RESEARCH NOTE: BEAN GRAIN CHARACTERISTICS AND PRICES PAID AT RETAIL MARKETS IN UGANDA: IMPLICATIONS FOR BEAN BREEDING[1]

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Bean grain size and color characteristics are investigated to determine their effect on prices paid at consumer markets in Uganda. A price equation that include measures of these characteristics along with market location, grain supply, and marketing month variables is estimated for fresh (high moisture) and dry beans. Neither grain size nor color are found to have a significant impact on either fresh or dry bean prices. Bean breeders should thus not use grain color or size as important indicators of consumer preferences unless strong tradition indicates otherwise. Variation in market prices paid is more a function of market location and month of sale than characteristics of the grain.

1. Introduction

National agricultural research programs in eastern Africa and in the SADCC countries of southern Africa are involved in research efforts to screen bean (*Phaseolus vulgaris* L.) breeding lines to find heavier yielding varieties. Large numbers of breeding lines from the geographical origin of beans in the Andean highlands of Colombia, Ecuador, and Peru and Meso-America and promising lines from neighboring countries are screened each season. Breeding lines are evaluated on both research stations and farms' fields to determine their performance under local production conditions.

Conditions necessary for farmer acceptance of new varieties are; 1) they must perform in farmers' production environments better than currently sown cultivars using acceptable levels of inputs and 2) they must be acceptable to consumers. Plant breeders and agriculturalists generate amply information relating to the first condition from their research activities and breeders readily use it in their programs. Information on the second condition, however, is sparse as little is known concerning consumers' preferences for characteristics of beans or, for that matter, most common food crops produced in sub-Saharan Africa. Information concerning these characteristics is vital to the success of breeding programs. New varieties that are not acceptable to consumers are unlikely to be adopted even if they are heavy yielding.

The objective of this paper is to investigate the importance of bean grain size and color on prices paid at retail markets in Uganda. The purpose is to provide bean breeders with information on preferred characteristics of bean grain for inclusion in their breeding program. The conventional wisdom in Uganda, and to some extent in other areas of eastern and southern Africa, is that varieties with large grain size and that are red in color are highly preferred. Releasing varieties without these characteristics is believed to be risky, even though they may be heavy yielding. Establishing criteria in the selection of bean varieties in Uganda is further complicated by the fact that 30-35 percent of grain produced is consumed in the fresh, high moisture state (Grisley, 1992). Breeders thus have to consider two food commodities for which consumers may have differences in preferences.

2. Area of study and survey methods

Uganda is the third largest producer of beans in sub-Saharan Africa with production averaging 272,000 tons annually over the period 1986-88 (Grisley, 1990). Only Kenya and Burundi are larger producers at 396,000 and 298,000 tons, respectively. As a food crop, beans rank in importance with the basic staples cooking bananas (matoke), cassava, sweet potatoes, and maize.

A recent survey found that over 135 different bean cultivars (including landraces) are produced in Uganda (Grisley and Sengooba, 1992). Producers thus have a vast pool of cultivars to select from in terms of plant growth and production habits and grain characteristics. This diversity in available cultivars is both a blessing and a curse to breeders. Greater diversity of currently produced cultivars suggest that criteria imposed in the screening of new varieties can be more general. However, difficulties in the targeting of new varieties at the farm level increase the number of cultivars sown across farms within a specific location.

The 12 largest and most important food retail markets were selected for study during 1990. These markets are located in the larger towns of Mbale, Tororo, and Jinja in the east; Masaka, Mbarara, and Kabale in the south and southwest; and Kasese and Fort Portal in the west. The Kampala located markets are Owino, Nakasero, Wandegeya, and Kawempe. Geographical areas in which these markets are located are also important in bean production. Beans are normally produced during the two rainy seasons of March-June and September-December, but limited quantities can be produced throughout the year.

Four markets were selected in the Kampala area because it is the most populated region in the country -- and hence largest consumer of beans -- and because various markets tend to serve different consumer cliental groups. Nakasero and Wandegeya are considered to be upscale, urban markets, while Owino is the market of preference for most consumers. Food prices are believed to be lower in Owino than in the other two markets. Kawempe is a rural market in close physical proximity to

Kampala. Hence prices are expected to be greatly influenced by Kampala markets.

Retailers selling fresh beans usually specialize in only one or two different cultivars in addition to selling other fresh produce. Dry bean retailers, however, typically sell only beans, with each offering a wide selection of cultivars. The quantity and type of fresh beans offered do not change greatly on a day-to-day basis, but can vary considerably over longer periods of time. The quantity and selection of dry beans is more stable than that of fresh beans because dry beans can be stored indefinitely with little or no loss of quality. Fresh bean quality is more variable and grain deterioration can occur a few days after harvest.

Little is known about consumers' preferences for fresh and dry beans, but they are assumed to be close substitutes in consumption both within and across fresh and dry grain states. Change in the price of one cultivar can be expected to result in a shift in consumption to another cultivar or a shift in consumption across the fresh and dry bean groups. Over time, prices within and across fresh and dry bean forms can be expected to move in tandem.

The March and June periods were selected for study because they reflect opposite extremes in the bean production and marketing cycle. March is at the beginning and June at end of the bean production period. Dry beans are expected to be more abundant in March and fresh beans more abundant in June. In addition, both fresh and dry beans are believed to be more abundant in June than in March. Information on cultivars offered for retail was collected by making a purchase of one tin can of both fresh and dry beans of each cultivar offered in each market. The weight per can of dry beans was approximately one kilogram across the cultivars found. Weight per can of fresh beans was not taken because fresh beans are retailed by volume.

3. Research methods

A price equation is estimated to determine the effect that market location, weekly sales volume, and selected grain characteristics have on market prices of fresh and dry beans. The estimated equation is:

$$P = a + B_1X_1 + \ldots + B_{11}X_{11} + B_{12}X_{12} + B_{13}X_{13} + B_{14}X_{14} + B_{15}X_{15} + \ldots + B_{25}X_{25} + u$$

where:
X_1 = Mbale market dummy
X_2 = Tororo Market dummy
X_3 = Jinja Market dummy
X_4 = Kabale Market dummy
X_5 = Kasese Market dummy
X_6 = Mbarara Market dummy
X_7 = Masaka Market dummy
X_8 = Fort Portal Market dummy
X_9 = Nakasero Market dummy
X_{10} = Wandegeya Market dummy
X_{11} = Kawempe Market dummy
X_{12} = month dummy (March = 1, June = 0)
X_{13} = number of beans per can (or kg)
X_{14} = cans of beans sold during past week
X_{15} = brown grain color dummy
X_{16} = pink grain color dummy
X_{17} = gray grain color dummy
X_{18} = purple grain color dummy
X_{19} = blue grain color dummy
X_{20} = mixture of grain types color dummy
X_{21} = black grain color dummy
X_{22} = white grain color dummy
X_{23} = orange grain color dummy
X_{24} = green grain color dummy
X_{25} = yellow grain color dummy
u = error term with zero mean and constant variance.

B_1 through B_{25} are the variable parameters to be estimated. In the set of market dummy variables the Kampala located Owino Market was the omitted variable. The grain color red was selected as the omitted variable in the set of bean grain color dummy variables. The variable, cans of beans sold in the past week, was retailers' estimate of their bean sales. The price equation identified was estimated for three different relationships. Dependent variables are the price of fresh beans, the price of dry beans, and the difference in the price of fresh and dry beans on a per can basis.

4. Results

A total of 33 cultivars were offered in March and 30 were offered in June. Thirteen of the 33 cultivars offered in March were not offered in June and 12 of the 30 cultivars offered in June were not offered in March. This suggests significant diversity in fresh and dry bean cultivar types across the two time periods. In addition, 4 to 5 other cultivars and a mixture of cultivars were sold in the dry form in most markets. Most markets offered 3-4 cultivars in both the fresh and dry form in March and 4-5 cultivars in June. The Kabale Market had the greatest diversity across cultivars during both time periods. Nakasero and Wandegeya Markets had the least diversity with only 3 cultivars offered in each time period.

The local cultivar Kanyebwa occurred frequently across both markets and time periods. It was offered in 5 markets in March and 7 in June. The released cultivar K-20, locally known as Nambale, was next most popular, found in 2 markets in March and 7 in June. The local semi-climber, Mutike, was offered in 3 markets in both time periods while 5 other cultivars were offered in 3-4 markets in only one of the time periods. A total of 22 cultivars were offered in only one of the two time periods.

Fresh bean prices in March ranged from Uganda shillings (USh) 170 to 400 per can with an average price of USh275 (USh700 = US$1). Fresh bean prices were less in June at USh212 per can with a range of USh150 to 250. Dry bean prices averaged USh187 per can in March and USh131 in June; a 30 percent decrease in price over the three month period. The higher price found for both types of beans in March was expected given that beans are less abundant in that month. Correlation between fresh and dry bean prices across the same cultivar was 0.74 in March and 0.21 in June. Evidently, the greater availability of cultivars and their supply allows for greater substitution during June. Across all markets, greater variability in prices by grain type were found for March than in June. Fresh bean prices were more variable than dry bean prices in both time periods.

4.1 Fresh Beans

The Chow test was used to determine whether model parameter values associated with fresh and dry beans were the same (Chow, 1960). The calculated F-value was 8.6 and significant, suggesting the two data sets contain significantly different regression coefficients for the model estimated. The model identified above was thus estimated separately for fresh and dry beans.

For fresh beans the adjusted R-square was 0.78 and the F-value was 13.9 and significant (Table 1, column 1). All market location variables external to Kampala were significant and with a negative sign. Fresh beans were selling at Ush40 to 97 less in these markets compared to the Owino Market. No difference in fresh bean prices were found between the Kampala located markets. Hence consumers were not paying a premium for fresh beans in the upscale markets. Farmers/traders could profit from transporting fresh beans from other markets to Kampala markets if the added transportation and handling costs and associated risks were less than market location parameters reported. This is not expected to be the case because beans are traded in a competitive environment and further arbitrage across these markets can not be expected to yield additional profit. There are few governmental or other institutional regulations that limit movement of most food crops in Uganda.

The marketing month variable was significant and positive, indicating that fresh beans were retailing at USh80 (32 percent) more per can in March than in June. This was expected because March is at the beginning and June at the end of the production season. If circumstances permit, bean producers could thus realize higher prices by harvesting fresh beans during off-peak periods. Grain size, as measured by the number of grains per can, was significant and positive, but the parameter estimate was small at USh0.04 per can. The quantity of beans sold variable was significant and negative. However, the parameter was small at USh0.40 per can, implying that quantity sold has little impact on price. This result would be expected in a competitive market with many retailers.

Bean cultivars were categorized by color into 12 groups. When color patterns were striped, speckled, or mottled the grain was assigned the dominant color type. Only 2 of the 11 grain color dummy variables were significant. The parameter for pink was USh26.8 and that for a mixture of cultivars, and hence colors, was USh49.4. These findings contrast sharply with the conventional wisdom that beans red in color bring higher prices.

4.2 Dry Beans

For dry beans, market location variables external to the Kampala area were not significant (Table 2, column 2). Dry beans were thus not selling at prices significantly different from those in the Owino Market which averaged USh153 per kilogram across all cultivars. This result was expected given that the markets studied were located in important bean producing areas and that dry beans can be easily and cheaply transported between market areas with little or no risks in spoilage. Bean supplies have, evidently, been arbitraged across markets such that no additional profits can be extracted. Dry beans in the Nakasero and Wandegeya Markets were, however, selling at USh78.3 and USh44.2 per kilogram higher than dry beans in the Owino Market. This may be due to the low volume of beans sold in these markets.

Dry beans were selling at USh62.3 per kilogram more in March than in June. In a competitive market, differences in bean prices across time are a function of holding costs and market participants' expectations of production and demand factors in the following season. The fact that the parameter was large -- 46 percent of the average price prevailing across the twelve markets in June -- may indicate that the supply of beans produced in the March-June season of 1990 was larger than expected, or alternatively, that the carryover of grain from the second season of 1989 into early 1990 was small relative to demand.

Estimates for the quantity of grain sold over the past week and the number of beans per kilogram, a measure of grain size, were not significant. Similar to that of fresh beans, the former result would be expected in a competitive market. The latter result suggest that consumers do not place a price premium on dry bean grain size. Only one of the grain color dummy variables was significant; grain of yellow color was selling at USh62.6 per kilogram higher than grain of red color.

4.3 Difference Between Fresh and Dry Beans

A final equation was estimated with the difference between the price per can of fresh and dry beans of the same cultivar as the dependent variable. Values of the variable were positive as fresh bean prices were higher than their dry counterparts. This relationship was estimated to investigate for differences in preferences between fresh and dry beans within cultivars. All market location variables were significant and negative with the exception of the Kawempe Market. (Table 1, column 3). The negative sign indicates that the difference between the price of fresh and dry beans in the Owino Market was greater than the corresponding difference in other markets. Fresh beans were thus selling at a premium to their dry counterparts in the Owino Market relative to that in other markets. This result could be related to a higher demand for fresh beans by urban consumers with larger incomes. The shorter cooking time for fresh beans may also be a factor influencing their price in the large Kampala urban area.

Estimates for the marketing month and difference in the number of grains per can variables were not significant. The former result indicates that fresh and dry bean prices move in tandem over time. The latter finding suggest the difference between fresh and dry bean prices for the same cultivar is not influenced by differences in grain size. Across the set of grain color variables only the brown color was found to be significant. When compared to red color beans, the difference in price between fresh and dry beans of brown color was greater by Ush26.9 per can. Thus fresh beans of brown color were bringing a premium price relative to their dry counterparts. Only two bean cultivars were recorded as brown in color; the widely popular Kanyebwa and Kammenya-miggo which was available in only one market. The results found for the grain color brown thus apply primarily to Kanyebwa. However, Kanyebwa is not believed to be popular because it is brown, but because it has a highly favorable taste when prepared fresh. When fresh, Kanyebwa is pinkish in color. Recall that the color pink had a significantly higher price in the fresh bean price equation. Recall also that in the dry bean estimates the color brown was not significant. These results imply that consumers are paying a premium for Kanyebwa in the fresh form.

5. Discussion and Conclusion

The results suggest that the two most visible characteristics of bean grain, size and color, may not by themselves be reliable indicators of consumers' preferences for either fresh or dry beans. At the minimum, color should only be used as a criterion in selection when combined with other evidence that consumers in selected areas already have strong preferences for beans of that grain color. Some colors seem to be widely accepted, such as red and brown, while others, such as black, are accepted in only localized areas (Grisley and Sengooba, 1992).

A second important finding is that consumers paid a premium for selected cultivars in the fresh state (e.g., Kanyebwa) compared to their dry counterparts.

Table 1: Regression estimates for fresh and dry bean prices in Uganda

Variable	Parameter estimates		
	Fresh	Dry	Difference
Market location dummy variables			
Mbale	-81.2 ***	-1.92	-69.7 ***
Tororo	-85.5 ***	17.4	-90.7 ***
Jinja	-54.2 ***	-17.8	-72.6 ***
Kabale	-75.8 ***	-9.9	-85.6 ***
Kasese	-97.0 ***	-18.8	-115.9 ***
Mbarara	-39.7 ***	-8.9	-45.1 ***
Masaka	-64.6 ***	15.1	-74.5 ***
Fort Portal	-77.5 ***	-7.3	-99.5 ***
Nakasero	-6.7	78.3 ***	-65.4 ***
Wandegeya	17.5	44.2 **	-35.6 *
Kawempe	-26.1	9.9	-19.4
Marketing month[a]	80.0 ***	62.3 ***	10.3
Number of beans/can	0.04 ***	-0.01	0.1
Cans sold per week	-0.40 ***	-8.9	-
Bean color dummy variables			
Brown	11.7	-7.9	26.9 **
Pink	26.8 ***	17.5	-4.0
Gray	19.9	9.3	16.1
Purple	2.9	-19.5	28.4
Blue	24.6	-0.7	-1.7
Mixtures	49.4 ***	5.3	15.9
Black	3.2	-1.1	20.3
White	1.7	17.1	3.9
Orange	11.6	5.4	16.3
Green	-23.3	-37.2	15.6
Yellow	27.5	60.6 *	0.2
Intercept	237.9 ***	141.8 ***	95 ***
Adjusted R-square	0.78	0.52	0.44
F-value	13.9 ***	4.0 ***	3.3 ***
Sample size	86	98	86

Notes:
Significance levels: * = P < 0.10, ** = P < 0.05, *** = P < 0.01.
The Kampala located Owino Market was the omitted market in the set of market location dummy variables and the color red was the omitted color in the set of grain color dummy variables.

This suggests there is some economic rationale for bean breeders to establish different sets of criteria when selecting and/or breeding for fresh and dry bean varieties. Varieties that are preferred in one form may not be preferred in the other.

While not tested here, taste may be the dominant criterion in consumer selection of beans. Unfortunately, taste is one of those elusive characteristics that is difficult to quantify; it is not directly observable and it is subjective in nature. In this regard, further research on the chemical composition of beans may lead to the identification of factors that can be associated with taste. However, the food industry in general has come to rely heavily on consumption tests from both consumers and recognized taste experts to obtain measures of taste. For example, the food processing industry in developed countries relies upon consumer taste tests while the wine industry relies upon the opinion of taste experts. These and other methods may prove to be useful in bean selection or breeding programs to increase the probability that varieties released are acceptable to consumers.

The results found here may have implications for bean breeding strategies in other countries of eastern and southern Africa. Some cultivars common to Uganda are also are sown in other countries, especially Kenya. In a recent study of retail markets in Kenya, Grisley and Munene (1992) found that K-20, the most widely grown variety in Uganda and which was released as GLP-2 in Kenya, was available in all markets surveyed and constituted over 60 percent of all bean supplies. Consumer preferences for beans, however, can be expected to differ significantly across production and consumption areas of sub-Saharan Africa and more research is needed on this topic. In this regard, economist can play a vital and important role in the development and implementation of crop breeding strategies.

Note

1. An earlier version of this paper was written while the authors were employed by CIAT. The views expressed are those of the authors alone.

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