for the two crops. Approximately 70% of the total sorghum purchased between 1982-1985 was milled at the Kicukiro location and sold as flour, and the rest was sold as sorghum grain. OPROVIA generally charges its customers 3 FRW/kg to grind sorghum into flour.

OPROVIA sells primarily to national institutions and international food aid organizations based on forward contracts established for large deliveries, Tables 15-17. OPROVIA has been a major supplier for the World Food Program (WFP) in Rwanda and for MINIFINECO (Ministry of Finance) which conducts all government purchasing. In November of each year, OPROVIA participates in a closed bidding process conducted by MINIFINECO for providing large government institution's with beans and sorghum including 26 police and army posts and 27 prisons. In October and November, OPROVIA sends representatives to talk with farmers and check local market prices throughout the country to estimate the size of the harvest. A commission of senior staff members at OPROVIA then decides on bean and sorghum bid prices to MINIFINECO.

OPROVIA has traditionally purchased the majority of its beans and sorghum from merchants: an average of 93% of total bean purchases and 85% of total sorghum purchases during the period 1979-1985, Table 18. In 1985 and 1986, OPROVIA drastically increased direct purchasing from farmers and farmer cooperatives and decreased purchasing from merchants. This policy change took place for three reasons: 1) in 1985 OPROVIA had 7 new locations in Rwanda;

Table 15
Purchasers of OPROVIA Beans

Year	Total (tons)	MINI-FINECO	Schools Churches Cooperat. Communes	World Food Program	Merchant	Retail	Cath. Relief Services	Other[1]
		Percent of Annual Total						
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[2]	4053	89	0	11	0	0	0	0

NOTES:

1) "Other" includes purchases by parastatals and private companies.

2) Figures for 1986 are unofficial estimates.

Table 16
Purchasers of OPROVIA Sorghum Flour

Year	Total (tons)	MINIFINECO	World Food Program [3]	Merchants	Retail
		Percent of Annual Total			
1980	227	100	0	0	0
1981	N/A [1]	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[2]	198	67	33	0	0

NOTES:

1. "N/A" indicates that the figures are not available.

2. 1986 figures are unofficial 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 FRW/kg fee for grinding was paid by the Ministry of Foreign Affairs (MINAFET). In 1986, the WFP started milling the sorghum themselves.

Table 17
Purchasers of OPROVIA Sorghum

Year	Total (tons)	MINI-FINECO	Churches Cooperat. Communes	World Food Program	Merchants	Retail	Other
				Percent of Annual Total			
1979	865	4	2	0	56	37	0
1980	948	0	3	11	51	35	0
1981	1352	N/A [1]	N/A	N/A	N/A	N/A	0
1982	956	0	2	74 [4]	2	22	0
1983	118	0	6	0	0	94	0
1984	1733	4	9	0	1	28	62 [3]
1985	107	N/A	N/A	N/A	N/A	N/A	N/A
1986 [2]	2961	0	1	13	0	86 [5]	0

NOTES:

1) "N/A" indicates that the figures are not available.

2) 1986 figures are unofficial estimates.

3) "Other" for 1984 is divided into two parts. Four percent includes sales to OPROVIA, GRENARWA, 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 therefore suitable for beer-making.

Table 18
Suppliers of OPROVIA's Beans and Sorghum

Year	Total (tons) Beans	Total (tons) Sorghum	Producers Beans	Producers Sorghum	Cooperatives Beans	Cooperatives Sorghum	Merchants Beans	Merchants Sorghum
			Percent of Annual Total					
1979	3327	1623	3	3	0	0	97	97
1980	4901	1838	0	0	0	18	100	82
1981	4876	2339	2	0	12	6	86	94
1982	4029	602	1	0	8	12	91	88
1983	4825	2609	1	5	3	12	96	83
1984	5405	2954	5	5	1	7	94	88
1985	3885	3302	12	24	0	11	88	65
1986	3290	4167	50	38	40	31	10	31

2) the premium associated with Rwanda's official price for beans was high enough to attract producers who normally would not undertake the transport costs associated with selling to OPROVIA; and 3) the national government encouraged measures taken to directly impact farm-gate prices.

This change in purchasing policy represents a major change in standard operating procedures as the number of transactions to be conducted at each warehouse increased dramatically, especially with the 30 kg limit per producer implemented during the 1986 bean campaign. This policy change therefore influences the type of quality inspection system that OPROVIA can use in its operations. Deliveries involving tons of beans or sorghum require different quality testing methods than those involving a large number of small quantities.

2. OPROVIA's Purchasing Procedures and Rejection Policies

OPROVIA has a rejection policy for beans and sorghum, but according to warehouse managers, it is rarely applied to producers and only occasionally applied to merchants and cooperatives. Survey results affirm this. For example, of the 164 producers surveyed who were in the process of selling sorghum in the September, 1986 buying campaign, well over half had previously sold beans or sorghum to OPROVIA and only one (less than 1% of those with previous sales) had been refused due to poor quality. The majority of cooperatives interviewed, 50% of those with contracts in 1986, sold to OPROVIA for the first time in 1986. None reported having been refused due to quality. Thirty merchants were surveyed of which 37% had made previous sales to OPROVIA. Of those with previous sales, approximately 20%, 7% of total surveyed, had been rejected by OPROVIA due to poor quality.

Rejections are based on what is termed a "système artisanal", improvised techniques designed to overcome equipment and labor constraints associated with sampling and testing for quality. According to the most recent manager's manual issued by senior management, the following rules are to be followed with regard to rejections:

> "It is absolutely necessary to refuse any sacks delivered which contain live insects. We will tolerate up to only 1% of insect damaged grains. To make a determination, it is necessary to take a handful of grains and observe if there are more than three attacked grains, moldy grains, or three pieces of foreign material, in which case the delivery is refused. However, each time the decision will depend on your good sense and the needs of OPROVIA."

According to warehouse managers, the methods of testing are the same for small and large scale transactions though sampling is generally more thorough with cooperative and merchant deliveries; a warehouse employee, usually the manager or foreman, checks whether the product is sufficiently dry, whether the quantity of foreign material is high, the age as determined by color, the degree of insect infestation, and the quantity of defective grains. Moisture checking is done by biting. Though moisture meters have been supplied to each warehouse, they are difficult to calibrate and are not used.

Beans and sorghum are resacked after both large and small purchases and are put into OPROVIA bags to standardize the weight. In the re-sacking process, workers can observe the quality of the product and rejections can take

place at this point, though they are infrequent. Senior administrators at OPROVIA feel that resacking during purchasing serves as a strong disincentive for increasing weight with sizeable foreign objects, e.g., rocks, bricks, etc., as beans and sorghum are dumped out of containers brought by producers just after weighing, a process which occurs in front of all other sellers at the receiving station.

Though rejections due to poor quality are infrequent, warehouse managers indicated that they have refused large deliveries. Kibungo once refused 14 tons of sorghum and Gisenyi once refused 15 tons of beans. Both suppliers were cooperatives. Managers indicated that sellers who are rejected due to poor quality generally return to sell again. It is not clear from the results of the informal interviews with warehouse managers whether these sellers returned after cleaning or with a different lot of beans.

Both OPROVIA's forward purchasing contracts with cooperatives and forward sales contracts with the World Food Program (WFP) have stipulations concerning quality, and in both cases, the specifications are much less stringent than those included in OPROVIA's managers manual discussed earlier. For cooperatives, beans are to be refused unless they are from the most recent harvest, well dried and contain no more than 2% insect damaged grains, no more than 5% foreign material, and no live insects. There are no quality specifications for sorghum in cooperative contracts. WFP contract requirements for beans and sorghum are as follows: the grains must be well dried, from the most recent harvest, and have been fumigated before delivery, contain less than 4% defective grains, less than 0.5% other grains, less than 5% harvest residues, and less than 1% insect damage. WFP's deliveries are usually made as sorghum flour with MINAFET (Ministry of Foreign Affairs) paying the milling costs. The exception was 1986 when OPROVIA reports that WFP took delivery of sorghum grain and ground it into flour themselves.

OPROVIA delivers grain according to a pre-arranged schedule. MINIFINECO deliveries must all be inspected by three members of a commission chosen by MINIFINECO among personnel within receiving institutions. The commission is instructed to inspect the quality and quantity of all merchandise delivered to the institutions by government contractors. Specifications concerning product quality are contained in an annually updated document. The document covers all types of products purchased by the government and therefore the section on quality is very general: Article 9 states that products should be of "...good quality and lacking any visible alterations..." Three signatures are obtained after each delivery but are regarded by OPROVIA administrators as being a formality, i.e., they usually do not involve quality checks.

Price differentials for quality are never paid by OPROVIA for a specific type of quality though they are sometimes used to obtain large-sized beans in the prefecture of Cyangugu to satisfy regional preferences. The premium paid for larger beans is one or two FRW per kg, depending on market conditions.

3. Product Handling and Storage Policies

Most of the product handling in warehouses is not mechanized. The Kicukiro warehouse does have a motorized belt elevator (conveyor) for help in building piles, and most warehouses have two-wheel hand carts for transporting

up to half a dozen bags at a time. Heavy-duty portable scales are used for weighing.

All purchases of beans and sorghum are usually dumped into a large bulk pile on the warehouse floor before being rebagged in standardized weights, generally 90 and 80 kgs respectively for beans and sorghum. The bags are then stacked on wooden pallets to form large piles ranging in size from 50-200 tons. To minimize the cost of rebagging, some warehouse managers have begun giving bags to cooperatives prior to delivery. Several managers indicated that not much time is saved, however, as the scales in the cooperative are usually different than the scales at OPROVIA and rebagging to adjust for weight is often necessary.

OPROVIA has a policy to stock according to two quality characteristics in three of its warehouses: Kibuye, Nyamata, and Rukomo. The quality factors are age and variety and apply only to the handling and storage of beans, not to sorghum. According to the warehouse manager manual, the movement of stocks is to be based on a first-in, first-out system.

Due to unmechanized handling, all rebagging and stacking must be finished before fumigation can occur to ensure that the warehouse area is unoccupied by workers during the treatment process. There can therefore be a delay of several weeks or even months between the time beans and/or sorghum are purchased and the time stocks are fumigated. This interval is sometimes even further prolonged due to a shortage of tarps to cover piles being fumigated. Thus, no more than one or two warehouses can be fumigated at the same time, a process which takes 3-5 days, and most cannot be fumigated at the most appropriate time.

Despite these problems, data from experiments concerning the effects of fumigation in OPROVIA warehouses show that it can be 100% effective in killing insects in beans and sorghum. Besides fumigation with phoshine gas (phostoxin), most beans are treated prior to rebagging by ad-mixture with a residual insecticidal dust (currently Actellic 1%). Sorghum, however, is only fumigated. As fumigants provide no residual effects, measures must be taken to prevent reinfestation from other sources.

None of the warehouses are now mechanically aerated though air ducts. Claustras in the lower and upper walls allow for some natural ventilation.

4. Price Policy

Prior to 1985, the prices OPROVIA offered for beans and sorghum varied during the buying period and according to warehouse locations to reflect current market conditions. This approach facilitated efforts to fulfill OPROVIA's goal of keeping a slight upward pressure on producer prices. This price policy, maintained until government regulated price schedules were strengthened in 1985, was viewed as being effective, at least in areas near OPROVIA outlets. However, a survey of marketing and storage activities in Rwanda completed in 1983 indicated that OPROVIA's bean prices were lower than what other traders offered. This may be explained by the fact that the survey was limited to a few markets during a period when demand for beans by all traders was high.

In 1986, the Government of Rwanda changed its policy concerning official pricing of agricultural products. Official prices for beans and sorghum had been installed in Rwandan markets for a number of years but were largely ignored by most market participants, including OPROVIA, until 1986 when the government decided to enforce the official price policy and require state organizations to observe them. The 1986 official bean price for producers was set at 35 FRW/kg. Cooperatives and merchants who sold to OPROVIA in 1986 received an additional two franc per kg premium for transport and temporary storage costs. The forward contract price OPROVIA had negotiated with MINIFINECO the previous November was 37 FRW/kg which was above the fixed farm-gate price but did not provide a sufficient margin for OPROVIA to cover all its costs. To prevent substantial losses to OPROVIA, the prearranged purchase price with MINIFINECO was renegotiated and increased to 45 FRW/kg.

Official bean prices were estimated by OPROVIA to have been an average of 8-10 FRW, approximately 25%, over market prices during 1986, while the 1986 official price for sorghum of 22 FRW/kg was close to local market levels. According to OPROVIA's internal commission on prices and marketing, market prices for sorghum varied between 15-18 FRW/kg in some areas while in others the market price was the same as the official price, causing some cooperatives in Butare to default on their contracts to sell sorghum to OPROVIA.

The difference between official and market prices for beans in 1986, approximately 10 FRW/kg, created strong incentives for all market participants to sell to OPROVIA. Those producers able to sell 30 kgs, the maximum allowed, on a given day made a premium of 300 FRW above the market price. This corresponds to several times the normal daily wage in rural areas of Rwanda (60-100 FRW). The incentive therefore existed for bean deficit families to buy beans and resell to OPROVIA or to work as a proxy for merchants attempting to exploit the high official price.

The strength of the incentive to sell to OPROVIA is depicted in Table 19 which shows warehouse manager estimates of the average number of producers who arrived to sell on a market day in 1986. Most warehouses have only two or three employees to handle transactions. Managers stated that one of the most important problems in their operations was having to turn away producers who stood in line all day.

Producers have recently been given a high priority in OPROVIA's purchasing strategies. For example, the average quantity of beans purchased directly from producers was 3% between 1979 and 1985. In contrast, OPROVIA purchased 50% of its beans directly from producers in 1986. The same change occurred with regard to sorghum: OPROVIA purchased an average of 5% from producers between 1979 and 1985 but supplies from producers increased to 38% in 1986.

OPROVIA's new policy to emphasize purchases from cooperatives and producers caused transactions with merchants to decrease from 65% of total sorghum purchases in 1985 to 32% of total purchases in 1986 (a decrease of 843 tons). Due to this change, it is reasonable to assume that a certain percentage of individuals in line to sell to OPROVIA in 1986 were merchants or proxies for merchants who were taking advantage of the higher official price for sorghum that OPROVIA was paying and the "unlimited quantity" policy offered to producers. As there was no way to determine the commercial role of the

Table 19

Manager Estimates of the Number of Producers
Arriving on a Single Market Day
During the 1986 Buying Campaign

	Beans		Sorghum	
	Mean #	Max #	Mean #	Max #
Kibungo	350	600	220	300
Gisenyi	150	200	250	300
Gitarama	500	1000	100	200
Nyamata	800	1000	300	400

respondents chosen for the survey with a direct question, the enumerators and warehouse managers discriminated in the selection of individuals in line by eliminating those with commercial sacks and those who appeared too young to be a decision-maker within a farm household. This discrimination is not expected to bias results.

The fact that a price differential existed between the official price OPROVIA paid for sorghum and market prices was affirmed in an informal market survey of prices conducted by OPROVIA which showed that the official sorghum price of 22 francs per kilo was approximately 4-7 FRW higher than market prices in some areas though the market price was found to be higher in other areas. A price incentive explains why producers chose to stand in sometimes long OPROVIA lines rather than to sell to merchants, cooperatives, or to consumers in the central market.

D. Assessing the Impact of Quality Standards for OPROVIA Suppliers

Producers, cooperatives, and merchants are the suppliers of all the beans and sorghum purchased domestically by OPROVIA. As described earlier, a survey was conducted of each of these groups between September and December, 1986. This section synthesizes the results of all three surveys.

1. Producer Suppliers

The objective of the producer survey was to determine: 1) whether producers recognized differences between the various quality grades OPROVIA researchers had designed for beans and sorghum, 2) current producer practices concerning the quality factors emphasized in the grades, and 3) the specific pricing or rejection practices which would offer adequate incentives to producers to supply a particular quality product. One hundred sixty-four producers were interviewed in five OPROVIA warehouse locations, Table 20.

Survey Procedure Three Rwandan enumerators visited five OPROVIA warehouses/retail outlets between September 19 and October 4, 1986 to survey producers. This three week period was the end of OPROVIA's sorghum buying for the year. Because the survey was not ready to be fielded until the end of the two month buying campaign, the number of outlets where buying was still taking place was limited. Consequently, the locations for surveying were chosen in regard to the following priorities: those OPROVIA warehouses/retail outlets 1) where transactions with producers were continuing, and 2) which were most representative of the various agro-economic conditions of Rwanda.

The producer questionnaire contained three categories of questions:

(1.) Selling prices
- Distance travelled
- Cleaning activities prior to marketing for cash
- Proportion of sorghum sold for cash
- Previous sales to OPROVIA and to merchants
- Experience with rejections due to poor quality
- Experience with price differentials based on quality
- Relative difficulty of different cleaning tasks
- Household members who clean: tasks, time, uses for subquality grains

Table 20
Representiveness of the Producer Survey Sample

Perfecture	OPROVIA Location	Sorghum Purchased from Producers (tons)	Percent of 1986 Total from Producers	Number of Producers Surveyed
Gitarama	Gitarama	51	3	19
Kibungo	Kibungo	277	17	33
Kigali	Kicukiro	140	9	40
Kigali	Nyamata	461	29	36
Kibungo	Rwamagana	376	24	33
			82	164

(2.) Reaction to changes on OPROVIA's pricing practices in regard to quality:
- Responses to a premium for high quality
- Responses to a rejection for low quality

(3.) Perceptions of quality
- Sorghum:
  - How big a difference between the three samples representing the quality standards proposed by researchers?
  - Ranking of the three samples and naming of the quality factors upon which the rankings are based.
- Beans:
  - Cleaning practices associated with beans according to intended use, eating, selling, storing, planting.

At the onset of our sampling, producers were selected only if they had indicated that they had previously sold beans to OPROVIA. After the first day of surveying, it was clear that the number of observations for these questions would be very low if this selection process was used throughout the survey and this practice were subsequently dropped. As a result, the number of observations for the questions concerning the bean samples is lower than 164 given the screening that took place during the first day of the survey.

A pretest of the questionnaire was conducted on eight producers at Kicukiro. Following the pretest, it was decided that a written translation of the questionnaire from French into Kinyarwanda was not necessary because there were only three enumerators and all of them were well versed in the goals of the research and purpose of the individual questions.

At each of the five OPROVIA warehouse/retail outlets, the survey was conducted at a table with two chairs set away from the public buying area. The survey took an average of twenty minutes to conduct. Producers who came to OPROVIA to sell sorghum first stood in line in front of the warehouse to have their bag or basket weighed and then moved to another line which led to the administrative office where they received their payment. Warehouse managers cooperated in the survey by requesting producers in line for payment to participate. Those producers who agreed were compensated by being placed at the head of the payment line after the interview was finished.

Producer Characteristics Of the 164 producers surveyed, approximately 60% were male and 40% were female. Half lived very near, 1-5 km, the OPROVIA buying location. The other half of the respondents were equally divided between living 5-10 km from OPROVIA and living more than 10 km. Forty percent of those living over 10 km were in Kibungo.

Sixty-four percent of the producers surveyed said that the sorghum they commercialized in 1986 represented a small proportion of the total they produced; whereas 18% reported selling more than half of their production, 17% reported selling about half, and 1% could not make this estimate.

Respondents were asked if they had ever sold anything to OPROVIA before. Half had previously sold sorghum to OPROVIA and half had previously sold beans. Those who had previously sold sorghum were more likely to have also

sold beans (63%). Of those selling sorghum for the first time, 36% had previously sold beans.

Of the 87 producers who had previous sales of sorghum to OPROVIA, only one had been refused due to poor quality. This producer indicated that the reason for the refusal was that the sorghum he brought for sale had contained too much foreign material.

These figures concerning contact with OPROVIA are interesting to compare to a 1986 SESA producer survey which shows that 43% of producers had heard of OPROVIA, 13% had purchased something from OPROVIA, and 7% had sold something (Loveridge, 1987). It is clear that the discrepancy between the two surveys with regard to producers' experience with OPROVIA is due to the fact that the OPROVIA survey, unlike the SESA survey, took place at OPROVIA outlets where respondents were much more likely to have had previous contact with OPROVIA than respondents in a less targeted sample. In general, the results of the two producer surveys point out that producer contact with OPROVIA is relatively limited.

Respondents were questioned as to whether they had ever made sales to merchants. Approximately 50% of the producers responded positively. Of these, 6% had been offered a higher price for higher quality of sorghum. Only 5% had previously been rejected by a merchant because of poor quality.

Producer Practices Concerning Quality (Sorghum) Producers were asked whether they did anything to their sorghum before coming to OPROVIA to improve its quality. Sixty-two percent responded that they did not do anything, with most commenting that it was already in good condition or that it had been improved before storing. Several who responded "no" also commented that they "checked" it to ensure that it did not contain insects or was not rodent damaged. Table 21 shows the responses of the 38% who indicated that they improved their product before commercializing.

The question concerning whether the producer did anything to improve quality before coming to sell to OPROVIA did not specify a time. It is therefore likely that producers who cleaned their sorghum prior to storage responded either positively or negatively to this question. If this misinterpretation took place, then the percentage of producers who clean before coming to OPROVIA is underestimated.

According to a previous producer survey undertaken by the Project, producers spend an average of 2.5 days sifting and sorting sorghum (Projet GRENARWA II-Recherches, 1987a). The cleaning of sorghum is almost without exception done by a female member of the farm household. The study also determined that winnowing and sorting of beans took an average of 1.5 to 2 days. Cleaning beans, like cleaning sorghum, is done primarily by females.

To assess the impact of a grading system on present practices concerning sorghum quality, four hypothetical questions were asked. First, producers were asked whether they would clean all their sorghum in the future if OPROVIA offered 5 FRW more per kilo for the highest quality. The 5 FRW increase, used in all four hypothetical questions, is a 23% premium for higher quality based on the official price of 22 FRW/kg, not including any premium associated with the official price in a particular region.

Table 21
Activities Undertaken by Producers Who Indicated that They Attempted to Improve Sorghum Quality Before Coming to OPROVIA (n=164)

Task Undertaken	Percent Who Clean Before Selling	Percent of Total Sample
Winnowed	94	35
Sorted	53	20
Sieved	2	1
Other (inspected, threshed)	26	10

The positive responses to this question, Table 22, may occur because producers have cleaner beans to sell and could therefore earn the premium without any extra labor or because the cost of any additional labor for more cleaning would be less than the premium offered.

Producers were then asked whether they would sell more if OPROVIA paid a higher price for high quality and accepted unlimited quantities of the higher quality, Table 23. Though the majority of producers who responded negatively indicated that their remaining sorghum was reserved for home consumption, three producers commented that they would increase production next year if this OPROVIA practice continued.

Two hypothetical questions were also asked concerning possible changes in OPROVIA's rejection policies. First, producers were asked what they would do if their sorghum were refused by OPROVIA because of poor quality; multiple responses were recorded. The responses are consistent with previous comments concerning price incentives and average distances traveled by producers to sell to OPROVIA. As Table 24 shows, the majority indicated that they would clean and return if refused due to poor quality. The price incentive that already exists in the market, the difference between market prices and the official price, must therefore be enough to cover the cost to transport the product somewhere, perhaps back to the farm to be cleaned and to cover the loss in weight which will occur in the cleaning process.

The second question concerning rejection policy asked whether producers would accept 5 FRW/kg less if they were refused by OPROVIA because of poor quality. Though approximately half responded positively, it is clear that the existence of a price differential between the official price and the market price changed the sense of the question. Rather than asking whether producers would accept a penalty price for substandard quality, the question actually asked whether they would accept approximately the market price for substandard quality. The results of the the question are therefore not consistent with the intended sense. It is likely that the 40% who responded negatively were actually voicing their opinion against the possibility of doing away with the premium.

Producer Perceptions of Quality (Sorghum) To determine whether standard ideas concerning sorghum quality exist among producers, three sorghum samples (500 grams each in clear plastic bags) were shown to the respondents who were then asked whether they saw a difference between the samples, to rank them in regard to quality, and to explain why they ranked the samples the way they did.

The three samples were selected to determine whether foreign matter or damaged grains was more important to producers with regard to quality. The first sample, Sample A, did not contain any foreign material or damaged grains; the second, Sample B, contained 5% damaged grain and no foreign material; and the third, Sample C, contained 3% foreign material and no damaged grains. Damaged grains included insect, mold, germinated, sprouted, shrunken/-shrivelled, and rodent damaged grains. Foreign material included stones, other types of seeds, insects, dirt, harvest material, and rodent pellets. These quantities were in accordance with the grades for sorghum proposed by OPROVIA researchers.

Table 22

Responses to the Question:
"If OPROVIA offered you 5 FRW more per kilo for high quality sorghum, would you clean the sorghum you brought here in the future to get the higher price?"

	Percent of total (n=164)
Yes	96
No	3
Don't Know	1
	100

Table 23
Responses to the Question:
"If OPROVIA offered 5 FRW more per kilo for your sorghum that was of high quality, would you sell more if OPROVIA accepted unlimited quantities?"

	Percent of total (n=164)
Yes	38
No	59
Don't Know	3
	100

Table 24
Uses of Sorghum If Rejected by OPROVIA
(Multiple responses recorded.)

Uses	Percent of total (n=164)
Return after cleaning	61
Try to sell elsewhere	17
Use the sorghum myself	24
Other (take a lower price, I never sell low quality)	4

The intent of the questions concerning quality was to determine if these general levels of damaged grain or foreign material were recognizable to producers and also to determine which type of problem they considered to be more damaging to overall product quality. The results of these questions show that producers saw a clear difference between Sample A and the other two samples, but Samples B and C were viewed as being similar with regard to quality, Tables 25 and 26. Most importantly, 89% cited correctly the type of problem associated with the sample when asked why they ranked the samples the way they did. However, of the 11% who gave an incorrect response, most said the problem with the sample containing foreign material was damaged grain and vice versa, i.e. they incorrectly identified the quality problem associated with the two samples. Also, 5% said that the kernel size was the main factor in their ranking of the samples though all three samples contained the exact same size, All three samples were in fact constituted from the same lot of sorghum, which was thoroughly blended beforehand.

Producer Practices Concerning Quality (Beans) The objective of the section on the questionnaire concerning beans was to determine if producer practices concerning quality varied significantly between beans designated for eating, planting, selling, or storing. Five small samples of beans in petri dishes were shown to the producers. The samples represented five different types of damage. Table 27 shows the results of the responses concerning present bean cleaning practices in regard to product use.

In general, the results show that producers tend to clean more before planting and eating, with the exception of insect damaged grains. Efforts to clean before selling are lower than before eating and planting and about the same prior to storing. This result concerning insect damage is contrary to results of a similar damaged perception survey (Projet GRENARWA II-Recherches, 1987a). The survey did not find any difference in perceptions between insect and other types of damage with regard to beans intended for consumption. They did, however, come to the same conclusion that cleaning efforts are most severe for those beans intended for planting.

In this survey concerning quality standards, one of the main research objectives was to determine at what price producers would be willing to clean their beans of all damaged grains before offering them for sale to OPROVIA. The questions to determine this price was, "If OPROVIA offered you 200 FRW more per 100 kilos for your beans if you removed all damaged grain, would you do it?" A 200 FRW per kilogram increase is approximately 7% of the official fixed price for beans. The obvious flaw with the question is that many producers may not produce, commercialize, or be able to transport this quantity and therefore answered the question in regard to one or more of those constraints. In general, the responses were positive. Over 75% of the producers interviewed indicated that they would remove damaged beans for an additional 200 FRW per 100 kilos, Table 28. Of the 19% who said no, a little more than half said they could not undertake the work, regardless of the price differential, time constraints, too old, etc. The other half of the respondents who answered negatively to the question said they would do it for 3 to 5 FRW/kg more. Of the 78% who responded yes, i.e., they would remove damaged grains, almost all said the task of cleaning one kilo would take less than an hour.

The distribution of those within the household who would actually do the cleaning is shown in Table 29. It is predominantly female members of households

Table 25
Magnitude of Quality Difference Perceived
Between Three Sorghum Samples

Difference Between All 3 Samples	Percent of total (n=164)
Large	44%
Small	50%
No difference	5%
Not answered	1%
	100%

Table 26
Distribution of Quality Rankings
for Three Sorghum Samples

Sample	Percent of total (n=164) Best	Medium	Worst
A: No damaged grain, no foreign material	92	3	1
B: 5% damaged grain, no foreign material	1	49	44
C: 3% foreign material, no damaged grain	3	42	49
No difference	6	6	6
	102*	100	100

* Percentages totaling greater or less than 100% are the result of rounding.

Table 27
Cleaning Practices for
Beans According to Designated Use*

Remove Before	Insect Damage	Mold Damage	Rodent Damage	Germinated Seeds	Shrunken /Shrivelled Seeds
			(% of total, n-154)		
Eating	62	96	83	83	80
Planting	93	97	99	99	90
Selling	67	73	59	61	62
Storing	76	78	58	66	68

* Rwandan Consumer Standards for Dry Beans," N.R. Read and E. Nizeyemana. USAID-University of Minnesota-Government of Rwanda Local Storage Cooperative Research, 1986.

Table 28
Responses to the Question:
"If OPROVIA offered you 200 FRW more for 100 kilos of your beans if you removed all the damaged grains, would you do it?"

Response	Percent of total (n=154)
Yes	78
No	19
Don't Know	3
	100

Table 29
Household Distribution of Labor for Cleaning Beans
(Multiple responses were recorded.)

Household Member	Percent of total (n=120)
Wife	93
Daughter	41
Hired Worker	11
Son	10
Husband	5
Other (neighbor, relative)	3

who would perform this work. The tasks involved include almost no sieving though winnowing and hand-picking would be done simultaneously.

Table 30 shows the distribution of responses to the question of what is done with the inferior beans which are removed during the cleaning process. Beans that are picked out are, for the most part, thrown out though a fair amount of respondents indicated that some are eaten by the household.

The last question of the survey asked about perceptions of the relative difficulty in cleaning damaged grains in comparison to foreign material. Table 31 shows that there is a mix of ideas among producers as to the relative difficulty of the different types of cleaning tasks for improving bean quality.

2. Cooperative Suppliers

Prior to the first bean harvest in January of 1986, OPROVIA established a limit for the quantity of beans and sorghum which would be purchased from cooperatives in each prefecture, in accordance with estimates of future demand. The 1,317 tons of beans to be purchased from cooperatives were divided among 60 cooperatives known by OPROVIA to be functioning and forward contracts were established. The same process took place prior to the sorghum campaign when contracts to purchase a total of 1,270 tons of sorghum were made with 49 cooperatives, all of whom had sold beans to OPROVIA in 1986. The majority of the cooperatives with OPROVIA contracts in 1986 had never sold to OPROVIA before.

A total of 27 of the 60 cooperatives who sold beans to OPROVIA in 1986 were surveyed at the end of the 1986 sorghum buying campaign. The objectives of the survey were to determine: 1) cooperative storage and price policies concerning quality, 2) whether cooperative managers perceive a difference between the grades proposed by OPROVIA researchers and 3) responses of cooperatives to OPROVIA's use of quality standards.

Survey Procedure Managers at 27 cooperatives in 6 prefectures were interviewed between October 15 and November 4, 1986. The prefectures were chosen according to two criteria: first, those areas where OPROVIA purchased most of its beans and sorghum in 1986 and second, those areas which represented the variety of agro-economic conditions in Rwanda.

Table 32 provides an overview of the representiveness of the sample of cooperatives interviewed according to the quantity sold to OPROVIA in each prefecture. The prefectures selected were those where almost all purchases between OPROVIA and cooperatives take place. The cooperatives included in the sample supplied approximately 15% of the beans and sorghum purchased by OPROVIA in 1986.

The questions fell into three categories:

(1) Buying, selling, and storing practices:
- Storage capacities
- Length of storage
- Sources of demand
- Cleaning practices
- Rejection policies and experiences

Table 30
Uses For Rejected Beans
(multiple responses recorded)

Use	Percent of total (n=120)
Throw away	91
Eat	27
Plant	3
Feed to animals	2
Don't know	2

Table 31

Relative Difficulty of
Cleaning Damaged Grains Compared
to Foreign Material

	Percent of total (n=154)
Damaged grains are easier	31
Damaged grains are more difficult	46
Same work	22
Don't know	1
	100

Of the 27 cooperatives surveyed, the average number of years the cooperatives had been in operation was 9, with a minimum of 2 years and a maximum of 19 years.

Table 34 shows the distribution of responses to the question concerning average and maximum storage capacity. There was a 70-ton difference between the average quantity of beans stored and the maximum stored and an 85-ton difference for sorghum. Beans are, on average, stored less than half a year, and sorghum is stored a few months longer. None stored either crop longer than a year.

Buying and Selling Practices Table 35 summarizes the responses to the question of monthly purchases and sales. April is the month of greatest buying as well as selling activity and February through April is the period of greatest buying activity with a secondary peak in July/August, following the second bean harvest.

September through December is the period of the greatest selling activity. The selling peak in April is most probably explained by sales to OPROVIA, as Table 36 shows that an average of 82% of total bean sales made by cooperatives were to OPROVIA. OPROVIA made most of its purchases during April in 1986. Results of this question show that cooperatives generally sell throughout the year but mostly just before the primary harvest, except for sales to OPROVIA which occur mainly in April.

Storage Practices Three questions were asked concerning bean storage practices:

(1) Do you remove damaged beans before storing?
(2) Do you remove foreign material before storing?
(3) Do you separate according to quality before storing?

In general, the survey responses showed that cooperatives do not remove foreign material or damaged grain, though one manager mentioned that he would give a sieve to the producer if the problem were severe and one said he might do it for a small quantity of beans. Only 25% of the managers indicated that they separate according to quality, and of these cooperatives, the only quality factor accounted for in the separation process was age. Nearly all of the cooperatives who stock beans according to age also sell according to age.

Cooperative managers were asked to assess the relative magnitude of losses due to storage in their operations. Seventeen percent said they had problems, 58% said they had a few, and 25% said they had none. The largest stock loss cited was 2 of 10 tons of beans from insect infestation.

The most important cause of storage losses cited by cooperative managers was insect attack, Table 37. Loss in weight due to a reduction in moisture content of the grain was also considered quite important. Prolonged storage was cited in one out of six cases but it's unclear what the fundamental cause really was in these situations: more time for insects and other organisms to cause damage, reduced market value over time, etc. Damage by molds and rodents was perceived as relatively unimportant.

Bean Rejection Practices The contracts that OPROVIA negotiates with cooperatives stipulate the quality of product to be received. Contracts for

Table 33
Summary of Defects in Bean Samples

	Insect & Mold	Other Damage	Stones	Other Foreign Material	Brokens	Total
			Percent of Total Weight			
Sample A	0.5	0.5	0.3	0.7	0.5	2.5
Sample B	1.0	1.0	0.4	1.6	1.0	5.0
Sample C	5.0	5.0	0.5	2.5	1.5	14.5

- Price policies concerning quality
- Purchasing/sales schedule

2) Perceptions of quality
   - Magnitude of the difference between three bean samples and ranking according to quality
   - Opinion of a premium/discount pricing system in Rwanda

Several questions involved showing the cooperative manager samples of beans. Three samples were used, each of which contained 500 grams of beans from the most recent harvest. The three samples corresponded to the maximum permissible limits by weight of each quality factor for the three grades of beans currently proposed and being tested by OPROVIA/University of Minnesota researchers. Sample A contained 2.5% total defects, Sample B contained 5% total defects, and Sample C contained 14.5% total defects. Defect characteristics are shown in Table 33.

The category "Other Damage" contains germinated, rodent damaged, and shrunken/shrivelled grains. The category "Other Foreign Material" includes other types of seeds, insects, dirt, harvest residues, and rodent pellets.

The questions associated with the bean samples were designed to determine specific price differentials that cooperative managers would assign to the bean samples which represented the standards proposed by OPROVIA researchers. These questions proved to be the most difficult to analyze. The quality problems represented in the bean samples were limited to damaged grains and foreign material, as these are the main factors included in the proposed standards. Two cooperatives not included in the sample were visited as part of a pretest. During these interviews it became apparent that the age of the bean samples unexpectedly influenced responses. The managers were asked what price they would assign to one kilo of each type of quality if price differences existed in the market. They were then asked the quality factors which were considered in their pricing decisions. Both of the managers interviewed in the pretest cited age as the most important problem associated with the samples.

The samples were subsequently updated and in the actual survey, almost all the managers indicated that they based the price they offered on the percentage of damaged grains and foreign material, the two quality factors being tested, though 22% still named age as a factor. Thirty-three percent of the managers, mostly in Kibungo, also based their price on the presence of certain bean varieties in the mixture offered. The preferred mixtures in Kibungo contain mostly dark red varieties. The samples used in the survey were a typical mixture of varieties available in markets in the prefecture of Kigali. Although this mixture contained some red beans, they did not constitute the predominant seed type. Preferences for particular varieties therefore influenced responses concerning price differences even though the samples used were all the same mixture. The effect was to inflate the percentage of managers who offered a price lower than present market prices for the higher quality samples. As a result, responses concerning prices were affected by managers basing prices on quality factors not intended to be present in the samples.

Table 32
Representiveness of the Cooperative Survey Sample

OPROVIA Purchases of Beans (1986)

Prefecture	% of Total Purchases from Coops	# of Coops Surveyed	% of Total Purchases from Coops in Sample	Avg Qty (tons) Purchased per Coop in Sample
Butare	3	1	61	23
Byumba	12	2	56	50
Gisenyi	3	1	39	16
Gitarama	4	3	100	20
Kibungo	48	12	40	23
Kigali	25	8	78	25
All Others	5	0	0	0
	100%	27	Avg: 56%	Avg: 25

OPROVIA Purchases of Sorghum (1986)

Prefecture	% of Total Purchases from Coops	# of Coops Surveyed	% of Total Purchases from Coops in Sample	Avg Qty (tons) Purchased per Coop in Sample
Butare	2	1	0	12
Byumba	14	2	18	57
Gisenyi	2	1	0	20
Gitarama	17	3	43	30
Kibungo	38	12	53	21
Kigali	26	8	69	27
All Others	1	0	0	0
	100%	27	Avg: 46%	Avg: 28

Table 34
Cooperative Storage Characteristics
(% of total, n=26 for beans and n=27 for sorghum)

	"What is the average quantity that you store?" (tons)		"What is the maximum that you have ever stored?" (tons)		"How long do usually store?" (months)	
	Beans	Sorghum	Beans	Sorghum	Beans	Sorghum
Average	9	13	35	38	5	8
Minimum	1	2	10	15	3	4
Maximum	60	45	80	100	10	12

Table 35
Monthly Bean Purchases and Sales
(% responding that they buy/sell in that month, n=27)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Buy	4	35	50	81	4	8	23	15	4	4	---	---
Sell	---	---	4	69	19	12	19	19	39	46	46	30

Table 36
Cooperative Sales, 1986
(n=27)

	Beans		Sorghum	
	% of Coops with Sales to:	% of Total Sales	% of Coops with Sales to:	% of Total Sales
OPROVIA	85	82	85	64
Producers	55	13	74	29
Merchants	15	5	15	7
		100%		100%

Table 37

Causes of Storage Losses
of Beans and Sorghum
(Multiple Responses Recorded, n=27)

Loss Factor	% of Coops Surveyed
Insect Infestation	29%
Weight loss due to moisture loss	25%
Stored for too long	17%
Mold damage	8%
Rodent damage	4%

beans state the following: "Under conditions of poor quality, OPROVIA grants the right to their warehouse managers to refuse deliveries. The beans must be from the first harvest of (current year) recognizable by their color and brightness. The beans must be well dried and must not contain: more than 2% insect damaged grain, more than 5% foreign material, nor any live insects." Sorghum contracts do not include quality specifications. None of the cooperatives interviewed had ever had sorghum or beans refused by OPROVIA because the quality was poor.

All of cooperatives said they refuse beans or sorghum if the quality is not good. Half said they reject at the beginning of the buying campaign after which producers begin to bring only acceptable quality beans, while the other half reject throughout the year.

The two most important quality factors on which rejections are based are foreign material and damaged grains, Table 38. Moisture, age, variety, and insects are factors of lesser importance. It's interesting to note that one cooperative in Butare with an average stored quantity of 20 tons uses a moisture meter for decision-making concerning rejections.

Bean Pricing Practices Twenty-four percent of cooperatives said they set bean prices according to quality. Almost all indicated that the quality factor accounted for in the price was age though a small percentage, 8%, said that foreign material was a factor.

Eighty-five percent said they never see imported varieties of beans when they were asked whether a price differential existed between domestic and imported beans. Four managers, approximately 15%, said a price differential sometimes exists in their area. These four were located in Byumba, Gisenyi, Gitarama, and Kigali. Two cooperatives specified the differential: the cooperative in Gisenyi cited a 9 FRW/kg discount for Zairian beans and the cooperative in Byumba cited a 3 FRW/kg discount for imported beans. The cooperative in Gitarama said that imported beans were available in 1984 but at the same price as domestic beans. The cooperative in Kigali did not specify the country of origin or price differential. Only the cooperative in Gisenyi claimed to commercialize imported beans. This cooperative reported that 20% of its beans purchases are imported.

Perceptions of Quality Three quarters of the managers surveyed said that producers sometimes try to sell them mixtures of old and new beans but that this occurs infrequently. One quarter of the managers said that producers never bring them mixtures of old and new.

The bean samples, described previously, were used to assess managers' perceptions of quality. When asked what kind of difference they perceived among the three samples, 56% said the difference was small, 41% said there was a large difference, and 3% said there was no difference at all. The managers were then asked, "If there were a system of quality standards in the market where different qualities of beans received different prices, how much would you offer for one kilo of beans of this quality?" Table 39 shows how the price for each sample related to the market price in the area where cooperatives were located; the average market price was 26.5 FRW/kg.

Table 38

Quality Factors Considered in Rejections of Beans and Sorghum (Multiple Responses Recorded, n=27)

Quality Factor	% of Coops Surveyed
Foreign material	90%
Damaged grains	70%
Moisture	45%
Age/Color	40%
Origin/variety	30%
Live insects	30%

Table 39
Average Difference Between Current Market Price
and Price Proposed for the Sample
(n=27)

	Sample A (2.5% defects)	Sample B (5% defects)	Sample C (14.5% defects)
Avg franc increase	4	5	1
Percent citing premium	20%	16%	5%
Avg franc decrease	4	3	4
Percent citing discount	45%	63%	84%
Percent Citing Market Price	35%	21%	11%
	100%	100%	100%

Thirty-five percent of the managers priced the three samples in descending order according to increasing levels of defects with a difference between each price. Twenty-seven percent priced the samples in descending order with at least one difference in price, i.e., two of the samples were given the same price. Thus, over 60% of cooperative managers associated price with relative quality.

The magnitude of the premiums and discounts offered is surprising. One cooperative priced B at 10 FRW/kg less than the market price and another priced B at 10 FRW/kg more. Two cooperatives discounted C by 10 FRW/kg. A 10 FRW/kg premium or penalty represents one-third of the average market price. These extreme responses could reflect the hypothetical nature of the question; managers could have been emphasizing relative quality levels in the prices they cited due to the phrasing of the question. Most surprising is the fact that approximately half of the managers offered a discount price for Samples A and B. This result is attributed to the number of managers who included varietal preferences as well as perceptions of age as factors in their pricing decisions which is shown in Table 40. As discussed in the section on methods, this problem resulted in inflated figures concerning discounts for the two highest quality samples.

The majority of managers identified the two principal quality problems in the three samples, Table 40: damaged grain and foreign material. The question concerning prices was intended to determine whether these quality problems were recognized by cooperative managers. The unexpected responses concerning age and variety biased results but the outcome was as expected. Managers recognize the quality factors in the samples at levels in the grades proposed by OPROVIA researchers and are divided roughly equally between those who thought the difference was large or small.

Two additional samples were shown at the end of the survey. One had no defects and the second was Sample C, discussed above, which contained 14.5% defects. The purpose of using these samples was to find out what incentives are necessary to change operating procedures concerning quality at the cooperative level. First, managers were asked if they saw a difference between the two samples. Eighty-five percent said they saw a large difference and 15% said they saw a small difference. Managers were then asked two questions concerning how they would react to price premiums paid by OPROVIA for high quality. The premium suggested in the question, 5 FRW/kg, translates into a premium of approximately 14% of the official price that OPROVIA paid for beans in 1986, not including any premium associated with the official price in many areas of Rwanda. Responses are summarized in Tables 41 and 42.

The distribution of responses in Table 41 shows that 40% of cooperative managers believe a price premium of at least 15% would be an adequate incentive to begin penalizing poor quality more severely. At least 40% of managers therefore believe that quality can be improved through increased rejections. The vast majority indicated that they would not undertake cleaning for a 5 FRW/kg premium. The 78% who said "no" in Table 42 were asked at what price they would be willing to clean more to improve quality. No one offered a price. Instead, the vast majority responded that cleaning was producers' work and that they would pass the price premium along to producers rather than do it themselves. One manager said that with a 5 FRW/kg premium, he would purchase equipment to do the cleaning.

Table 40
Quality Factors Considered In Assigning
Prices to Three Bean Samples
(multiple responses recorded, n=27)

Quality Factor	Percent of Coops Surveyed
Foreign material	96%
Damaged Grain	89%
Origin/variety	33%
Age/color	22%
Infestation	7%
Usability as seed	4%
Mix of old and new	4%

Table 41

Responses to the Question:
"If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you reject more beans brought to you than usual?"
(n=27)

Response	Percent of Coops Surveyed
Yes	41%
No	44%
Don't know	15%
	100%

Table 42

Responses to the Question:
"If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you increase the amount of time spent cleaning beans?"

Response	Percent of Coops Surveyed
Yes	11%
No	78%
Don't know	11%
	100%

An open-ended question was included at the end of the survey asking cooperative managers for their opinions concerning a quality standard system for beans and sorghum. Approximately 75% said they thought it was a good idea. For the most part, the managers commented that quality would improve if producers found they could earn a higher price for cleaner beans or sorghum. Of those who thought it was a bad idea, the majority said there was too much room for fraud and/or that bean and sorghum quality was already satisfactory.

3. Merchant Suppliers

Merchants are a major link in the marketing system of food products in Rwanda. To determine merchant practices concerning quality, a survey was conducted jointly by researchers from OPROVIA and the Agricultural Survey and Analysis Project (SESA). The survey of 30 merchants with fixed-place operations, a storefront, incorporated questions from three different researchers, each pursuing a different research topic related to the marketing and storage activities of food crop merchants. One part of the survey pertained to storage practices and problems. A second section defined monthly transaction schedules to determine when merchants buy and sell, who are their suppliers and what is the geographic origin of their beans. A third section dealt with practices and perceptions of product quality.

Survey Procedures Two Rwandan enumerators visited 30 merchants in six prefectures between November 18 and December 3, 1986. Respondents were selected on the basis of whether a merchant had a fixed-place operation and whether they commercialized beans and/or sorghum. To facilitate identifying merchants who had previously sold to OPROVIA, a questionnaire was sent to OPROVIA warehouse managers in August which asked for the names of 10 merchants in their area who had previously sold large quantities to OPROVIA. Among other questions, the warehouse manager survey requested information concerning quantities sold, storage capacity, location, and vehicle ownership. The response rate to this survey was low despite repeated requests for the information.

The merchant survey took place in the prefectures that are most representative of the various agro-economic conditions in Rwanda. Table 43 shows the distribution of the number of merchants surveyed among prefectures. Of the 30 merchants surveyed, all commercialized beans and 70% commercialized sorghum.

There were three major difficulties encountered in locating and interviewing merchants. First, the turnover rate of merchants in business appears to be fairly high, as several of the merchants named by warehouse managers were no longer in operation. Second, many merchants are open only on market days which are held twice a week in most parts of Rwanda. Third, the enumerators noted that the response of merchants to their association with OPROVIA was sometimes negative. Two merchants refused to cooperate and several merchants closed their shops before one of the enumerators arrived at their store. OPROVIA's sudden change of policy in 1986 to purchase directly from farmers and farmer cooperatives left many merchants holding large stocks without a bulk buyer. Also, it is possible that some merchants suspected that the interviewers were tax collectors or enforcement agents of official bean and sorghum prices.

Table 43
Description of the Merchant Survey Sample

Prefecture	Number of Merchants Sampled	Percent Commercializing: Beans Only	Sorghum Only	Beans and Sorghum
Butare	5	0	0	100
Byumba	6	50	0	50
Kibungo	5	20	0	80
Kibuye	2	50	0	50
Kigali	6	17	0	83
Ruhengeri	6	33	0	67
Total	30	Avg. 28	0	72

Because of these difficulties as well as time constraints, the original goal of conducting 50 merchant interviews was dropped after 30 interviews were obtained. Each of the six targeted prefectures was visited at least once. The relatively small number of observations makes comparisons of results according to particular factors such as size or location of operations inconclusive.

The survey questionnaire had three parts, each including questions of a different researcher from either OPROVIA or SESA. Whenever possible, questions within the three sections which were similar were combined to keep the questionnaire as short as possible. The first section of the questionnaire(OPROVIA) included questions concerning storage facilities, storage problems, and rodent and insect prevention techniques. The third section (SESA) contained questions concerning quantities of beans purchased and sold, the origin of the beans, and the timing of purchases and sales.

The second section (OPROVIA) of the questionnaire concerned perceptions and practices of merchants with regard to quality. The section concerning quality contained 3 groups of questions.

1) Buying, selling, and storage practices:
   - Products commercialized
   - Previous contacts with OPROVIA
   - Storage capacities
   - Sources of supply and demand
   - Purchasing/sales schedule
   - Cleaning practices
   - Rejection policies
   - Pricing policies
   - Present quality in the market
   - Presence of imported beans in the market

2) Perceptions of quality
   - Magnitude of the difference between three bean samples and ranking according to quality
   - Pricing according to quality

3) Reactions to changes in OPROVIA pricing policies
   - Changes in cleaning practices or rejection policy as a result of a premium paid by OPROVIA for high quality
   - Opinion of a premium pricing system for quality in Rwandan markets

Several questions involved showing the merchant the three samples of beans described in the section on cooperatives, Table 33.

Merchant Buying and Selling Practices

All of the merchants interviewed commercialize beans and 70% of them commercialize sorghum. Thirty-seven percent had previous transactions with OPROVIA. Of those with previous sales, approximately 20% said they had been rejected at least once in the past by OPROVIA because their beans or sorghum were of poor quality.

The majority of merchants in the sample indicated that during the last 12 months they purchased beans and sorghum primarily from producers. This is

consistent with the producer survey where half of the producers interviewed said that they had previously sold to a merchant. None of the merchants made purchases from cooperatives in the last year, Table 44. This result is expected given the results of the cooperative survey which indicate that approximately 15% of cooperatives had sold to a merchant in 1986, and the quantities sold amounted to only between 5%-7% of total sales.

The difference between truckers-buyers and assemblers is that the former transport relatively long distances to benefit from spatial price differences whereas assemblers collect small quantities to make a wholesale transaction in the market, usually in the same area.

The calendar in Table 45 shows that, as expected, merchants frequently sell near the end of the calendar year, just before the large harvest and buy just after the two annual harvests, February-March and June-August. The calendar also shows that a small percentage of merchants buy and sell throughout the year.

The majority of merchants interviewed, 83%, reject beans which are of "poor quality", while 17% never reject beans due to quality. Table 46 shows that merchants who reject beans are more likely to reject those from producers than those of another merchant but that in general, rejections are infrequent.

The surveys indicate that the merchants' rejection factors are those specified for the OPROVIA standards. Of the 80% of those merchants who reject for poor quality, all of them named either foreign material or damaged grain first in their list of quality factors considered when making rejections, Table 47.

About 36% of merchants in the sample said they reject for high moisture content. It is unknown whether or not they use a moisture meter for testing this factor, though it is doubtful. In numerous visits by Project staff to commercial centers in Rwanda over the past several years, few moisture meters have been observed. Where they do exist, they are generally not used. It has been noted that individuals in the grain business usually depend on various tactile tests to determine whether grain is sufficiently dry for storage.

Almost half of the merchants interviewed said that producers sometimes bring them mixtures of old and new beans but that this did not occur often. Only 10% said that this occurred half of the time or more. It is interesting to note that one of the six merchants who responded that the "quality of beans is all the same" for purchases did not give the same response concerning sales. This merchant indicated that he mixes different qualities of beans at the time of sale.

Approximately 30% of the merchants surveyed base prices on quality, Table 48. Responses concerning these quality factors were almost identical for purchases and sales, as shown in Table 49. All the merchants who named color as a factor for either purchases or sales named it first. It is interesting to note that although the majority of merchants interviewed reject beans on the basis of foreign material and damaged grains, only a small minority price according to these characteristics while approximately the same proportion who reject according to age (as determined by color) also price with regard to this factor.

Table 44
Merchant Sources of Supply and Demand
During the Previous 12 months
(n=30)

Supply	Percent of Merchants Surveyed
Producers	60
Producers & Truckers[a]	13
Truckers & Assemblers[a]	10
Truckers	7
Assemblers	2
Cooperatives	0
No response	7
	99%

Demand	Percent of Merchants Surveyed
Producers	50
Producers & Truckers[a]	23
Producers & OPROVIA[a]	7
No response	20
	100%

[a]These categories were created to account for those merchants who cited more than one source.

Table 45
Calendar of Merchant Purchases and Sales for the Last 12 Months

	Percent of respondents that bought/sold in:											
	Nov 85	Dec 85	Jan 86	Feb 86	Mar 86	Apr 86	May 86	Jun 86	Jul 86	Aug 86	Sep 86	Oct 86
Buy (n=28)	4	4	7	50	32	7	4	21	14	25	7	14
Sell (n=23)	30	13	0	13	21	13	13	13	30	35	35	26

Table 46
Frequency of Merchant Rejections of Beans Due to Quality
According to Supply Source

	Producers	Cooperatives	Merchants
		Percent of Total (n=30)	
DO NOT REJECT	17	17	17
REJECT			
Often	17	0	7
Rarely	63	0	17
NEVER BUY FROM THEM	3	83	60
	100%	100%	101%

Table 47
Responses to the Question:
"What are the quality factors on which you base rejections?"
(Multiple responses recorded.)

Factors	Percent of Merchants Surveyed (n=30)
Damaged grain	70
Foreign material	60
Moisture content	36
Color	13
Varietal mixture	13

Table 48
Responses to Questions:
"Do you usually buy/sell beans of
different quality at different prices?"

Response	Percent of merchants surveyed: Purchases	Sales
	(n=30)	
Yes	27	30
No	53	53
Quality is all the same	20	17
	100%	100%

Table 49
Responses to the Question:
"On what quality factors do you base prices?"
(Multiple responses recorded.)

Factors	Percent of merchants surveyed: Purchases (n=30)	Sales
Never price according to quality	53	53
Color (age)	13	13
Foreign material	10	13
Moisture	10	10
Damaged grain	7	7
Country of origin	3	7

The low percentage of merchants who price according to the country of origin, Table 50, is surprising because 30% of the merchants interviewed said that imported beans sometimes sell at different prices from domestic beans. The majority who indicated that imported beans do not exist in the market were located in Kibungo and Kigali. The magnitudes of the price difference between imported and domestic beans were mixed, Table 51. According to one merchant, "The price difference depends on the availability of beans at the time." However, the surveys showed that imported beans are priced differently from domestic beans.

The questions concerning average and maximum amounts stored were difficult for some merchants to estimate and others were not willing to offer figures. Of those merchants that did answer, results show that the maximum amount of beans and sorghum stored is about twice the amount that is normally stored, Table 52. Also, the average amount of sorghum stored is about twice the amount of beans that is normally stored. This is undoubtedly because sorghum is harvested only once per year in most areas, while beans are harvested twice.

One-third of the merchants interviewed store according to quality, Table 53, but only a minority of these follow this practice on a regular basis. Of those merchants who separate beans by quality before storing, most differentiate according to the same factors as those considered in pricing decisions. Color is the most important factor, but foreign material, damaged grains, and moisture content are factors in storage decisions for roughly 10% of the surveyed merchants, Table 54. Few merchants clean beans or sorghum after purchase and prior to storing. Only one of the thirty merchants undertake cleaning; he specified that he sometimes picks out foreign material. The majority (80%) said that they regularly check their stocks during storage.

The most important storage problem for merchants is insects, Table 55. Seventy percent said that they always or frequently have insect problems. More than a third associated their storage problems with moisture or humidity. Nearly a quarter indicated that they do not encounter any problems whatsoever.

Perceptions of Bean Quality When three bean samples were shown to merchants which represented the three grades proposed by OPROVIA researchers, only ten percent of the merchants interviewed did not see a difference among the three samples while the majority were roughly equally divided between those who thought the difference was large, 43%, and those who thought the difference was small, 47%. Recall that the three bean samples contained the maximum permissible quantity of foreign material and damaged grain defined within the grades that the sample represented. Sample A contained 2.5% defects, Sample B contained 5% defects, and Sample C contained 14.5% defects.

The merchants were then asked, "If there were a system of quality standards in the market where different qualities of beans received different prices, how much would you offer for one kilo of beans of this quality?" Table 56 shows how the average price differences for each sample relative to the market price in each merchant's market area. The average market price was 25 FRW/kg.

Table 50
Responses to the Question:
"Is there a different price for
imported beans and domestic beans?"

Response	Percent of Merchants Surveyed (n=30)
Imported beans never found in this region	53
Always	10
Sometimes	20
No	10
Don't know	7
	100%

Table 51
Magnitude of the Price Difference
Between Imported and Domestic Beans
(n=30)

Prefecture	Percentage of merchants surveyed responding that a price differential exists (n=30)	Price of imported beans compared to domestic beans
Butare	60	3-5 FRW/kg less
Kibungo	20	5 FRW/kg less
Kibuye	50	2-3 FRW/kg less
Ruhengeri	50	1-2 FRW/kg more
Kigali/Byumba	0	N/A

Table 52
Estimated Quantities of Beans and Sorghum Stored
(n=30)

	Average	Maximum
	tons	
BEANS	3	13
(Percent of all merchants surveyed who responded)	(70)	(80)
SORGHUM	8	25
(Percent of all sorghum merchants surveyed who responded)	(77)	(87)

Table 53
Frequency of Separating Beans
in Storage According to Quality

Response	Percent of Merchants Surveyed (n=30)
Always	17
Sometimes	17
Never	50
No response	17
	101%

Table 54
Quality Factors Used for Separation of Beans in Storage
(Multiple Responses recorded.)

Factors	Percent of Merchants Surveyed (n=30)
Never store according to quality	50
No response	17
Color	20
Foreign material	13
Damaged grain	10
Moisture	10
Country of origin	3
Varietal mixture	3

Table 55
Responses to the Question:
"What are your most important storage problems?"
(Multiple responses recorded.)

Response	Percent of Merchants Surveyed (n=30)
Insects	70
Humidity	27
Moisture content	10
Impurities	7
Aging	3
No problems	23

Table 56
Average Difference Between Current Market Price
and Price Proposed for the Sample

	Sample A (2.5% defects)	Sample B (5% defects)	Sample C (14.4% defects)
Avg. FRW/kg increase	1	1	1
Percent citing premium	28	20	12
Avg. FRW/kg decrease	2	2	3
Percent citing discount	8	20	40
Percent citing market price	64	60	48
	100%	100%	100%

Of those merchants who perceived a difference between the samples and gave a price difference, approximately one quarter priced the three samples in descending order according to increasing levels of defects with a difference between each grade. Twenty percent priced the samples in descending order with at least one difference in price. Two of the samples were given the same price. The remaining 56% gave the same market price for all three samples. However, of those who responded to the question concerning hypothetical price differences, most correctly related relative quality, as represented in the sample, with price. It is interesting to note that, on average, the premiums offered were less than the discounts. Merchants seem more willing to penalize than to reward quality.

Also, there were several unexpected responses. For example, a discount price was assigned to Sample A by two of the merchants. One of the two who assigned a discount to Sample A stated that moisture content was high, which was not a problem with the beans in the sample. The other named foreign material and damaged grain. In addition, three merchants offered a premium price for Sample C. Two assigned the same premium price to all three samples.

In general, the responses for this question apply to the quality factors represented in the samples. Ninety-six percent of the merchants named either foreign material or damaged grain as the first factor on which they based the prices they offered for the three samples. Table 57 shows that of those who identified a difference between the samples, the majority correctly identified the quality problem.

A minority of the merchants surveyed cited color, country of origin, and moisture content as quality problems, Table 57. The order of the responses was recorded and since all but two gave foreign material and damaged grain as their first and second response, the prices merchants quoted can be assumed to relate to the quality problems represented in the samples.

The results from the merchant survey are not consistent with the results of the cooperative survey which used similar bean samples and questions regarding quality. In that survey, factors not intended to be included in the sample (age, color, and variety) influenced results. This problem makes it difficult to compare the results of the two surveys.

Reactions to a Quality Standards System Merchants were asked to identify the sample which most represents the quality of beans that they normally purchase. Most, 78%, selected the best sample, Sample A, as typical of the quality of beans they buy, Table 58. Two merchants chose the worst quality, Sample C, containing 14.5% defects, as most representative.

Two additional samples were shown at the end of the survey. One had no defects and the second was Sample C, which contained 14.5% defects. The purpose of using these samples was to find out what incentives would be necessary for merchants to change their buying practices concerning quality. First, merchants were asked if they saw a difference between the two samples. All of the merchants said that there was a difference. Ninety-seven percent said they saw a large difference, and three percent said they saw a small difference. Merchants were then asked two questions about how they would react to price premiums paid by OPROVIA for high quality, basing quality on

Table 57
Quality Factors Accounted For In Pricing Three Bean Samples
(Multiple responses recorded.)

Response	Percent of Merchants Surveyed (n=30)
Don't see a difference/ no response	20
Foreign material	67
Damaged grain	67
Color	7
Country of origin	3
Moisture content	3

Table 58
Responses to the Question:
"Which sample most resembles the type of beans brought to you for purchase?"

Response	Percent of Merchants Surveyed (n=30)
Sample A (2.5% defects)	78
Sample B (5% defects)	10
Sample C (14.5% defects)	6
No response	6
	100%

the two samples just presented to them. Responses are summarized in Tables 59 and 60.

The distribution of responses in Table 59 shows that half of the merchants surveyed believe a price premium of approximately 14% would be an adequate incentive to begin penalizing poor quality more severely. This premium does not account for any premium associated with the official bean price paid in 1986 or for the loss in total weight that would occur during the cleaning process. The results show, however, that at least half of the surveyed merchants believe that quality can be improved through increased rejections.

Approximately one-fifth of the merchants indicated that they would not undertake cleaning for a 5 FRW per kilo premium. For cooperatives, the majority, 78%, responded that cleaning was producers' work and that they would pass the price premium along to producers rather than do it themselves. Over three times as many cooperative managers rejected the idea of cleaning more for a premium price than merchants.

An open-ended question was included at the end of the survey. Merchants were asked to give their opinions concerning a quality standard system for beans and sorghum. Seventy percent said they thought it was a good idea. Of these merchants, the majority indicated that it was the role of suppliers in the market to control quality and/or that grades would stimulate supply of high quality. Of those who thought a system of quality standards was a bad idea, 27%, most believe that quality in the market is already high.

E. Assessing the Impact of Quality Standards for OPROVIA Clients

Personnel within three institutions, the Ministry of Finance (MINIFINECO), the World Food Program (WFP), and the national Brewery (BRALIRWA), were interviewed to determine institutional perspectives on the quality of beans and sorghum in Rwanda. The two most important buyers of OPROVIA's beans and sorghum are the Ministry of Finance (MINIFINECO) and the World Food Program (WFP). In 1985, these two institutions purchased 99% of the beans and the majority of the sorghum flour sold by OPROVIA. Personnel at various administrative levels within these two institutions were interviewed in January, 1987, to determine what problems, if any, they encounter with the quality of beans and sorghum that they purchase and how they presently control the quality of deliveries made to their institutions. Rwanda's sole brewery, BRALIRWA, has never purchased grain from OPROVIA but was included in the institution survey to find out what system they use to control the quality of the grains they buy.

The objectives of the institutional survey were to determine: 1) what quality problems, if any, are perceived by representatives of institutional buyers in their purchasing activities of beans and sorghum and 2) the methods used by institutions for controlling the quality of the beans and sorghum that they purchase.

1. Survey of Bean and Sorghum Users

Administrators with MINIFINECO, WFP, and BRALIRWA were interviewed

Table 59
Responses to the Question:
"If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you reject more beans brought to you than you normally reject?"

Response	Percent of Merchants Surveyed (n=30)
Yes	53
No	10
Don't know	37
	100%

Table 60
Responses to Question:
"If OPROVIA offered a 5FRW/kg difference between these two types of beans, would you increase the amount of time you spend in your operations separating and cleaning your beans to obtain the higher price?"

Response	Percent of Merchants Surveyed
Yes	43
No	20
Don't know	37
	100%

during the first three weeks of January, 1987. At MINIFINECO, the representatives chosen at prisons, army camps, and national police installations were those individuals responsible for receiving bean and sorghum deliveries and controlling the storage, handling, and inventory of the deliveries. A total of 3 prisons, 2 national police headquarters, and 3 army camps were visited in four different prefectures, Kigali, Gitarama, Kibungo, and Ruhengeri. These eight institutions received 55% of MINIFINECO's purchases of beans in 1986 and 26% of the total sorghum flour purchased.

At WFP, the survey took place at the administrative headquarters which is responsible for negotiating contracts. At BRALIRWA, the agronomist in the firm was contacted. Due to time constraints, it was impossible to conduct a representative survey of bean or sorghum consumers within MINIFINECO or WFP.

Two questionnaires were used in the survey. One was used for MINIFINECO and WFP interviews and the second was designed for the interview at the national brewery. The questionnaire for MINIFINECO and WFP contained the following groups of questions:

(1) Quantities purchased
(2) Rejection, handling, and storage practices
(3) Perceptions of quality

The questionnaire also included a question concerning preferences for different types of contracting agreements concerning quality. This question was asked only if the administrative personnel interviewed were responsible for contract negotiations.

The questionnaire underwent one major change before the survey was conducted. Originally, it was divided into two groups: questions applicable to OPROVIA's deliveries and questions applicable to other suppliers. The questionnaire was submitted to administrators and researchers for comments and, in the review process, it was pointed out that the format of the questionnaire might be inappropriate due to the timing of the survey during the agricultural year. Specifically, it was felt that since the survey was being conducted just weeks before the new harvest, institutions would be receiving OPROVIA's very lowest quality of beans and sorghum with regard to age, and responses concerning overall quality would be biased against OPROVIA. To reduce any effects due to the timing of the survey, it was decided to remove the word OPROVIA from the questionnaire and to refer to suppliers in general terms. This change is not viewed as having posed any particular problems.

The second questionnaire, used in the interview with the agronomist at the national brewery, included the same groups of questions as noted above but were formulated specifically for a brewery's operations.

2. Purchases by the World Food Program

The WFP normally purchases an average of 500 tons of beans and 750 tons of sorghum from OPROVIA for its beneficiaries, refugees. Its suppliers are OPROVIA and private merchants.

The WFP's choice of supplier is dependent on price, though for several reasons they prefer to buy from OPROVIA than from merchants. First, WFP is

required to advertise in newspapers before making purchases from merchants so that competitors can bid on the contract. This involves more time than negotiating a contract with OPROVIA. Secondly, the beans or sorghum offered by merchants must be visually inspected by WFP representatives prior to finalizing a contract which also increases the cost of the transaction.

With regard to the quality of OPROVIA's deliveries, however, the WFP administration has received complaints from within their organization concerning problems with moisture and age. The WFP administration has made both written and verbal complaints concerning quality to OPROVIA and, in one case, OPROVIA replaced moldy beans that it had delivered.

Since then, the WFP administration has developed an informal system for ensuring adequate quality from OPROVIA. When the WFP is ready to take delivery on a contracted amount, contacts within OPROVIA are requested to inspect the quality coming out of a warehouse. If the quality is considered low, the request for delivery is delayed until a later time. Deliveries are made on a monthly basis to some WFP recipients and trimesterly to others. Since this informal method of controlling the quality of OPROVIA deliveries was installed, WFP reports that the quality is average, and that they are usually satisfied with deliveries. The average amount of time that WFP stores beans or sorghum on its premises is one month. It is stored in the sacks furnished by suppliers.

3. Purchases by MINIFINECO

A total of 5 military installations out of a national total of 26 and 3 prisons out of a national total of 27 were visited in four different prefectures. The combined amount of purchases of these institutions in 1986 was 977 tons of beans and 53 tons of sorghum flour. According to MINIFINECO figures, this represents 55% of the beans and 26% of the sorghum flour MINIFINECO contracted to buy from OPROVIA in 1986 (Government of Rwanda, 1985).

All 5 of the military institutions received beans and sorghum flour exclusively from OPROVIA. All 3 prisons visited received beans from only OPROVIA, but two reported having private merchants as their supplier of sorghum flour. Three institution representatives said that they purchased beans from merchants as well as from OPROVIA in 1984 when there was a national shortage due to lack of rains and subsequent poor harvests.

When asked about quality, all but three of the representatives said that the quality of both beans and sorghum was good or very good. All of those giving this response said that the quality was the same that one could find in the local market. When comparing the beans delivered with those in nearby local markets, three respondents said that beans delivered by OPROVIA were better than those in the market due to the following reasons: OPROVIA beans had been fumigated, they were not imported from Uganda, and they were good enough to use as seed in their institution's gardens. However, three respondents said that that quality of OPROVIA's beans was average.

The following factors were cited as problems in beans by the three institutions that specified quality problems: moisture, age, too long to cook, variety (small beans, or too many black beans which are considered inferior due to their discoloring of the cooking water), and beans damaged by insects. Insects were cited as the main quality problem in sorghum flour.

Two institutions said that they had previously thrown out 1%-2% and 420 tons, respectively, of beans purchased from merchants in 1984 when there was a national shortage due to drought conditions. The beans had not been properly dried. Another institution cited throwing out 11 tons out of 600 tons purchased in 1983 due to insect infestation within their own stocks. Two institutions said they threw out beans in 1983 because they were too old and therefore difficult to cook. None of the institutions had thrown out sorghum flour due to poor quality despite the fact that one institution reported storing sorghum flour up to eight months after delivery.

In almost all cases, OPROVIA delivers the beans or sorghum directly to the institution. Two military camps said that they sometimes send a truck of their own when supplies are very low. All said that the deliveries were inspected when they arrived.

Three of the institutions had refused deliveries of beans due to poor quality. None had ever refused a sorghum flour delivery. One of the three refused delivery in 1986 because the beans were old and insect damaged. The second cited refusing a merchant delivery in 1984 because the beans were not properly dried and were from Uganda. The third also cited refusing merchant deliveries due to moisture and insect damage and this institution reported making a rejection approximately once every four months during 1984.

None of the institutions sorts or cleans beans prior to storage. In most cases, the beans are stored in the bags in which they are delivered and without any special handling. In some cases, the beans are mixed with an insecticidal dust before storing. The average length of storage time for beans for these institutions was 3 months, with a low of 2 weeks and a high of 5 months. The average length of time that sorghum flour is stored was 4 months, with a low of 3 months and a high of 8 months. The reason given for storing sorghum flour for 8 months was inadequate supplies of sugar which is used with sorghum flour. Cleaning and sorting are done at most institutions just prior to cooking. The tasks involved are sieving, hand-picking, and washing the beans to eliminate residues from fumigants.

Two institutions said that they had made complaints to OPROVIA concerning quality. In one case, a delivery of poor quality beans was replaced.

4. BRALIRWA Sorghum Purchases

Prior to 1986, the only grain BRALIRWA used in its beer was imported barley (sprouted for malt) and imported maize (defatted yellow "corn" meal) as an adjunct. In 1986, the brewery used 300 tons of locally grown red sorghum for the first time as a partial substitute for the maize. Though white varieties of sorghum do not pose a problem with the taste of beer as red varieties do because of the tannins in red sorghum, white sorghum is relatively scarce in Rwandan markets. Between 5% to 10% of red varieties can be used in beer before a problem with the tannins occurs. The current formula contains 85% barley, 10% maize, and 5% sorghum.

Beginning in 1987, the brewery plans on switching to white sorghum and will secure its supply by undertaking contract production. Seed of white sorghum varieties was being imported at the end of January, 1987 from Zimbabwe and are considered adapted to the climatic conditions of the lower altitudes of Rwanda.

Contracts have been made with cooperatives and merchants in those areas for 500 tons to be harvested in June and July of 1987. Based on the outcome of this arrangement, BRALIRWA plans to increase production to 3,000 tons of white sorghum through contract farming within two years. To date, finding contract growers has not been a problem.

In its 1986 purchases of red sorghum from merchants in Gisenyi, the quality restrictions were as follows: 100% free of damaged grains or foreign material, no evidence of use of insecticides, no insects, a moisture level of approximately 12%, and from the most recent harvest. Contracts with merchants were made after receipt of small samples. Prices were generally 2-4 FRWs higher than the official price for sorghum but were based on market conditions rather than quality. The grain was visually inspected at delivery and all deliveries were cleaned with an automatic cleaning machine. Deliveries were made every two weeks and none of the deliveries were rejected due to poor quality.

The system of quality control with regard to 1987 purchases of sorghum from contract farmers will be very different. The contracts include a list of quality specifications and specific penalties in cases where these specifications are not met. First, the same quality specifications as listed above will apply to all contractors. In cases where the quantity of foreign material or damaged grains exceeds 5%, the supplier will pay all cleaning costs. Also, the loss in weight from cleaning will be deducted from the total delivered. In cases where the quantity is less than 5%, the only penalty is the deduction of the weight of the foreign material and damaged grains. BRALIRWA will store the sorghum in its Gisenyi operations which is presently able to accommodate the 3,000 tons anticipated to be purchased in 1989.

5. Product Handling and Storage Policies

Most institutions receiving deliveries based on MINIFINECO contracts do not clean before storing. Instead, beans are usually sieved and washed following storage and just prior to cooking. On average, these institutions store beans for three months and sorghum for four months. WFP recipient organizations also usually sieve and wash beans prior to cooking. The average time that they store beans or sorghum flour is one month.

The brewery used the red sorghum that it purchased in 1986 immediately after delivery. In 1987, with the advent of contract farming, the brewery will purchase from producers in August and September and then store throughout the year. They used a mechanical cleaner on their 1986 red sorghum purchases and will do the same with future white sorghum purchases.

F. General Findings from Surveys

1. Purchasing and Rejection Policies

OPROVIA's buying, storing, and selling procedures account for quality differences on a limited basis. First, OPROVIA has a rejection policy based on moisture content, number of live insects, and amount of foreign material which are determined quickly and subjectively. According to survey results of producers, cooperatives, and merchants, OPROVIA in fact rarely rejects low quality grain. Informal interviews with warehouse managers confirm that

rejections are infrequent though large deliveries, over 10 tons, have been refused on occasion.

Quality specifications are included in purchase contracts with cooperatives which supplied approximately 40% of the beans and 30% of the sorghum OPROVIA purchased in 1986 and also in sales contracts with the World Food Program which accounted for half of OPROVIA's total bean sales and over 80% of sales of sorghum flour in 1985. Both types of contracts specify moisture, foreign material, and damaged grain as the main quality factors to be assessed. OPROVIA warehouse managers are directed to sample for these factors in their purchasing activities by visual observation, smelling, and biting.

The recent policy change to directly purchase from producers, with limits of 30 kg per transaction, and to decrease merchant deliveries greatly enlarges the number of transactions per warehouse per day and therefore limits the type of inspection and testing possibilities associated with a grading or rejection policy. A quality standards system would need to account for the workloads experienced at each warehouse during typical buying campaigns. This could include increasing the length of the buying campaigns or the issuing of tokens to distinguish those producers who come to sell but are not able to be served on a particular market day. The token would acknowledge their right to sell 30 kg of beans on another specified market day.

The survey results show that, in general, cooperatives and merchants control the quality of their purchases through the rejection of poor quality lots rather than through the use of price incentives or penalties. Cooperatives and merchants consider foreign material and damaged grain to be the most important quality factors on which to base rejections. All of the cooperatives and 80% of the merchants interviewed reject beans based on at least one of these two quality factors.

By comparison, only about one quarter of the cooperatives and merchants interviewed said that they adjust prices according to quality. In these cases, color, an indicator of age, was the main quality factor used to determine price. The factor mentioned the most frequently after color was foreign material, though only a small percentage of the merchants or cooperatives base price on this factor.

Though rejection of low quality beans or sorghum is the principal method for maintaining a minimally sufficient level of quality in their purchases, merchants and cooperative managers indicated that rejections are infrequent. Half of the cooperative managers said that they reject only at the beginning of the buying campaign and the majority of merchants said that they rarely reject. Only one quarter of the merchants interviewed said that they reject often. The low rate of rejections was affirmed by producer survey results which showed that of those with previous sales to merchants, only 5% had ever had beans or sorghum refused due to poor quality. Producers were not asked their rejection experiences with cooperatives.

The low rejection rate could indicate relatively high quality or relatively low standards. The former hypothesis is supported by merchant responses to the survey question concerning three bean samples. Merchants were asked which of three bean samples were most like the beans they normally purchase. The samples were representative of the three grades for beans proposed by FSM II

researchers and contained 2.5%, 5%, and 14.5% defects. The vast majority of the merchants indicated that the sample containing 2.5% defects was most like the quality of beans they normally purchase.

2. Product Handling and Storage Policies

None of the cooperative managers or merchants surveyed clean the beans that they buy. The surveys indicated that the cleaning of beans and sorghum takes place only at the producer level. Survey responses are inconclusive as to what point in production and commercialization activities producers clean sorghum.

Responses to the questions of cleaning practices with regard to the intended use of beans are more reliable. Each producer was shown six different types of bean damage and asked whether he/she removed them before eating, storing, planting, or selling. Responses indicate that producers are likely to clean beans more stringently before planting and eating than before selling or storing. Insect damaged beans are the one exception to this finding. The labor for cleaning beans is almost without exception undertaken by female members of the household. The tasks involved are winnowing and hand-picking. The majority of the damaged grains are thrown out though they are sometimes eaten. These results are similar to those found by another component of the Project (Projet GRENARWA II-Recherches, 1987a) concerning producer cleaning activities.

With regard to product handling, one quarter of the cooperative managers and merchants interviewed said that they segregate beans according to quality in storage. The quality factor used most often for this segregation is age, as determined by color, though small percentages of both merchants and cooperative managers also named foreign material, damaged grain, and moisture. Most suppliers who stock according to age also sell according to age.

The surveys show that the majority of both cooperatives and merchants experience losses during storage. Approximately three quarters of both cooperatives and merchants said they sometimes or frequently had storage losses. The most frequently cited cause was insects. Moisture was the second most important storage problem for both groups. High moisture grain is very vulnerable to mold damage.

3. Perceptions of Bean and Sorghum Quality

Nearly all of the cooperative managers and merchants said that they perceived a difference between the three samples they were shown which represented the three proposed grades for beans containing 2.5%, 5%, and 14.5% defects. Responses in both groups were approximately equally divided between those who thought the difference was large and those who thought it was small. Only ten percent of merchants and three percent of cooperative managers said they did not see any difference.

When asked what price they would assign to each of these three samples if prices in the market reflected quality, approximately half of the merchants and cooperative managers priced the three samples in descending order according to increasing levels of defects, with at least one difference in price. The other half of both groups either found the hypothetical nature of the question difficult to respond to, or did not think there was a difference among the samples and

gave the same price for all three samples. When naming the factors on which they based their answers, the majority of those cooperative managers and merchants who responded identified correctly the quality problem as damaged grain and foreign material.

Producers were also asked to judge the magnitude of the difference among samples, rank them in order of quality, and describe the quality problem associated with each. The samples used in the producer survey contained sorghum rather than beans because the respondents were producers standing in line to sell sorghum to OPROVIA. Only 5% of the producers interviewed said that there was no difference among the three samples. The remainder was equally divided as to whether the difference was large or small. Almost all cited the type of problem associated with the sample correctly when asked why they ranked the sample the way they did.

4. Determining Price Differentials

The bean and sorghum samples used in the surveys were intended to determine not only perception concerning quality, but also the opinions of market participants concerning appropriate price differentials for the three proposed grades.

Responses to the questions concerning price differentials were difficult to analyze in all three surveys. First, the respondents had to assess the premium named in a particular question with regard to the existing implicit premium being paid by OPROVIA, the difference between official and market prices. For example, producers were asked if they would accept a 5 FRW/kg discount by OPROVIA because the quality of their sorghum was poor. Yet a 5 FRW/kg discount on the 1986 official price for sorghum still yielded the market price in some areas. Second, in the merchant and cooperative surveys, half of the respondents gave the same price for each of the three samples. This occurred despite the fact that the question was prefaced with "...if different qualities received different prices in the market..." and also despite the fact that the vast majority in both cases had said that they perceived a difference in quality between the samples. Third, several cooperative managers indicated that the prices that they gave for the three samples were based on two quality factors not intended to be represented in the samples, namely age and variety.

Due to these problems, it is impossible to assess the relevant price differentials which would apply to the proposed grades. However, the survey results do show that: 1) producers would be willing to clean more for a premium; and 2) traders would be willing to reject more if a premium price were paid for higher quality. Specifically, the producer survey results showed that for a 5 FRW/kg premium, 23% of the 1986 producer price, all the producers said they would clean their sorghum. When asked if they would accept 2 FRW/kg more, 7% of the 1986 producer price, all the producers said they would clean their sorghum. When asked if they would accept 2 FRW/kg more, 7% of the 1986 producer price for beans, for cleaning the damaged grain from a 100 kg bag of beans, 80% said yes. Finally, half of the producers said they would clean their grain and return to OPROVIA if their sorghum was rejected due to poor quality, indicating that the average 4-7 FRW/kg premium for sorghum associated with the official price in most markets was a sufficient incentive for producers to improve quality.

In the case of merchants and cooperatives, over half of the merchants said they would increase rejections as a way to improve quality if a 5 FRW/kg premium, 14% of the 1986 price paid to merchants and cooperatives for beans, were offered for high quality. By comparison, 40% of cooperatives said they would reject more. Responses to the question of whether they would undertake more cleaning in their operations to gain the premium price differed between the two groups. Almost half of the merchants responded positively whereas only 11% of the cooperatives answered in the affirmative.

BRALIRWA's approach towards controlling sorghum quality may be a good model. It entails precise specifications and measurement of specific quality parameters: age, moisture, foreign material, and damaged grain. Their use of deductions based on certain limits concerning these factors and intention to reject in extreme cases will be interesting to monitor over the next three years. For OPROVIA, reaction of contracting merchants and farmers to this system which includes facilities for upgrading the quality of delivered grain, e.g., mechanical cleaning, will be as important to monitor as a pilot test within its own operations.

G. Implications for Applying Quality Standards to OPROVIA's Marketing Activities

Data concerning the quality of beans at different levels in the Rwandan marketing system show that quality after harvest and before storage is generally good at the farm level but poorer at the cooperative and merchant level. The quality of the grain OPROVIA purchases 2-3 months after harvest is poorest of all. It seems likely that suppliers are selling their lower quality grain to the government with the knowledge that there is little chance of receiving a penalty price or having their product rejected. As a result, OPROVIA probably acquires the poorest quality product in the market. This is, in fact, the same result found in other developing countries where grain quality in public markets was found to be higher than in government stocks (Steinke and Pfost, 1978).

A grading system could be used to improve the quality of the grain OPROVIA purchases. Although OPROVIA already has a system of specification buying whereby warehouse managers are instructed to accept lots of grain according to established criteria and although quality specifications are presently included in purchasing contracts with cooperatives, the evidence shows that these quality specifications are not strictly applied.

This section of the report considers how a new system of quality standards as proposed by FSM II researchers can be used to improve OPROVIA's marketing operations. The first part examines the alternative systems that OPROVIA could adopt. The second part defines the performance criteria of a quality standard system. The third part discusses the performance criteria as well as the known shortcomings of the current specification system with regard to the proposed alternative systems. Finally, recommendations are made concerning a new system of quality control in OPROVIA's grain purchasing activities.

1. Alternative Quality Standard and Grain Inspection Systems

The discussion below describes several systems which OPROVIA could implement to improve its purchasing practices.

Retention of Current Practices The present system entails simple and limited buying specifications accompanied by relatively subjective inspection methods--quick, visual checks of grain to ascertain whether there are any obvious quality problems present. As the specifications are heavily dependent on manager judgement, the quality of grain purchased varies across buying points. Uniformity of application is low.

No price differentials are set according to quality. Rejections for poor quality are made only in extreme cases. Tighter quality standards are maintained for large volume deliveries than for small ones.

Precise Quality Criteria with Objective Testing and a Rejection Policy Grades are established as buying specifications accompanied by thorough, representative sampling procedures and objective analysis of grain samples. There are no price differentials, but a strictly enforced rejection policy. Two options may be considered: (a) only large deliveries are graded; small deliveries made by producers are subject only to quick visual inspection in order to eliminate obviously low quality, or (b) all deliveries are sampled and tested regardless of size. This latter option is not explored given the sizeable increase in personnel it would require.

Precise Quality Criteria with Objective Testing and Price Differentials Grades are established as buying specifications accompanied by more thorough, representative sampling procedures and objective analysis of grain samples. There are price differentials, with or without grades, combined with a strictly enforced rejection policy for samples graded "substandard". Two options may be considered: (a) small deliveries made by producers are subject only to quick visual inspection as above in order to eliminate obviously low quality, or (b) all deliveries are sampled and tested regardless of size. This latter option is not explored given the sizeable increase in personnel it would require. The differentials could be based on either a sliding scale so that particular levels of poor quality are penalized by a specified discount or a standard discount for each of the three grades.

2. Performance Criteria for Quality Standards

Three performance criteria are usually associated with a grading system: operational feasibility, protection of market participants from unfair practices of other traders, and the effect of the system on current marketing processes (Hill, 1985). In the subsequent discussion, we focus on these criteria with respect to OPROVIA, but the considerations are also important for a national grading system.

Performance Criteria 1: Operational Feasibility Sampling and laboratory quality testing possibilities depend on the number of deliveries per warehouse during a buying season and also on the number and availability of trained personnel.

OPROVIA's recent shift away from purchases from large merchants and increased reliance on individual producers and producer cooperatives has resulted in greater numbers of transactions conducted at each warehouse during

buying campaigns. The limit of thirty kilograms of beans per producer delivery makes objective testing of grain delivered by producers unfeasible. It is probably feasible only in cases of large cooperative and merchant deliveries.

Is it possible to apply the standards to all of the large scale cooperative and merchant deliveries made to OPROVIA? With regard to labor requirements, the quality testing process for the proposed standards entails two tasks: sampling and grain analysis. A typical cooperative delivery averages about three tons and sampling for this quantity would take about twenty minutes. The person sampling must first ensure that 90%-100% of the bags are available for insertion with a sampling probe to guarantee randomness. Several samples are then taken and are mixed together. From this composite sample, a small working sample is obtained of 1,500 grams for beans and 1,000 grams for sorghum. The number of samples taken is dependent on the size of the delivery and the judgement of the sampler.

The analysis of grain quality entails measuring moisture content, sieving out and counting insects as well as weighing fine foreign material, hand-picking and weighing large foreign material and damaged grains, and calculating the grade based on established criteria. This process is estimated to take twenty minutes on average, depending on the experience of the technician and the relative quality of the sample.

OPROVIA presently has two staffs that are concerned with product quality. The Stock Conservation and Monitoring staff is responsible for all fumigation and inspection activities at warehouses. This staff is also responsible for creating and administering procedures for quality testing at the time of purchase. Given their existing tasks, they would play a logical role in any new sampling and testing procedures.

There are also four technicians who assist FSM II researchers in matters related to quality control. Two are assigned to physical grain quality testing and two to sensory quality (texture, taste, color), cookability, and viability/germination testing. Their workloads are currently assigned by researchers studying bean storability.

Two of the four laboratory technicians contributed to the creation of the proposed quality standards and are trained in all sampling and testing procedures. All four technicians can use moisture meters. One FSM II researcher is trained in the technique of calibrating moisture meters. These technicians could be used to manage the grading activities. They could not be expected to do all of the testing. Decisions on grades and prices have to be made rather quickly at the time and location of delivery. Nevertheless, the present laboratory staff could be involved in the following tasks:

(1) Conducting all sampling and testing for the strategic stock facilities located at Kicukiro.

(2) Settling disputed quality tests at warehouses.

(3) Monitoring warehouse sampling and testing techniques on a periodic basis.

(4) Responding to merchant or cooperative requests for testing prior to a transaction.

The warehouse personnel chosen to do sampling and/or testing would be the manager and/or foreman. Moisture meters were issued to warehouses, and managers were trained in their use several years ago, but the number of managers presently trained in the use of these instruments is not known. All of the meters were collected and tested in the central laboratory at Kicukiro in December, 1986, and only two of the seven were found to be in working or repairable order. A suitable moisture meter costs approximately U.S. $350. The estimated total cost of equipping a warehouse for objective testing is approximately U.S. $1,250, including shipping costs for imported items (See Appendix C).

The mechanics of the testing system at the warehouse level limit the number of tests. Given the estimated time from sampling and testing, an average of 40 minutes, the absolute maximum number of deliveries which could be graded is four per morning and two per afternoon. Many warehouses have implemented buying schedules whereby producers are allowed to sell only on market days and large deliveries take place on all other work days. This limits the number of days that large scale deliveries can be made to four days per week. A typical buying campaign lasts eight weeks; thus, a warehouse could conduct a maximum of 192 tests per campaign. Assuming that the average amount per delivery is 3 tons, a warehouse could test 576 tons of large scale deliveries per campaign. The average amount of beans supplied by cooperatives per warehouse in 1986 was approximately 150 tons with a range of 20 to 406 tons. The largest amount of sorghum purchased from cooperatives by a warehouse in 1986 was 345 tons at Kibungo, and from merchants it was 539 tons at Kicukiro.

Based on an average of three tons per delivery, it would be possible to test 100% of large deliveries during a buying campaign but the spacing of deliveries would have to be coordinated and a great deal of the manager's and/or foreman's time must be available for sampling and testing activities. In addition, the program would need to be regularly monitored at the warehouse level to ensure that the meters are calibrated correctly and that the sampling and testing procedures are being uniformly applied to all large-scale purchasers.

Performance Criteria 2: Fairly Applied Penalty System Poor Quality Grading systems for agricultural products usually involve a price penalty or a rejection policy to make it costly for suppliers to deliver low quality. With regard to large purchases, it may be difficult to change the present bidding system for government contracts so that a discount policy for poor quality can be installed. But a persuasive argument can be made that price differentials can and should recognize that distinctly different qualities of the same product ought not to receive an identical price and that the relatively high government-fixed price is meant to be the price set for premium quality grain (Kayinamura, 1986).

More empirical research needs to be conducted before an estimate of appropriate discounts can be made. There are two types of discount pricing systems which could be tested. A simple system would apply a standard discount to each of the three grades, e.g., a 5% discount for Grade No. 2 and a 10% discount for Grade No. 3 which are equivalent to a net price of 33.3 and 31.5 FRW/kg, respectively, for beans, given a base price of 35 FRW/kg.

A more complex system, and probably more equitable, would assign a discount to each type of defect evident in the sample. In this system, the seller is penalized only for the defects present. An example of a discount schedule for three quality factors which could be considered for use in Rwanda is provided in Table 61. The schedule is only a starting point, however, and experience will indicate appropriate modifications. Also, users will need flexibility to alter the size of the discount or premium as the market situation changes. Differences in supply or demand and seasonal differences in product quality may require changes in incentives in order to obtain the desired quantities and qualities of a particular product.

To determine the discounts with these schedules, the base price is multiplied by the discount factor corresponding to the level of each defect found. Each discount is subtracted from the base price to obtain the net purchase price per kilogram. The discount factors are expressed as FRW per FRW so as to function for any commodity regardless of base price. The discounts start at 13% moisture content, 1% damaged grain, and 1% foreign material which are in fact the maximum limits for Grade No. 1 as now proposed. Grain which grades No. 1 for these quality factors would thus receive the full price. Grain with 15% moisture, 2.4% damaged grain and 3.1% foreign matter would be discounted 8.05 FRW (35(.15 + .03 + .05)) given a base price of 35 FRW/kg.

The rationales used in preparation of these schedules warrant some explanation. For moisture, a weight adjustment for excess moisture has already been taken into account as explained previously (Section III and Table 8). The moisture discount described here is simply intended to cover costs of drying to the buyer or as an incentive to dry for the seller. Between 13 and 15% mc, the discount is 0.5% of the base price for each 0.5% of moisture. Above 15% mc, this increases to 1.0% and above 18% to 1.5% of the base price, reflecting the increased costs and risks of managing higher moisture grain.

For both damaged grain and foreign material, the discount is 1.0%. This accounts for both the weight of this undesirable material and for the costs of cleaning to the buyer or the incentive to clean for the seller. A discount which accounts solely for weight provides no economic incentive for upgrading or improving grain quality.

A problem with a discount price policy, as well as a rejection system, is that fraud and kickbacks can easily occur in a system in which prices depend on either laboratory test outcomes and/or simple subjective testing. The effectiveness of a pricing schedule or rejection policy will be influenced by the extent to which abuses occurred within the system.

Performance Criteria 3: Specifications Should Account for Current Market Practices and Perceptions The surveys of producers, cooperatives, and merchants who commercialize beans and sorghum show that rejection is the main method buyers use for controlling quality, though approximately one quarter of cooperative managers and merchants said that they also use discounts to penalize low quality lots. The two quality factors most often taken into account in transactions which result in rejection are foreign material and damaged grain, the two principal factors in the standards proposed by FSM II researchers. Age is the main factor for which a discount price is applied to a transaction.

Table 61
Example Discount Schedules for Several Quality Factors in Rwandan Beans and Sorghum

Moisture Content (%)	Discount Factor (FRW/FRW)	Damaged Grain (%)	Discount Factor (FRW/FRW)	Foreign Material (%)	Discount Factor (FRW/FRW)
13.1-13.5	0.000	1.1-1.5	0.01	1.1-1.5	0.01
13.6-14.0	0.005	1.6-2.0	0.02	1.6-2.0	0.02
14.1-14.5	0.010	2.1-2.5	0.03	2.1-2.5	0.03
14.6-15.0	0.015	2.6-3.0	0.04	2.6-3.0	0.04
15.1-15.5	0.025	3.1-3.5	0.05	3.1-3.5	0.05
15.6-16.0	0.035	3.6-4.0	0.06	3.6-4.0	0.06
16.1-16.5	0.045	4.1-4.5	0.07	4.1-4.5	0.07
16.6-17.0	0.055	4.6-5.0	0.08	4.6-5.0	0.08
17.1-17.5	0.065	over 5.0	(-.02+.02)(%DG)	over 5.0	(-.02+.02)(%FM)
17.6-18.0	0.075				
18.1-18.5	0.090				
18.6-19.0	0.105				
19.1-19.5	0.120				
19.6-20.0	0.135				
20.0	(-.465+0.03)(%MC)				

The cooperative and merchant surveys showed that the vast majority of respondents perceived a difference in quality when shown samples of beans (sorghum in the case of producers) which were representative of the level of defects in the proposed grades. The majority of producers interviewed distinguished between the two types of quality defects, foreign material and damaged grain, in sorghum samples.

Given these results, it seems likely that a specification buying policy installed by OPROVIA based on these tested quality factors would conform to current market practices and perceptions concerning quality. The main factor influencing how suppliers react to a new specification system will be the size of the premium associated with OPROVIA's selling price.

3. Which Transactions Should be Subject to Quality Testing and Standards?

Not all of OPROVIA's beans and sorghum transactions can be or need to be subjected to detailed quality testing and standards. The following recommendations are made concerning the most feasible way OPROVIA could apply this system to its operations.

Producer Purchases It was generally accepted that producer deliveries to OPROVIA warehouses are too numerous for sampling and testing according to the proposed grading procedures. Warehouse buying campaigns could, however, be made more orderly so that existing visual and sensory methods of inspection can be properly employed. For example, as is the case already at some warehouses, producer deliveries could be scheduled to take place only on days when there are nearby public markets (usually two days per week) and large-scale deliveries could be scheduled to take place only on non-market work days.

Additionally, buying campaigns could be extended. This would be particularly beneficial with regard to the bean buying campaign as producers are sometimes not able to dry beans properly when the rainy season following the January harvest is particularly rainy or humid. A longer buying campaign would provide warehouse managers with more time for sampling and testing for quality and would provide producers more time to dry beans before commercializing. The procedure would create some additional expense because of the temporary labor hired for rebagging and handling tasks in the warehouse during buying campaigns and increased insect damage resulting from the longer time between harvest and fumigation.

Use of tokens could decrease the crowds of producers at the warehouse sales line. For producers who come on a market day to sell but who are obviously not going to be served, a token would acknowledge their priority in selling on another market day. This alternative would decrease transaction costs for producers because they could use the time spent standing in line in other ways. Producer transport costs, however, would increase since they would have to return on another day.

Finally, visual materials such as posters or blister packs, samples of grain affixed to a poster with plastic, would provide warehouse personnel with a reference to show producers in cases of rejections. This would offer warehouse personnel a viable way of justifying the outcome of their analysis of grain presented by producers and the basis for their rejection decision. The

dissemination of posters to cooperatives and merchants would also improve supplier understanding of OPROVIA's quality policies.

Purchases for Security Stocks A quality standards system is of particular importance with regard to future purchases of stocks for the strategic reserve. The equipment and trained personnel located at OPROVIA's Kicukiro laboratory could be instrumental in establishing and conducting a system of quality control for large-scale deliveries made for security stocks, where the costs of stock losses, both in quantity and quality, could be very high. Initial quality of these stocks is important. Moisture content is very important because it is a determining factor in preventing mold development in grain and delaying the onset of hardness in beans. Damaged grain and foreign material also affect long-term storability and quality maintenance.

Purchases From Cooperatives and Merchants Certificates or forms which report the results of quality testing for large purchases would be one way to ensure the uniformity of quality testing at all OPROVIA buying points. In addition, the use of delivery schedules, already adopted by some warehouse managers, to improve the timing of deliveries would facilitate more complete sampling and testing.

The proposed quality standards, including the objective system of sampling and testing, could be adapted to OPROVIA warehouses. However, a pre-test of the proposed system at large- and small-sized warehouses should be made to determine the exact time commitment required of the warehouse manager and/or the warehouse foreman as well as the expected change in quality attributable to the new buying procedures. A plan for this pilot test is outlined in Appendix C.

4. Procedures to Implement a Standards System for OPROVIA

To implement quality standards for OPROVIA, the following activities are proposed:

- Use existing sampling techniques in conjunction with a rejection policy for producers, cooperatives, and merchant deliveries based on approximate levels of defects in the proposed grades.

- Assign Kicukiro laboratory technicians the task of using the proposed sampling and objective testing procedures for all future deliveries of beans and sorghum made to the strategic reserve. A system should be established whereby the technicians are informed in advance of delivery schedules. Test outcomes should be reported to both warehouse personnel as well as senior management. A strict rejection policy should be used in cases where grain does not meet the requirements for Grade No. 1.

- Revise the current manager handbook to include step-by-step sampling instructions.

- Develop and distribute a new form for warehouse managers to report test outcomes for all large deliveries. The form would accompany transaction data to the central administrative office and would be designed and monitored by laboratory personnel presently responsible for quality testing.

- Distribute a book to warehouse managers for recording total transactions and rejections according to type of seller--producer, cooperative, or merchant.

- Produce posters with color photos for warehouses to provide suppliers with exact information concerning expected quality.

- Conduct a training session with warehouse staff in sampling using traditional methods (as specified in the revised manual). This should take place prior to the next bean buying campaign and could involve either sending technicians to warehouses or holding meetings at the central offices in Kicukiro.

- Schedule producer deliveries only on market days and coordinate large-scale deliveries during buying campaigns.

- Introduce the use of tokens for improving the orderliness of buying. The tokens will be given out after the maximum number of producers which can be serviced have arrived. A token represents the right of the holder to sell OPROVIA the maximum quantity allowed on another market day.

- Train temporary baggers in recognizing rejectable lots according to the quality requirements associated with the rejection policy. These laborers could act as a back-up check to the warehouse inspector.

- Conduct a pilot test at two warehouses, large and small, to determine how the tasks of sampling and testing could be effectively distributed between the warehouse manager and foreman. This would include unexpected complications with the system and supplier response to the change in purchasing practices.

- Contact the national Brewery (BRALIRWA) to discuss the outcome of their new specification system.

- Test price differentials in conjunction with the objective testing of large-scale deliveries. Any pricing schedule adopted should be designed in accordance with market test outcomes. Reject lots which do not meet Grade No. 2 or better. Place in long-term storage, the Strategic Reserve, only those lots of beans and sorghum meeting standards for Grade No. 1 and having a moisture content less than 13%.

V. FUTURE RESEARCH NEEDS

A. Pilot Test of Proposed Quality Standard System

This section describes one way of testing the feasibility of using the proposed standards in both a large and small OPROVIA warehouse. The main research questions associated with this test are as follows: Is it possible to test 100% of the large-scale deliveries with the procedures associated with the proposed standards? What is the most feasible way of distributing the tasks of sampling and testing among warehouse personnel? To what degree can the quality of beans purchased be expected to improve? How much does the premium price OPROVIA offered (with regard to market prices) influence supplier responses to the new system?

Pilot Test Design. Two warehouses would be selected, one which buys a large amount of beans and one which buys a small amount. The laboratory quality testing staff at Kicukiro would prepare a first draft of a warehouse manager manual concerning all of the details and instructions for sampling and testing (in Kinyarwanda and French). The preparation of forms for reporting quality test results would also be the responsibility of the central laboratory technicians. After these two documents are completed, the two warehouse managers should be brought to the central laboratory for training prior to the beginning of the bean buying campaign.

The equipment to be issued at the warehouse is specified in Appendix C. A technician would travel to the two warehouses to calibrate the moisture meter and to aid in the installation of the system the first few days of the test.

The forms for reporting the quality test results would be forwarded to the Kicukiro laboratory which would monitor the results of the quality testing and respond to any problems encountered at the warehouse level. The technicians at the central laboratory would also be responsible for monitoring the stocks at the two warehouses to determine overall quality purchased before and after the implementation of the proposed grades. The warehouses should keep a record of the total number of large-scale transactions and the number of rejections made due to quality.

The warehouse managers should be given the flexibility to design and assign the tasks of testing and sampling in their operations. At the end of the buying campaign, administrators of the pilot test should interview the managers and foremen to find out how the system performed and what modifications were made and/or needed.

Following this test, the results would be analyzed to see whether the sampling and testing program was feasible given existing labor and time constraints. Optimally, a determination should be made of the savings due to improved quality and reduced losses so that this benefit can be compared to the costs of the program (equipment, training, and monitoring). The decision of whether to implement the program should depend on the availability for funding, the operating costs, and overall improvement in quality and other benefits revealed by the pilot test.

The system to be adopted should apply to all warehouses (except the security stocks). A specification system installed within only selected warehouses for a prolonged period could cause distortions in the marketing system whereby sellers would benefit from hauling low quality to specific points where testing was known to be less intensive.

Price differentials also need to be uniformly applied if they are chosen as the preferred means for rewarding quality. The success of price differentials would depend to a large extent on the effectiveness of the program monitoring system.

B. Evaluation of Demand for Quality Standards by OPROVIA's Clientele (Retail Sales)

This section describes an experiment for determining the existing demand for retail grades for beans among OPROVIA's retail customers. The experiment was not undertaken in conjunction with this feasibility study due to difficulties associated with OPROVIA's mandate to offer official prices for the beans and sorghum it purchased in 1986. It is, however, an effective way to determine retail demand for grades and may be useful in those circumstances where OPROVIA would like to differentiate price according to quality.

There are several research questions associated with the experiment. Is there a demand for different grades of beans and sorghum at the retail level in Rwanda? Does this demand differ between OPROVIA outlets? What are the premiums consumers are willing to pay for high quality and discounts they consider necessary to undertake the labor intensive activity of cleaning and sorting beans themselves?

Survey Design. Three different qualities of beans which reflect the grades tentatively established by Project researchers would be placed on sale in four OPROVIA retail outlets. The price difference between the different grades would be 5% different at two of the retail outlets and 10% different in the other two outlets. The sales of the three types of quality would be recorded by OPROVIA managers and assessed by analysts throughout the duration of the survey.

Survey Implementation. A proposal requesting permission and technical support for conducing a consumer test in OPROVIA retail outlets would be made to OPROVIA management. It should be made clear in the request that it is necessary for OPROVIA to sell beans at market prices rather than official prices in order to obtain meaningful results from this experiment.

Six tons of beans (1.5 tons per outlet) would be requested of OPROVIA to be used in the survey. The beans would be transferred from OPROVIA warehouses to the OPROVIA laboratory to be grouped according to three types: "Premium Quality", "Average Quality", and "Unsorted". Once separated into categories, the beans will then be divided into 1 kg clear plastic bags.

Managers at the five retail outlets would be advised of the details of the survey and informed of the reporting and management requirements. The bags would be displayed with signs describing the quality and price differences.

The managers would keep records of the dates and the quantities of each quality type purchased. Purchase records would be monitored weekly at all four outlets. The managers would be instructed to discontinue the experiment if the stocks of any one of the three types of quality beans are depleted. A survey of market prices for beans would be made weekly to ensure that the price for the average quality is competitive in that area.

Over the course of several months, the results of the sales would be analyzed. The relative demand for different grades of beans and the appropriate price differentials between grades would then be assessed.

C. Feasibility Study of a National System of Quality Standards

At what point in the future could Rwandan bean and sorghum markets be expected to benefit from a government-sponsored system of quality standards? First, it is necessary to assess nationwide the conditions which would warrant government involvement in grain quality standards and compare the present grain trading practices in Rwanda to those conditions.

In developed countries, national standards systems, whereby the government installs and administers grades for grains, evolved as a response to the presence of too many different specification systems for quality in a single grain market. One of the functions of government was to undertake the task of establishing standard criteria and to distribute the cost of the uniform standards to all traders who used them. National grading systems provide inspectors who test and grade grain before a purchase takes place for a fee, usually paid by the seller of a lot of grain. This reduces fraud in large transactions and reduces the cost to buyers of inspecting lots themselves.

In the U.S., a balance has been found between mandatory grading, where government requires that every transacted lot be officially graded, and a voluntary program, where government establishes a uniform system of standards as a service to those involved in the grain market. In this system, the government provides and administers the uniform standards and assesses users for the cost of the program. There is mandatory grading for grain that is exported from the U.S. but for the most part, traders voluntarily have grain graded and pass the associated costs to their buyers who then pass the cost to processors and/or consumers. What features of the Rwandan marketing system for beans and sorghum support installing a similar system of national quality standards, now or in the future? Perhaps the most important impediment is that the majority of grain transactions in Rwanda involves small lots, produced by numerous small-scale farmers. Formal inspection and grading may not be useful or feasible in this type of trading.

Second, with regard to large-scale transactions, not enough is known about traders to determine if a voluntary system of grades would be accepted. For example, how many traders are in the market and what is the size distribution of their operations? What transport facilities and patterns are evident among long-distance and large-scale traders? Where would inspectors be stationed? Thus, additional study of Rwandan markets is needed to answer many of the questions regarding the feasibility of implementing bean and sorghum quality standards.

D. Development and Verification of Quality Standards for Other Grains and Food Products

In the future, OPROVIA will likely receive and handle a range of diverse food products such as rice, wheat, peas, and flour. Precise and objective quality standards and specifications will no doubt prove necessary for those products destined for processing (e.g., wheat for flour, maize for oil and flour) for which product uniformity is of paramount importance.

The task of developing and verifying these standards could well be assigned to the personnel of the Project's Food Quality Laboratory. Quality tests conducted on these products, both at time of reception as well as for monitoring purposes during the entire storage period, could also assist OPROVIA to maintain the quality of its stored products and to account more precisely for losses due to storage.

VI. RECOMMENDATIONS

1. After further testing and refinement during 1987, an improved system of grain quality standards and testing procedures should be implemented at OPROVIA for large grain purchases, and especially beans going into long-term storage (e.g., security stocks). The need for grain of high initial quality is greatest for these long-term stocks, because the potential for storage problems is highest. This system could substantially increase knowledge of the kind and range of quality received, and provide improved information for making important management decisions such as segregation of stocks according to storability, scheduling of stock rotations, and the timing as well as types of insecticide treatments. It would, of course, be the initial link in an effective quality monitoring program operating throughout the storage period. Furthermore, this system would serve as a precursor for the eventual creation of an official government-sponsored grain inspection system. In short, OPROVIA would be the testing ground for a quality system which could gradually evolve into one of national stature.

2. A rapid (5 minute) but more objective and precise quality testing procedure for small producer lots received by OPROVIA should be developed and tested. The small size and large number of producer lots received by OPROVIA make highly objective, time-consuming inspection and testing procedures difficult if not impossible.

3. For grain cooperatives and merchants, practical methods for more objective testing of quality should be investigated to improve storability of grain received and to reduce losses during storage. OPROVIA can assist in this effort because the methods used would likely be similar to those developed by OPROVIA to handle the large number of small lots it receives from producers. At the same time, OPROVIA would be helping these groups to effectively and economically meet new standards if implemented by the government through OPROVIA or otherwise. The ultimate benefit for all parties may be improved commercial relationships.

4. In combination with the installation of improved quality testing procedures, OPROVIA should institute with government approval a pricing system based on quality. In view of the current market situation and high government-fixed producer prices, the "fixed" price ought to be considered the price for premium quality grain, with discounts (penalties) imposed on grain whose quality is below a specified level. The discount schedule presented in this report, based on each quality factor and not on overall grade, should be a useful starting point. Initially, discounts should be based on amounts of damaged grain and foreign material for both beans and sorghum. Moisture content (mc) should be measured in both crops but weight adjustments as well as price discounts for excess moisture (13% mc basis) should be applied initially only to beans.

5. Coupled with price differentials, OPROVIA should institute a more severe rejection policy, which should be strictly respected and uniformly applied. Only grain which grades No. 1 or No. 2 should be considered acceptable under normal circumstances. Grain grading No. 3 or Substandard would therefore be rejected. However, flexibility should be maintained since conditions of refusal or acceptability are subject to change as a function of market conditions. Differences in supply or demand and seasonal

differences in product quality may require these changes in order to obtain the desired quantities and qualities of a particular product.

6. A study should be conducted to evaluate consumer demand for quality designations (grades) of beans at the retail level. This should involve actual sale to consumers of beans priced at different levels according to quality, and could be carried out at several OPROVIA outlets over a period of several months. The relative demand for different grades and appropriate price differentials between grades would then be assessed.

7. In the future, based on OPROVIA's experience, the Government of Rwanda should consider establishing an official system of grain quality standards and testing procedures for beans and sorghum. This would be the logical outcome of a gradual, evolutionary process. The grade designations selected should be the sole ones legally and officially recognized in Rwanda, and no grain should be in any way considered or labelled a particular grade without an officially approved inspection. This will discourage the development of separate grades by private traders and others.

   The GOR should consider a mandatory system for all international transactions (imports and exports) and all government purchases (OPROVIA, military camps, prisons, public schools, etc). The system should have a strong service orientation and be fee-based (revenue generating). The purpose would not be to regulate every single transaction but to provide services to those operating in the market with respect to describing and communicating about product quality.

8. Given the importance of the growing agro-processing industry, as experience is gained and success achieved, quality standards and procedures should be developed and tested for other grain crops, giving priority to those for which marketing and processing are important (e.g., wheat, maize, rice).

9. The goal of all these activities should be to improve overall quality of the grain OPROVIA buys and sells, to enhance storability of grain purchased and to reduce storage losses at all levels in the food supply system. For OPROVIA, these efforts should help improve its reputation as a supplier of high quality food products, establish its place as a national leader and advocate for quality in the Rwandan marketplace, and increase demand for its products and services and hence its revenues. It is expected that these efforts will produce similar benefits throughout the food marketing system.

REFERENCES CITED

Foster, George H. 1982. "Drying Cereal Grains", Storage of Cereal Grains and Their Products. pp. 79 - 116. Edited by Clyde Christensen. American Association of Cereal Chemists, St. Paul, MN.

Government of Rwanda. 1985. "Fourniture de Différents Produits Designés à l'Entretien des Services Publiques durant l'Année, 1986", Document II 167/Bud 07.09/MD 471, MINEFINECO.

Government of Rwanda. 1986. "Compte-rendu de la Réunion de la Commission des Prix", Ministry of Agriculture. OPROVIA Internal Document #108/09.30/04/86. Transmission CRR 10-9.

Hill, Lowell D. 1985. "Principles for Use in Evaluating Present and Future Grain Grades", University of Illinois Agricultural Economics Paper No. 85 E-329.

Kayinamura, Phocas. 1986. Rapport de Mission aux Etats-Unis d'Amérique. Projet GRENARWA II-Recherches, Kigali, Rwanda.

Loveridge, Scott. 1987. "Relationships Between Production, Farmer Perceptions, and Marketing In Five Prefectures", Agricultural Survey and Analysis Project and Michigan State University, Working Paper Series, forthcoming.

MINAGRI. 1986. "Résultats de l'Enquête Nationale Agricole 1984." Service des Enquêtes et Statistiques Agricoles, Ministère de l'Agriculture, Gouvernement du Rwanda, Rapport 1, Volume 1.

Projet GRENARWA II-Recherches. 1986. Inventaire des Variétés de Haricots Cultivées au Rwanda (Inventory of Bean Varieties Grown in Rwanda). Rapport technique final. OPROVIA/MINAGRI, Kigali, République Rwandaise.

Projet GRENARWA II-Recherches. 1987a. Enquête sur les Conditions et les Méthodes de Stockage des Grains au Rwanda (Survey of Conditions and Methodes of Grain Storage in Rwanda). Rapport technique final. OPROVIA/MINAGRI, Kigali, République Rwandaise.

Projet GRENARWA II-Recherches. 1987b. Etude sur les Qualités Sensorielles et l'Aptitude des Haricots à la Cuisson (Study of the Sensory Qualities and Cookability of Beans). Rapport technique final. OPROVIA/MINAGRI, Kigali, République Rwandaise.

Steinke, Kenneth and Harry B. Pfost. 1978. "Development of Grain Standards In Developing Countries," Food and Feed Grain Institute Research Report #12, Manhattan, KS.

OTHER REFERENCES

Agriculture Canada. "Guide Officiel d'Agréage des Grains", Commission Canadienne des Grains, 1985.

Food and Agriculture Organization. "Post-Harvest Losses in Quality of Food Grains." FAO Food and Nutrition Paper No. 29, United Nations, 1984.

Gittinger, J. Price, Economic Analysis of Agricultural Projects. Baltimore, MD., Johns Hopkins University Press, 1982.

Government of Rwanda. "Cahier Spécial des Charges", Document #I/3177/Bud.07.09/MP.416. 1985.

Kansas State University. "Grain Sorghum Kernel Damage", Agricultural Extension Service Pamphlet, Kansas State University, Manhattan, Kansas, 1969.

Kayinamura, Phocas. "Présentation sur les grades et standards du haricot et du sorgho au Rwanda." Conférence organisée par l'Universite de Minnesota, 1986.

MINAGRI (Ministry of Agriculture). "Rapport général préparé pour le stage-réunion des gérants d'entrepôts et succursales de commercialisation", OPROVIA Internal Document. 16-18, janvier, 1986.

MINAGRI (Ministry of Agriculture). "Projet GRENARWA II-Recherche Volet: Elaboration d'un systeme de standards et normes de qualité", OPROVIA Internal Document #030/09.30/04/86. 1986.

Morey, R. Vance. "Trip Report: Alternative Management and Quality Standards Components", LCS/FSMII USAID-University of Minnesota Project, 1986.

Morey, Vance and Harold Cloud, "Ideas For a Discount System with the Bean Grades (developed for OPROVIA's operations)", USAID-University of Minnesota-Government of Rwanda, Local Crop Storage Cooperative Research, Draft Report, 1986.

Nichols, John P., Lowell D. Hill, and Kenneth E. Nelson, "Food and Agricultural Commodity Grading", In Federal Marketing Programs in Agriculture: Issues and Options, edited by Walter J. Armbruster and others. Danville, IL, The Interstate Printers and Publishers, Inc., 1983.

Parker. P.E., G.R. Bauwin, and H.L. Ryan. "Sampling, Inspection, and Grading of Grain", in Storage of Cereal Grains and Their Products Third edition, C.M. Christensen, ed., American Association of Cereal Chemists, St. Paul, MN, 1982.

Rhodes, James V. The Agricultural Marketing System. Columbus, OH, Grid Publishing Co., 1983.

United States Government. "Official United States Standards For Grain", Department of Agriculture. Federal Grain Inspection Service. 1984.

_____"The United States Standards For Beans", Department of Agriculture. Federal Grain Inspection Service. 1982.

_____"Grain Inspection Handbook, Book 1", Department of Agriculture. Federal Grain Inspection Service. 1983.

_____"Grain Inspection Handbook, Book 2", Department of Agriculture. Federal Grain Inspection Service. 1980.

_____"Grain Inspection Handbook, Book 3", Department of Agriculture. Federal Grain Inspection Service. 1980.

_____"Grain Inspection Handbook, Book 4", Department of Agriculture. Federal Grain Inspection Service. 1984.

_____"Equipment Handbook," Department of Agriculture. Federal Grain Inspection Service. 1984.

_____"Inspection Handbook: Miscellaneous Processed Commodities, HB-2", Department of Agriculture. Federal Grain Inspection Service. 1975.

_____"Grain Grading Primer", Department of Agriculture. Publication #740, 1957.

_____"Inspection Handbook: Dry Beans", Department of Agriculture, Federal Grain Inspection Service. 1971.

_____"The U.S. Grain Standards Act. (as amended)", Department of Agriculture. Federal Grain Inspection Service. 1985.

_____"Agricultural Marketing Act of 1946", Department of Agriculture. Consumer and Marketing Service. 1969.

_____"Historical Compilation of Changes in the Grain Standards of the United States", Department of Agriculture, Federal Grain Inspection Service. 1986.

Waldstein, A., "Overview of Crop Storage and Marketing Activity in Rwanda", Small Farmer Marketing Access Project, USAID, 1983.

APPENDICES

APPENDIX A
PROPOSED RWANDAN STANDARDS FOR BEANS
(Version II - August, 1986)

DEFINITION OF TERMS

1.010 Beans

Dry, threshed, whole or broken, seeds of the grain legume Phaseolus vulgaris (L.) ("ibishyimbo" in Kinyarwanda) commonly grown and used for human food purposes.

1.020 Classes

Different categories of beans which are distinguished by different seed characteristics such as color, color pattern, shape, and size. A class can comprise several different varieties if their seed characteristics are similar. A class may be designated by the name of the grain type or variety but this does not signify nor imply varietal purity.

Because beans in Rwanda are generally offered in commerce as a mixture of varieties, the only class recognized under current Rwandan standards is the class named "mixed beans." Under the present rules, any beans which are presented as a single pure variety or grain type will be subject to the same standards and grading system established for the class "mixed beans."

1.021 Mixed Beans

The class which consists of any mixture of different varieties or grain types of beans. A mixture may be designated by the variety or grain type which constitutes 20% or more of the mixture on the basis of seed number.

1.030 Grades

A set of quality classifications and standards as described and provided for in section 1.200.

1.031 Representative Sample

A specified quantity of beans (minimum 1500 grams) drawn from a lot of beans by official inspection personnel using approved procedures and sampling objectives.

1.032 Representative Portion

Any specified quantity of beans obtained or removed from the representative sample by means of an approved dividing device.

1.033 Work Sample

A representative portion (900 to 1100 grams) of sufficient size to allow all determinations required for beans to be performed.

1.034 Dividing Device

Equipment for reducing the size for a sample while maintaining its representativeness. The Boerner Divider and the Riffle Type Divider are considered acceptable dividing devices when used according to established procedures.

1.035 Sieving Device

An 8 x 3/4 oblong hole metal sieve which is 0.032 inches (0.81mm) thick with perforations which are 8/64 inches (3.175mm) in width and 3/4 inches (19.05mm) in length.

1.040 Foreign Material

All matter including whole and broken beans which pass through the approved sieving device and all matter other than beans which are removed by hand-picking a representative portion of the sample. Foreign material includes grain or seeds other than beans, stones, dirt, insects and insect fragments and refuse (frass, webbing, etc.), rodent pellets, and plant materials (including bean pods, stems, and other chaff).

1.041 Whole Bean

A bean seed with less than one quarter of its normal mass removed.

1.042 Broken Bean

A bean seed with more than one quarter of its normal mass removed, and a bean the halves of which are held together loosely (split).

1.043 Stones

Mineral or concreted earthy matter, and other substances of similar hardness, that do not disintegrate readily in water.

1.050 Damaged Beans

Whole or broken beans that do not pass through the appropriate sieving device, which have been visibly injured or whose quality has been materially affected by insect attack, rodent feeding, mold growth, sprouting (germination), or abnormal maturation (shriveled, shrunken beans).

1.059 Defects

The sum of damaged beans, undamaged broken beans, and foreign material.

1.060 Moisture Content

The amount of water in the beans, expressed as a percentage on a wet weight basis, as determined by a Motomco moisture meter according to officially prescribed procedures or by any other officially approved device and method which gives equivalent results. Moisture content is not a grade factor in these standards but could be used in calculating the weight basis for determination of purchase price. Beans shall be purchased on basis of 13% moisture content.

PRINCIPLES GOVERNING APPLICATION OF STANDARDS

1.100 A systematic procedure using officially approved equipment shall be followed in the sampling and grading of beans. The procedure and required equipment are described in later sections of these standards. The basis of determinations are explained in the following sections (1.110 to 1.190).

1.110 All determinations, except insects, shall be made on the basis of weight and expressed to the nearest tenth of a percent by weight. Percentages shall be calculated by dividing the weight of the material removed by the weight of the sample portion used and multiplying by 100. Insects shall be determined on the basis of numbers per weight of beans as specified in section 1.140.

1.120 Odor shall be determined on the basis of the lot as a whole and/or the representative sample before sieving and removal of foreign material. Odors may be detected at the time of sampling and, when detected, shall be shown on the sampling form or ticket. The final determination, however, shall be made in the laboratory. Odors due to insecticides (natural or synthetic) shall not be considered objectionable if they are types that dissipate quickly, that is, if the odor disappears within four hours after the sample is allowed to air out in an open container.

1.130 Moisture content shall be determined on a representative portion of exactly 250 grams obtained from the work sample before sieving and removal of foreign material. Moisture content shall be based on the mean of three separate measurements (readings) using a Motomco moisture meter, and then converted to moisture content with an adjustment for temperature using the officially approved conversion chart.

1.140 Insect numbers shall be determined from the material of the work sample which passes through the approved sieving device and are the sum of all live and dead insects of any development stage whose bodies are essentially intact (eg: an insect wing or leg or antenna alone would not be sufficient to count as an insect; an insect missing a wing or leg or antenna would be sufficient to count as one). The number of insects found shall be converted to, and expressed as, the number per kilogram of beans.

1.150 Foreign material shall be determined in part (a) by sieving the work sample with a 8/64 x 3/4 inch (3.175 mm x 19.05 mm) oblong hole sieve, and in part (b) by handpicking a representative portion of 300 grams of sample. Total foreign material is calculated as the sum of the percentages by weight of material removed from both the sieving and handpicking operations.

1.160 Stones shall be determined by handpicking a representative portion of 300 grams of sample as part of the procedures for determining foreign material described in section 1.150.

1.170 Damaged beans shall be determined by handpicking the same representative portion of 300 grams of sample used in the determination of foreign material. Beans damaged by insects and molds shall be grouped together and weighed separately from beans damaged by other causes.

1.180 Undamaged broken beans shall be determined by handpicking the same representative portion of 300 grams of sample used in the determination of foreign material.

1.190 (reserved)

1.200 Grades and Grade Requirements for the Class Mixed Beans (See Table 13 for March, 1987 revised version.)

Grade	Maximum limits (by percent weight) of: Damaged Beans		Foreign Material		Undamaged Broken Beans	Total Defects*
	Insect & Mold	Total (D)	Stones	Total (FM)	(B)	(D+FM+B)
GOR No. 1	0.5	1.0	0.3	1.0	0.5	2.0
GOR No. 2	1.0	2.0	0.4	2.0	1.0	4.0
GOR No. 3	5.0	10.0	0.5	3.0	1.5	12.0

Substandard grade: The Substandard grade shall be beans which:

(a) Do not meet the requirements for the Grades GOR Nos. 1, 2, or 3.
(b) Have a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.
(c) Have more than 50 insects (live plus dead) per kilogram.

*NOTE: The standard for total defects is less than the sum of the foreign material, damaged grains, and broken beans. Therefore, samples which are approaching the maximum limits of all three quality factors for a given grade will not meet the requirements for that grade.

PROCEDURES FOR GRADING BEANS (sequentially)

1.300 A representative sample of at least 1500 grams of beans is taken by an approved sampler from the lot of beans submitted for official inspection. A sampling ticket (form) is completed, signed, and dated by the sampler.

1.301 The representative sample is examined for odor.

1.302 A work sample is obtained by reducing the representative sample in size, if necessary, to an amount between 900 and 1100 grams using an approved dividing device.

1.303 A representative portion of the work sample weighing exactly 250 grams is measured for moisture content using a Motomco moisture meter. Three separate readings are made on the same sample, with the test cell being emptied and

refilled for each reading. The mean of the three readings is converted to percent moisture content using the official conversion chart, with an adjustment made for temperature according to the instructions on the chart.

1.304 The work sample is shaken 30 times with a steady, uniform side-to-side motion on an 8/164 x 3/4 inch (3.175mm x 19.05mm) oblong metal sieve.

1.305 All insects of all stages of development, live and dead, which pass through the sieve, are removed and counted. Based on the weight of the work sample, the number obtained is converted to the number of insects per kilogram.

1.306 All material (except the insects counted above), which passes through the sieve, is weighed. This includes beans, whether broken or whole and whether damaged or not. This weight divided by the weight of the work sample sieved is multiplied by 100 to calculate the percent of foreign material found through sieving. This figure will be added to the percent of stones and other foreign material found through handpicking 300 grams of sample (see section 1.307) to determine the percent by weight of total foreign material.

1.307 A representative portion of the work sample weighing 300 grams is handpicked to remove insect and mold damaged beans, other damaged beans, undamaged broken beans, stones, and other foreign material. The weight of each of these components is divided by 300 grams and multiplied by 100 to determine their respective percentages by weight. The percent by weight of both stones and other foreign material is added to the percent of foreign material in section 1.306 to determine the percent by weight of total foreign material.

1.308 Total defects are then calculated as the sum of total damaged beans, undamaged broken beans, and total foreign material.

1.309 A grade is assigned to the sample. The grading certificate is completed, signed, and dated by the grading official.

EQUIPMENT APPROVED FOR GRADING BEANS (See Appendix C.)

APPENDIX B
PROPOSED RWANDAN STANDARDS FOR SORGHUM
(Version I - June, 1986)

DEFINITION OF TERMS

2.010 Sorghum

Dry, threshed, whole or broken, kernels of the cereal grain Sorghum bicolor (L.) Moench ("amasaka" in Kinyarwanda) commonly grown and used for human food purposes.

2.020 Classes

Different categories of sorghum which are distinguished by different kernel characteristics such as color, shape, and size. A class can comprise several different varieties if their kernel characteristics are similar. A class may be designated by the name of a grain type or variety, but this does not signify nor imply varietal purity.

Because sorghum in Rwanda is generally offered in commerce as a mixture of varieties, the only class recognized under current Rwandan standards is the class named "mixed sorghum." Under the present rules, any sorghum which is presented as a single pure variety or grain type will be subject to the same standards and grading system established for the class "mixed sorghum."

2.021 Mixed Sorghum

The class which consists of any mixture of different varieties or grain types of sorghum. A mixture may be designated by the variety or grain type which constitutes 80% or more of the mixture on the basis of seed number.

2.030 Grades

A set of quality classifications and standards as described and provided for in section 2.200.

2.031 Representative Sample

A specified quantity of sorghum (minimum 1500 grams) drawn from a lot of sorghum by official inspection personnel using approved procedures and sampling devices.

2.032 Representative Portion

Any specified quantity of sorghum obtained or removed from the representative sample by means of an approved dividing device.

2.033 Work Sample

A representative portion (900 to 1100 grams) of sufficient size to allow all determinations required for sorghum to be performed.

2.034 Dividing Device

Equipment for reducing the size of sample while maintaining its representativeness. The Boerner Divider and the Riffle Type Divider are considered acceptable dividing devices when used according to established procedures.

2.035 Sieving Device

A 5/64 triangular-hole metal sieve which is 0.032 inches (0.81mm) thick with equilateral triangular-shaped perforations the inscribed circles of which are 0.0781 inches (1.98mm) in diameter.

2.040 Foreign Material

All matter including whole kernels and broken kernels (pieces of kernels) which pass through the approved sieving device and all matter other than whole kernels of sorghum which are removed by hand-picking a representative portion of the sample. Foreign material includes seeds other than sorghum, stones, dirt, insects and insect fragments and refuse (frass, webbing, etc.), rodent pellets, smut sori, and plant materials (including sorghum glumes, rachis, and other chaff).

2.041 Whole Kernel

A sorghum grain (seed) with less than one quarter of its normal mass removed.

2.042 Broken Kernel

A sorghum grain (seed) with more than one quarter of its normal mass removed.

2.043 Stones

Mineral or concreted earthy matter, and other substances of similar hardness, that do not disintegrate readily in water.

2.044 Smut Sori

Compact spore masses (galls) which are covered by a light brown or gray membrane and resemble elongated sorghum kernels. Sori (sing. sorus) are produced by a seedborne disease called covered kernel smut caused by the fungus Sporisorium sorghi (syn. Sphacelotheca sorghi).

2.050 Damaged Kernels

Whole or broken kernels that do not pass through the appropriate sieving device, which have been visibly injured or whose quality has been materially affected by insect or rodent feeding, mold development, or sprouting.

2.060 Moisture Content

The amount of water in the sorghum, expressed as a percentage on a wet weight basis, as determined by a Motomco moisture meter according to officially prescribed procedures or by any other officially approved device and method which gives equivalent results. Moisture content is not a grade factor in these standards but could be used in calculating the weight basis for determination of purchase price. Sorghum shall be purchased on a basis of 13% moisture content.

PRINCIPLES GOVERNING APPLICATION OF STANDARDS

2.100 A systematic procedure using officially approved equipment shall be followed in the sampling and grading of sorghum. The procedure and required equipment are described in later sections of these standards. The bases of determinations are explained in the following sections (2.110 to 2.190).

2.110 All determinations, except insects and smut sori, shall be made on the basis of weight and be expressed to the nearest tenth of a percent by weight. Percentages shall be calculated by dividing the weight of the material removed by the weight of the sample portion used and multiplying by 100. Insects and smut sori shall be determined on the basis of numbers per weight of sorghum as specified in section 2.140 and 2.170.

2.120 Odor shall be determined on the basis of the lot as a whole and/or the representative sample before sieving and removal of foreign material. Odors may be detected at the time of sampling and, when detected, shall be shown on the sampling form or ticket. The final determination, however, shall be made in the laboratory. Odors due to insecticides (natural or synthetic) shall not be considered objectionable if they are types that dissipate quickly, that is, if the odor disappears within four hours after the sample is allowed to air out in an open container.

2.130 Moisture content shall be determined on a representative portion of exactly 250 grams obtained from the work sample before sieving and removal of foreign material. Moisture content shall be based on the mean of three separate measurements (readings) using a Motomco moisture meter, and then converted to moisture content with an adjustment for temperature using the officially approved conversion chart.

2.140 Insect numbers shall be determined from the material of the work sample which passes thorough the approved sieving device and are the sum of all live and dead insects of any development stage whose bodies are essentially intact (eg: an insect wing or leg or antenna alone would not be sufficient to count as an insect; an insect missing a wing or leg or antenna would be sufficient to count as one). The number of insects found shall be converted to, and expressed as, the number per kilogram of sorghum.

2.150 Foreign material shall be determined in part(a) by sieving the work sample with 5/64 inch (1.98 mm) triangular-hole sieve, and in part (b) by handpicking a representative portion of 30 grams of sample. Total foreign material is calculated as the sum of the percentages by weight of material removed from both the sieving and handpicking operations.

2.160 Stones shall be determined by handpicking a representative portion of 30 grams of sample as part of the procedures for determining foreign material described in section 2.150.

2.170 Smut sori numbers shall be determined by handpicking a representative portion of 30 grams of sample as part of the procedures for determining foreign material described in section 2.150. Smut sori shall be expressed as the number per 30 grams.

2.180 Damaged kernels shall be determined from the same representative portion of 30 grams of sample used in the determination of foreign material.

2.190 (reserved)

2.200 Grades and Grade Requirements for the Class Mixed Sorghum (See Table 14 for March, 1987 revised version.)

	Maximum limits (by percent weight) of:		
		Foreign Material	
Grade	Damaged Kernels	Stones	Total
GOR No. 1	1.0	0.5	1.0
GOR No. 2	3.0	1.0	2.0
GOR No. 3	5.0	2.0	4.0

Substandard grade: The Substandard grade shall be sorghum which:

(a) Does not meet the requirements for the Grades GOR Nos. 1, 2, or 3.
(b) Has a musty, moldy, sour, rancid, fermenting, or otherwise objectionable odor.
(c) Has more than 50 insects (live plus dead) per kilogram.
(d) Has more than 10 smut sori per 30 grams.

PROCEDURES FOR GRADING SORGHUM (sequentially)

2.301 A representative sample of at least 1000 grams of sorghum is taken by an approved sampler from the lot of sorghum submitted for official inspection. A sampling ticket (form) is completed, signed, and dated by the sampler.

2.302 The representative sample is examined for odor.

2.303 A work sample is obtained by reducing the representative sample in size, if necessary, to an amount between 900 and 1100 grams using an approved dividing device.

2.304 A representative portion of the work sample weighing exactly 250 grams is measured for moisture content using a Motomco moisture meter. Three separate readings are made on the same sample, with the test cell being emptied and refilled for each reading. The mean of the three readings is converted to percent moisture content using the official conversion chart, with an adjustment made for temperature according to the instructions on the chart.

2.305 The work sample is shaken 30 times with a steady, uniform side-to-side motion on a 5/64 (1.98mm) triangular-hole metal sieve.

2.306 All insects of all stages of development, live and dead, which pass through the sieve, are removed and counted. Based on the weight of the work sample, the number obtained is converted to the number of insects per kilogram.

2.307 All material (except the insects counted above), which passes through the sieve, is weighed. This includes kernels of sorghum, whether broken or whole and whether damaged or not. This weight divided by the weight of the work sample sieved is multiplied by 100 to calculate the percent of foreign material found through sieving. This figure will be added to the percent of stones and other foreign material found through handpicking 30 grams of sample (see section 2.308) to determine the percent by weight of total foreign material.

2.308 A representative portion of the work sample weighing 30 grams is handpicked to remove damaged kernels, stones, and other foreign material. The weight of each of these components is divided by 30 grams and multiplied by 100 to determine their respective percentages by weight. The percent by weight of both stones and other foreign material is added to the percent of foreign material found in Section 2.307 to determine the percent by weight of total foreign material. The number of smut sori found in the foreign material of this sample is counted and recorded.

2.309 The grading certificate is completed, signed, and dated by the grading official.

EQUIPMENT APPROVED FOR GRADING SORGHUM (See Appendix C.)

APPENDIX C

EQUIPMENT REQUIRED FOR PROPOSED SAMPLING AND GRADING OF RWANDAN BEANS AND SORGHUM

Qty. Per Testing Site	Total Price ($ U.S.)	Item	Description/Specifications
1	350	Moisture tester	Dickey John, Model DJGMT (for corn) portable, battery operated, with conversion charts for dry edible beans (Phaseolus vulgaris) and sorghum
1	180	Grain probe	Aluminum, open handle (non-partition), 8 openings, 130 cm long, smooth point
1	30	Grain probe	Nickel plated steel bag trier, 30 cm long, 2.6 cm outside diameter at large end
1	110	Scale	Triple beam balance, metric (grams), capacity of 610 grams plus weight set to increase capacity to 2610 grams, sensitivity of 0.01 grams, plus poly scoop and counter weight
1	30	Sieve	8/64" x 3/4" slotted holes (for beans) with solid bottom pan (commercial not precision grade)
1	35	Sieve	8/64" triangular holes (5/64" inscribed circle) for sorghum with solid bottom pan (commercial not precision grade)
3	15	Grain (sample) pan	Triangular, plastic, static proof, white, 10" x 10" x 2.5"
4	15	Analytical dish	Aluminum, straight edge and flat bottom, 2.5" diameter, 5/8" deep
1	35	Hand magnifying lens	Plastic, 10 power
2	10	Forceps	Nickel plated, approx. 5" long; one with blunt point for larger seeds and one with medium sharp point for smaller seeds and insects

Qty. Per Testing Site	Total Price ($U.S.)	Item	Description/Specifications
500	50	Sample bags	Plastic whirlpack bag, 42 ounce capacity
1	10	Pocket calculator	Solar powered, memory but no sophisticated functions
1	20	Work surface	Large tray or board (tan or buff color)
-	100	Misc. equipment	Bench brush, dust cloth, dust masks, lab coat, grading forms, several plastic buckets

Total = $990 FOB USA (does not include shipping charges or import duties)

NOTES:

This list assumes that a table and chair are provided as well as good natural lighting (but not electricity).

Because of its specialized nature, most of this equipment must be imported from Europe or the USA. For these items, air freight and handling charges would probably add $250 (25%) to the cost of the equipment. Some items can be found or made locally (e.g. forceps, work surface, misc. equipment). It is assumed that sufficient space, such as a relatively small area of an existing office, as well as a table (0.80m x 1.10m minimally) with a chair are available. The equipment listed is not dependent on electricity but quality testing does require adequate natural lighting if there are no electric lights. Battery-powered lamps are an option for supplemental lighting during overcast or darker periods.

APPENDIX D

SURVEY QUESTIONNAIRES

D.1 PRODUCER SURVEY - OPROVIA/GRENARWA II

(Research Component: Quality Standards for Beans and Sorghum)

IDENTIFICATION

1. Sex
   1._____M
   2._____F

2. Where do you live? (If you do not know where this is, ask "How many hours did you walk to get here today?")
   1._____< 1 km
   2._____1 to 5 km
   3._____5 to 10 km
   4._____> 10 km (specify)

3. Of all the sorghum that you produced this year, what quantity are you selling for cash?
   1._____Most of it(> 50%)
   2._____Half (50%)
   3._____Less than half (< 50%)

QUESTIONNAIRE - SORGHUM

4. Is this the first time you've sold something to OPROVIA?
   1._____Yes (if "Yes", go to question 5)
   2._____No

   IF NO:

   4a. Has OPROVIA ever refused your sorghum?
      1._____Yes
      2._____No (If "No", go to question 5)

   IF YES:

   4b. Why did OPROVIA refuse your sorghum?
      1._____Too many insects
      2._____Too many damaged grains
      3._____Too much foreign material
      4._____Variety
      5._____Age
      6._____Moisture
      7._____Other (specify)

5. If OPROVIA offered you 5 FRW/kg more for high quality sorghum, would you clean the sorghum you brought here in the future to get the higher price?
1._____Yes
2._____No
3._____Don't know

6. If OPROVIA offered you 5 FRW/kg more for high quality sorghum, would you sell more sorghum if OPROVIA accepted unlimited quantities?
1._____Yes
2._____No
3._____Don't know

7. If OPROVIA refused your sorghum because the quality was poor, would you accept 5 FRW/kg less than the normal price?
1._____Return to OPROVIA after improving the quality
2._____Try to sell elsewhere
3._____Use the sorghum myself
4.Other (specify):_____

9. Have you ever sold sorghum to a merchant?
1._____Yes
2._____No (If "No", go to question 10)

IF YES:

9a. Have you ever had a merchant offer you a higher price than normal for higher quality sorghum?
1._____Yes
2._____No

9b. Have you ever had a merchant refuse to buy your sorghum because it was not good quality?
1._____Yes
2._____No (If "No", go to question 10)

IF YES:

9c. Why did the merchant refuse your sorghum?
1._____Too many insects
2._____Too many damaged grains
3._____Too much foreign material
4._____Variety
5._____Age
6._____Moisture
7._____Other (specify)

10. Before coming here today, did you do anything to your sorghum to improve the quality?
1._____Yes
2._____No (If "No", go to question 11)

IF YES:

10a. What did you do to improve the quality?
1.____Winnowed
2.____Sorted
3.____Sieved
4.____Other (specify)

(SHOW THE THREE SAMPLES TO THE PRODUCER)

11. Do you see a.....difference between these three sorghum samples?
1.____Large
2.____Small
3.____No (If "No", go to question 12)

IF BIG OR SMALL:

In your opinion,
11a. ____Which is the best quality?
11b. ____Which is the medium quality?
11c. ____Which is the worst quality?

11d. Why did you choose this one as the best quality?

_____

11e. Why did you choose this one as the medium quality?

_____

11f. Why did you choose this one as the worst quality?

_____

12. Have you ever sold beans to OPROVIA?
1.____Yes
2.____No

QUESTIONNAIRE - BEANS

(SHOW THE PRODUCER THE FIVE SAMPLES THAT REPRESENT THE FOLLOWING DAMAGE CATEGORIES:)

1. Insect damaged seeds
2. Moldy seeds
3. Rodent damaged seeds
4. Germinated seeds
5. Shrunken/shrivelled seeds

13. Generally, do you take out these types of damage before:

	NO	YES	IF YES, WHICH TYPE OF DAMAGE?				
13a. EATING?			1	2	3	4	5
13b. PLANTING?			1	2	3	4	5
13c. SELLING?			1	2	3	4	5
13d. STORING?			1	2	3	4	5

14. Would you remove damaged grains from a 100 kilo sack for 2 FRW/kg more?
1._____Don't know (If "Don't know", go to question 15)
2._____Yes
3._____No

IF NO:

14a. At what price would you do it?
_____FRW/kg

IF YES:

14b. How many hours would it take you to do 1 kg?
1._____< 1
2._____1 to 3
3._____3 to 6
4._____> 6

14c. Who would do the work?
1._____Winnow
2._____Daughter
3._____Sieve
4._____Husband/father
5._____Son
6._____Other (specify)

14d. How would they do it?
1._____Wife/mother
2._____Sort
3._____Worker
4._____Other (specify)

14e. What do you do with the beans taken out during cleaning?
1._____Throw them out
2._____Eat them
3._____Store them
4._____Sell them
5._____Plant them
6._____Give them to the animals
7._____Don't know
8.Other_____

15. Is it easier to take out foreign material than damaged grains when you are cleaning beans?

1._____Easier 2._____More difficult 3._____Same work

D.2 COOPERATIVE SURVEY - OPROVIA/GRENARWA II

(Research Component: Quality Standards for Beans and Sorghum)

IDENTIFICATION

Cooperative Name_____
Prefecture_____
Commune_____
Location_____
Age_____

QUESTIONNAIRE

1. What is the average and maximum quantity of beans that you have ever stored?
   1a. Average_____metric tons
   1b. Maximum_____metric tons

2. What is the average and maximum quantity of sorghum that you have ever sorted?
   2a. Average_____metric tons
   2b. Maximum_____metric tons

3. Do you have problems with losses due to storage?
   1._____A lot
   2._____A little
   3._____No problem

   IF A LOT OR A LITTLE

   3a. What kind of problems?

   _____

   _____

4. What is the average length of time you store beans in your cooperative?
   _____months

5. What is the average length of time you store sorghum in your cooperative?
   _____months

6. What percentage of your bean stocks do you sell to:
   6a._____OPROVIA?
   6b._____Merchants?
   6c._____Producers?
   6d._____Others? (specify)

What percentage of your sorghum stocks do you sell to:

6e._____OPROVIA?
6f._____Merchants?
6g._____Producers?
6h._____Others? (specify)

IF THE COOPERATIVE HAS PREVIOUSLY SOLD TO OPROVIA:

6i. Has OPROVIA ever refused your beans or your sorghum because the quality was not as is stipulated in the contract?
1._____Yes
2._____No

7. Do you take out damaged grains before storing beans?
1._____Always
2._____Sometimes
3._____Never

7a. Why?_____

_____

8. Do you take out foreign material before storing beans?
1._____Always
2._____Sometimes
3._____Never

8a. Why?_____

_____

9. Do you separate beans of good quality from beans of poor quality before storing?
1._____Always
2._____Sometimes
3._____Never

9a. Why?_____

_____

IF ALWAYS OR SOMETIMES:

9b. Do you sell the poor quality ahead of the good quality?:
1._____Always
2._____Sometimes
3._____Never

9c. Why?_____

_____

10. When you sell your beans, do you establish different prices for different qualities?
1._____Yes
2._____No (If "No", go to question 11)

IF YES

10a. What are the most important quality factors upon which you base these prices?
1._____Color (age)
2._____Variety (origin of the seed)
3._____Moisture content
4._____Foreign material
5._____Grains damaged by insects, moisture, rodents, germination
6._____Other (specify)

(SHOW THE COOPERATIVE MANAGER THE THREE SAMPLES: A, B, and C.)

11. What type of difference do you see between these three bean samples?
1._____Large
2._____Small
3._____No difference

If there were a system of quality standards where different qualities of beans received different prices, how much would you offer for one kg of beans of this quality?

11a._____Type A 11b._____Type B 11c._____Type C

11d. What are the most important quality factors upon which you based these prices?
1._____Color (age)
2._____Variety (origin of the seed)
3._____Moisture content
4._____Foreign material
5._____Grains damaged by insects, moisture, rodents, germination
6._____Other (specify)

12. What months do you normally buy beans?

1._____Jan	7._____Jul	:	13._____Harvest
2._____Feb	8._____Aug	:	14._____Planting
3._____Mar	9._____Sep	:	15._____All year
4._____Apr	10._____Oct	:	
5._____May	11._____Nov	:	
6._____Jun	12._____Dec	:	

13. What months do you normally sell beans?

1._____Jan	7._____Jul	:	13._____Harvest
2._____Feb	8._____Aug	:	14._____Planting
3._____Mar	9._____Sep	:	15._____All year
4._____Apr	10._____Oct		
5._____May	11._____Nov		
6._____Jun	12._____Dec		

14. Do you normally offer different prices for different qualities of beans?
1._____Yes
2._____No (If "No", go to question 15)

IF YES:

14a. Under what conditions?

_____

14b. How frequently do you sell beans of different quality at different prices?

_____

15. Have you ever refused beans brought to you because the quality was not good?
1._____Yes
2._____No (If "No", go to question 16)

IF YES:

15a. How many times do you normally refuse beans brought to you because the quality is not good?

	Producers	Cooperatives	Merchants
1._____< 1 of every 10			
2._____1 of every 20			
3._____1 of every 50			
4._____1 of every 100			
5._____> 1 of every 100			

15b. What are the most important quality factors upon which you base refusals?
1._____Color (age)
2._____Variety (origin of the seed)
3._____Moisture
4._____Foreign material
5._____Grains damaged by insects, moisture, rodents, germination
6._____Other (specify)

15c. When do you refuse beans the most often?

_____

16. Do producers bring you mixtures of old and new beans very often?
1._____Never
2._____Not a lot
3._____About half the time
4._____Most of the time

17. Are beans imported from other countries priced differently than beans grown in Rwanda?
1._____Yes
2._____No
3._____Sometimes
4._____There are never imported beans in this region

18. What percentage of the beans you handle are imported?_____%

(SHOW THE COOPERATIVE MANAGER THE TWO SAMPLES? C & D)

19. What type of difference do you see between these two bean samples?
1._____Small
2._____Large
3._____No difference (If "No difference", go to question 20)

IF SMALL OR LARGE

19a. If OPROVIA offered a 5 FRW/kg difference between these two type of beans, would you reject more beans brought to you than usual?
1._____Yes
2._____No
3._____Don't know

19b. If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you increase the time that you spend in your operations separating and cleaning the beans brought to you to obtain the higher price?
1._____Yes (If "Yes", go to question 20)
2._____No
3._____Don't know (If "Don't know", go to question 20)

IF NO:

19c. How many francs more would you be willing to do it for?
_____FRW/kg

20. If a system of quality standards were installed in markets and in OPROVIA's operations where good quality beans earned a higher price than low quality beans according to the following factors:

-Insect, rodent, and moisture damaged seeds
-Stones
-Foreign material other than stones
-Moisture content

Do you think it would be a good or bad idea?

1._____Good/Why? _____

2._____Bad/Why? _____

D.3 MERCHANT SURVEY - OPROVIA/GRENARWA

(Research Component: Quality Standards for Beans and Sorghum)

I. IDENTIFICATION

DATE_____PREFECTURE_____

COMMUNE _____CENTRE_____

NAMES_____

II. QUESTIONNAIRE PART B - Quality Practices and Perceptions

16. What is the average quantity of beans that you store and what is the maximum quantity that you have ever stored?
16a. Average_____Metric tons
16b. Maximum_____Metric tons

17. What is the average quantity of sorghum that you store and what is the maximum quantity that you have ever stored?
17a. Average_____Metric tons
17b. Maximum_____Metric tons

18. Have you ever sold beans or sorghum to OPROVIA?
1._____Yes
2._____No

IF YES

18a. Has OPROVIA ever refused your beans or your sorghum because the quality was not acceptable?
1._____Yes
2._____No

19. Do you separate high quality beans from low quality beans in your operations?
1._____Always
2._____Sometimes
3._____Never

IF ALWAYS OR SOMETIMES:

19a. According to what factors?

ORDER
_____Color (age)
_____Country of origin (specify)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains due to insects, moisture, rodents, or germination
_____Varietal mixture
_____Other

20. Do you usually buy beans of different quality at different prices?
1._____Yes
2._____No

IF YES:

20a. On what quality factors do you base prices?

ORDER
_____Color (age)
_____Country of origin (specify)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains due to insects, moisture, rodents, or germination
_____Varietal mixture
_____Other

20b. Under what conditions?

21. When you sell your beans, do you establish prices according to quality?
1._____Yes
2._____No

IF YES:

21a. On what quality factors do you base prices?

ORDER
_____Color (age)
_____Country of origin (specify)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains due to insects, moisture, rodents, or germination
_____Varietal mixture
_____Other

21b. Under what conditions? _____

(SHOW THE MERCHANT THE THREE SAMPLES? A, B, AND C)

22. What difference do you see between these three samples?
1._____Small
2._____Large
3._____No difference

If there were a system in place where high quality beans are rewarded and low quality beans are penalized, how much would you offer for 1 kilo of this type of quality?

22a. _____Type A 22b._____Type B 23c._____Type C

22d. What are the quality factors upon which you have based these prices on?

ORDER
_____Color (age)
_____Country of origin (specify)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains due to insects, moisture, rodents, or germination
_____Varietal mixture
_____Other

22e. Which sample most resembles the type of beans brought to you for purchase? A B C

22f. What is the current market price for beans?_____FRW/kg

22g. What is the current market price for sorghum?_____FRW/kg

23. Have you ever refused beans brought to you because the quality was poor?
1._____Yes
2._____No

IF YES:

How often do you refuse beans because of poor quality?

23a. Producers
1._____Never
2._____Rarely
3._____Often
4._____I never buy from producers

23b. Cooperatives
1._____Never
2._____Rarely
3._____Often
4._____I never buy from cooperatives

23c. Merchants
1._____Never
2._____Rarely
3._____Often
4._____I never buy from merchants

23d. What are the quality factors upon which you base rejections?

ORDER
_____Color (age)
_____Country of origin (specify)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains due to insects, moisture, rodents, or germination
_____Varietal mixture
_____Other

23e. During what period of your purchasing do you refuse beans the most often? _____

24. How often do producers bring you mixtures of new and old beans?
1._____Never
2._____Not a lot
3._____Approx. half
4._____Most

25. Is there a different price for imported beans than for domestic beans?
1._____Yes (_____FRW less/more)
2._____Sometimes (_____FRW less/more)
3._____There are never imported beans in this region
4._____Don't know

26. What kind of cleaning do you do just after the purchase of beans?
1._____Winnow
2._____Hand-pick
3._____Sieve
4._____Dry
5._____Nothing - (Why?_____)
6._____Other (specify)

(SHOW THE MERCHANT THE TWO SAMPLES: C AND D)

27. What difference do you see between the two samples?
1._____Small
2._____Large
3._____No difference

IF LARGE OR SMALL

27a. If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you reject more of the beans brought to you than you normally reject?
1._____Yes
2._____No
3._____Don't know

27b. If OPROVIA offered a 5 FRW/kg difference between these two types of beans, would you increase the amount of time you spend in your operations separating and cleaning your beans to obtain the higher price?
1._____Yes
2._____No
3._____Don't know

IF NO:

27c. How many FRW more would you demand per kilo to separate and clean your beans?
_____FRW/kg

28. If a system of quality standards were installed in the market and also followed by OPROVIA where beans of high quality received a higher price than beans of low quality according to the percentage of grains damaged by insects, moisture, or rodents, the percentage of stones, the percentage of foreign material other than stones, and moisture content, would this be a good or bad idea?

1.____ Good/Why?_____

_____

_____

2.____ Bad/Why?_____

_____

_____

II. QUESTIONNAIRE PART C - Transactions

29. In the course of the last 12 months, during which months did you buy beans?

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Don't Know
Quantity (approx. metric tons)													
ORIGIN													
1=Rwanda													
2=Uganda													
3=Zaire													
4=Other													
5=Don't know													
SELLER													
1=Producer													
2=Assembler													
3=Trucker													
4=Coop													
5=Don't know													

30. In the course of the last 12 months, during which months did you sell beans?

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Don't Know
Quantity (approx. metric tons)													
ORIGIN													
1=Rwanda													
2=Uganda													
3=Zaire													
4=Other													
5=Don't know													
SELLER													
1=Producer													
2=Assembler													
3=Trucker													
4=Coop													

D.4 INSTITUTION SURVEY - OPROVIA/GRENARWA II

(Research Component: Quality Standards for Beans and Sorghum)

I. IDENTIFICATION

Name of the institution:_____

Location:_____

Name of respondent:_____

Respondent's title:_____

Role in purchasing activities:_____

Average quantity purchased annually:
Beans_____
Sorghum_____
Sorghum flour_____

Names of suppliers:_____

Method of delivery:_____

Frequency of deliveries:_____

II. QUESTIONNAIRE

1. How would you rate the quality of beans that you receive?
1._____Very good
2._____Average
3._____Poor

2. Are you normally satisfied with the quality of beans that you receive?
1._____Always/often
2._____Sometimes/not a lot
3._____Never

IF SOMETIMES OR NEVER:

2a. What are the most important problems with quality that you encounter?

ORDER
_____Color (age)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains from insects, moisture, rodents, or germination
_____Variety (specify)
_____Country or region of origin (specify)
_____Other (specify)

2b. How would you compare the quality of beans delivered by your different suppliers to each other or to quality in the marketplace?

_____

2c. Have you ever had to throw away beans that you had purchased because of poor quality?
1._____Yes
2._____No
3._____Don't know

IF YES:

2d. What is the average quantity that you have had to throw out because of poor quality?
1._____Majority (< 50%)
2._____Half (50%)
3._____30% to 50%
4._____10% to 30%
5._____ > 10%

2e. Do you throw out beans due to poor quality often?
1._____Yes (specify)
2._____No
3._____Don't know

3. Are you normally satisfied with the quality of sorghum flour that you receive?
1._____Always/often
2._____Sometimes/not a lot
3._____Never

IF SOMETIMES OR NEVER:

3a. What are the most important problems with quality that you encounter?

ORDER
_____Color (age)
_____Moisture
_____Foreign material
_____Number of insects
_____Odor
_____Other (specify)

3b. How would you compare the quality of sorghum flour delivered by your different suppliers to each other or to quality in the marketplace?

_____

3c. Have you ever had to throw away sorghum flour that you had purchased because of poor quality?
1._____Yes
2._____No
3._____Don't know

IF YES:

3d. What is the average quantity that you have had to throw out because of poor quality?
1._____Majority (> 50%)
2._____Half (50%)
3._____10% to 50%
4._____< 10%

3e. Do you throw out sorghum flour due to poor quality often?
1._____Yes (specify)
2._____No
3._____Don't know

4. Have you ever refused beans delivered to you because the quality was not good?
1._____Yes
2._____No
3._____Don't know

IF YES:

4a. What are the most important quality factors upon which you base rejections?

ORDER
_____Color (age)
_____Moisture content
_____Foreign material
_____Percentage of damaged grains from insects, moisture, rodents, or germination
_____Variety (specify)
_____Country or region of origin (specify)
_____Other (specify)

4b. Do you refuse often?
1._____Yes (specify)
2._____No
3._____Don't know

IF YES:

4c. Have you thought of requiring specific quality factors of your suppliers?
1._____Yes (specify)
2._____No
3._____Don't know

5. Have you ever refused sorghum flour delivered to you because the quality was not good?
1._____Yes
2._____No
3._____Don't know

IF YES:

5a. What are the most important quality factors upon which you base rejections?

ORDER
_____Color (age)
_____Moisture content
_____Foreign material
_____Number of insects
_____Other (specify)

5b. Do you refuse often?
1._____Yes (specify)
2._____No
3._____Don't know

IF YES:

5c. Have you thought of requiring specific quality factors of your suppliers?
1._____Yes (specify)
2._____No
3._____Don't know

6. What do you do with beans once they have been delivered, with regard to quality?
1._____Winnow
2._____Sort
3._____Sieve
4._____Change nothing
5._____Other (specify)

6a. Who does this work? _____

6b. How much time does it take for them to prepare one sack (of 90 - 100kg)?
1._____10 minutes
2._____15 minutes
3._____30 minutes
4._____45 minutes
5._____1 hour

7. What do you do with sorghum flour once it has been delivered, with regard to quality?
1._____Sort
2._____Sieve
4._____Change nothing
5._____Other (specify)

7a. Who does this work? _____

7b. How much time does it take for them to prepare one sack (90 - 100kg)?
1._____10 minutes
2._____15 minutes
3._____30 minutes
4._____45 minutes
5._____1 hour

8. How do you store:

1. Beans_____

2. Sorghum flour_____

3. Sorghum_____

9. Do you check on your stocks regularly for storage problems?
1._____Yes
2._____No

IF YES: How often?_____

10. What types of storage problems have you experienced?

_____

IF PROBLEMS EXIST:

10a. Who do you normally contact for improving the situation?

_____

11. What is the average amount of time that you store (time between reception and consumption)?_____

12. Have you ever formulated a complaint to a supplier because of the quality delivered?
1._____Yes _____Official (written) _____Non-official (verbal)
2._____No

IF YES:

12a. What happened after the complaint was made?
1._____No longer purchased from them
2._____Received a discount price
3._____Replacement of the bad product
4._____Other (specify)

13. In your organization, who negotiates purchasing contracts for:

1. Beans_____

2. Sorghum flour_____

3. Sorghum_____

IF THE RESPONDENT IS RESPONSIBLE FOR CONTRACT NEGOTIATION:

13a. Of the two following systems, which would you prefer having installed in your purchasing operations?

(1) Make a contract with a pricing schedule where different, specified qualities of beans receive different prices, and adjust the final price following the delivery and the verification of the quality actually delivered.

(2) Make a contract for a specified quality with a maximum permissible level of defects for several quality factors, and pay only for those quantities which are delivered which conform to those specifications.

1._____System 1 2._____System 2

13b. Why?_____

_____

14. What combination of price/quality would you prefer for your operations?
1._____Premium price for high quality
2._____Discount price for low quality

14a. Why?_____

D.5 SURVEY OF THE NATIONAL BREWERY - OPROVIA/GRENARWA II

(Research Component: Quality Standards for Beans and Sorghum)

I. IDENTIFICATION

Name of respondent:_____

Respondent's title:_____

Role in purchasing activities:_____

Do you use sorghum in your beer?
1._____Yes (continue with Part 1, question 1)
2._____No (continue with Part 2, question 14)

II. QUESTIONNAIRE PART 1 - If they use sorghum in their beer:

1. How many tons do you use per year?_____tons

2. What are the countries of origin of the sorghum you use?

_____

3. Who are your suppliers?

_____

_____

_____

4. How is the sorghum delivered?

_____

5. How frequently is it delivered?

_____

6. What is the average amount of time that you store sorghum (the average amount of time between delivery and utilization)?

_____

7. What is done to the sorghum just after delivery and prior to utilization (cleaning, inspection procedures, handling processes)?

_____

_____

8. Do you have quality specifications that you require your suppliers to observe?
1._____Yes
2._____No

IF YES:

8a. What are these specifications?

_____

_____

_____

9. Have you ever purchased sorghum from OPROVIA?
1._____Yes (specify when and how much)
2._____Never

IF YES:

9a. What did you think of the general quality of the sorghum that you purchased from OPROVIA?

_____

_____

IF NO:

9b. Is there any particular reason that you have not purchased sorghum from OPROVIA?

_____

_____

10. In general, are you satisfied with the quality of sorghum furnished by your suppliers?
1._____Always/often
2._____Sometimes/not often
3._____Never

11. What system do you use to control the quality of sorghum that you receive?

_____

_____

12. Have you ever refused sorghum delivered to you because the quality was poor?
1._____Yes
2._____No

IF YES:

12a. What are the quality factors upon which you usually base rejections?

_____

_____

13. Have you ever paid a discount or premium price to suppliers to encourage delivery of a particular quality of sorghum?
1._____Yes
2._____No

IF YES:

13a. How did it work?

_____

QUESTIONNAIRE PART 2 - If They Do Not Use Sorghum:

14. Why not?

_____

15. Have you ever used sorghum at this brewery?
1._____Yes
2._____No

IF YES:

15a. What were the results?

_____

16. What grain(s) are you using if not sorghum?

_____

17. What are the quality requirements of the grain you use?

17a. Physical quality (foreign material, damaged grain, moisture content, germination %, age, etc.)

17b. Varietal characteristics/genetic factors (seedcoat, color, endosperm type, floury vs. corneous, seed size)

18. What approximate amounts of each type of grain do you use?

_____

19. What are the buying specifications for the crops that you buy?

_____

20. What do you do with the crops after reception (clean, dry, grind, sprout, etc.)?

_____

21. What are your inspection procedures (sampling method, analyses conducted, what equipment is used)?

_____

22. Would it be possible to have a copy of your buying specifications or of a purchase contract that you normally use with your suppliers?

19. What are the buying specifications for the crops that you buy?

_____

20. What do you do with the crops after reception (clean, dry, grind, sprout, etc.)?

_____

21. What are your inspection procedures (sampling method, analyses conducted, what equipment is used)?

_____

22. Would it be possible to have a copy of your buying specifications or of a purchase contract that you normally use with your suppliers?