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Abstract

The objective of this study was to determine the impact of bean grain quality characteristics on market price. The data was collected from retail markets in Tanzania. Hedonic pricing provides a statistical estimate of premiums and discounts. Implications for development of bean markets include: i) extension agents should identify cost-effective ways to educate producers on targeting urban market niches based on consumer preferences for varieties, ii) breeding for bruchid resistant beans and use of appropriate storage technologies would alleviate the problems of storage damage, and iii) requiring a portfolio of grain quality characteristics to fit consumer preferences in local markets.
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Key words: Beans, markets, consumer preferences, hedonic, storage, Tanzania

JEL codes: D12, Q13

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Introduction

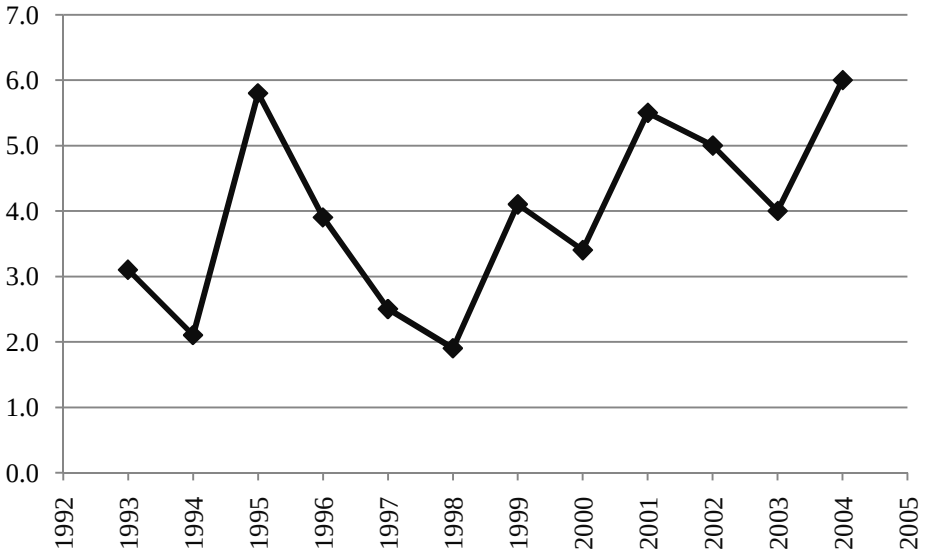
In Tanzania common beans (*Phaseolus vulgaris L.*) are by far the most important pulse crop both as a source of dietary protein and calories, as well as a source of farm income (Hillocks *et. al*, 2006). In recent years, bean consumption has increased because of increased population pressures both in rural and urban areas, and escalation of the cost of living. While production and other agronomic practices of beans in Tanzania have been studied (Hillocks *et. al*., 2006), consumer preferences in the rapidly growing urban markets are almost undocumented. Most farmers and merchants intuitively understand the preferences of their immediate customers, but they lack information on the preferences of new clientele in distant cities. Researchers, extension staff and NGO personnel need a way to identify the bean traits that they should focus on. This study uses hedonic pricing as a formal mechanism for estimating the strength of consumer preferences for bean characteristics in urban markets.

Aside from beans, Tanzania has several other legume crops that are grown in its diversified agro-ecological zones. For example, cowpeas are important in the southern regions and in the Lake zone and are produced primarily for the domestic market; chickpeas and pigeon peas are mainly produced in the Northern zone, Arusha and Manyara regions, and are primarily produced for export. The exportation of pigeon peas through the Kenya border is linked to an important market among the Indian community in the UK. Recently pigeon pea exports have been expanded to Middle Eastern countries; an effort engineered by the NGOs working in the Arusha region to help exploit the market for legume grains. Both chickpeas and pigeon peas are potential grain legumes for the export market, provided that the value chain is enhanced.

Tanzania Agriculture

Agriculture remains an important economic sector of the Tanzanian economy in terms of food production, employment generation, production of raw material for industries, and generation of foreign exchange earnings (National Bureau of Statistics, 2006c). Maize is the most important crop in Tanzania and it has a planted area 4.25 times greater than cassava, which has the second largest planted area (National Bureau of Statistics, 2006b). Following cassava in terms of area planted are beans, paddy rice, sorghum, cashew nuts, groundnuts (peanuts), cotton, banana, coffee, sweet potatoes and mangoes. Despite the various economic shocks that the Tanzania economy faces, the trend suggests that the agricultural sector is growing (Figure 1).

Figure 1: Average Annual Growth Rates of Agriculture in Tanzania (%) as Measured by Percentage Contribution to the GDP

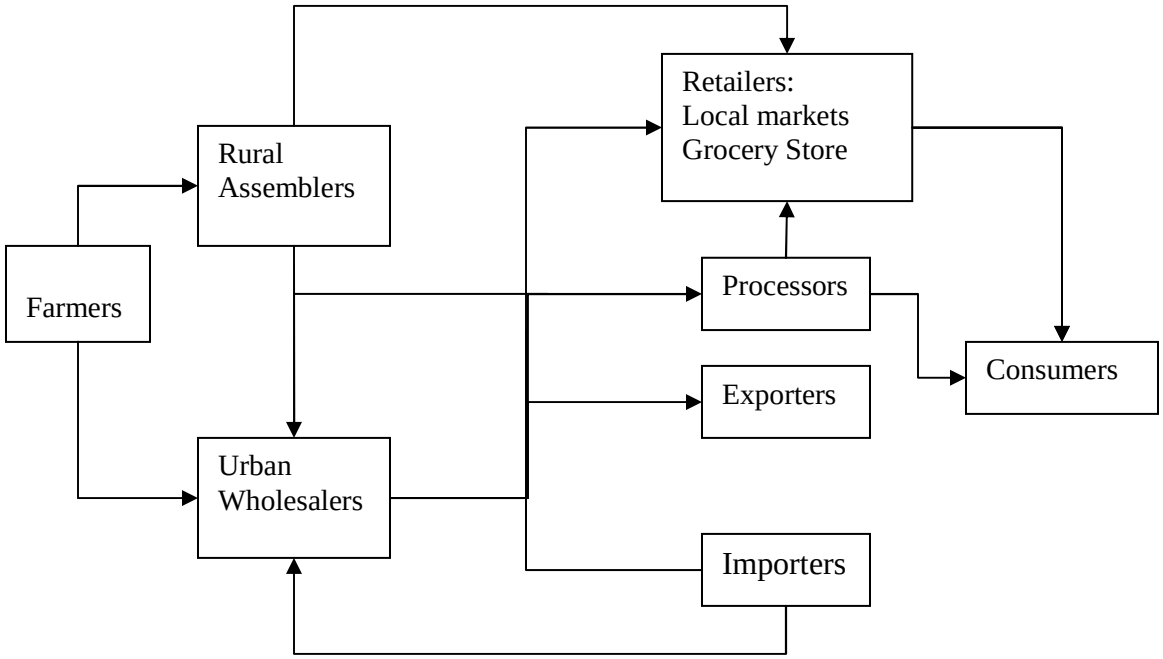


Source: National Bureau of Statistics, Tanzania, 2006a.

Bean Characteristics and Value Chain in Tanzania

The bean markets in Tanzania offer various types of beans that differ by color, shape, size and other cooking properties such as cooking time and digestibility. Beans are an important part of the diet of rural and urban dwellers in Tanzania, with an estimated consumption rate of 6.2 kilogram per person per year (FAO, 2008). Beans are a relatively inexpensive alternative source of protein in many household compared to animal or fish products. On average, Tanzania produces more than 500,000 tons of beans a year (Ministry of Agriculture, Food and Cooperative Tanzania, 2008). Bean production in Tanzania is dominated by smallholder farmers who normally do not store significant volumes of dry beans after harvest, so the quantity in the bean trade is expected to decline steadily after the harvest (WPF, 2005). Most of the countries in Sub Sahara Africa (SSA) are affected by the seasonality of trade that typically influences the food grain prices to be low at harvest time and substantially higher in lean seasons (Osborne, 2004). Data indicates that importation of beans from other countries into Tanzania has been minimal. Farmers in rural areas consume part of the beans they produce, but they sell surplus beans to urban consumers through various outlets, and the export markets mostly through informal cross-border trade. Figure 2 shows the typical in- country market chain for beans in Tanzania.

Figure 2: Typical In-Country Bean Market Chain in Tanzania



Tanzania like other African countries relies on the traditional open markets to trade most agricultural commodities. Therefore, the primary data collected for this study was from the open commodity markets in the Dar es Salaam and Morogoro regions. Understanding the consumer preferences at open market levels provides a starting point in understanding bean markets in Tanzania and elsewhere in Eastern and Southern Africa.

Other Studies and Motivation for the Research

In order to understand consumer preferences for commodity quality characteristics, researchers have attempted to model such behavioral patterns using hedonic model framework. For example Mishili *et. al.*, (2009) did a cross country comparison of consumer value perception of quality characteristic along the cowpea value chain in Nigeria, Ghana and Mali. They found that cowpea consumers in Nigeria, Ghana and Mali are willing to pay a premium for large cowpea grains. Also Faye *et. al.* (2006) reported on hedonic pricing analysis of six markets in Senegal and found that larger cowpea grains were preferred in all six markets, and grains with bruchid damage were discounted in the Tilene Market in Dakar. Further, they observed that preference for cowpea color, eye color and skin texture varied from market to market. Langyintuo *et. al.* (2004) reported that in the markets in Cameroon and Northern Ghana, consumers generally prefer large undamaged cowpeas grain. In both countries, grain eye color was noted to be an important grain quality characteristic that consumers are willing to pay a premium for. In Ghanaian markets (North Ghana), consumers prefer cowpeas with black eyes. In Cameroon, northern Ghana, northern Nigeria and Senegal, cowpea consumers place value on large cowpeas grains and dislike damaged cowpeas grain (Langyintuo *et. al.*, 2003, 2004). Further, in northern Ghana, consumers prefer cowpea grain with black eyes. However, cowpea consumers in northern Cameroon discount cowpea grains with black eyes. Langyintuo *et. al*. also reported that in northern Ghana, consumers pay a premium for white cowpeas.

The understanding of consumer preferences for common beans is paramount in order to understand the beans marketing and trade so as to be able to facilitate bean market development in Tanzania. Kinsey (2001) pointed out that consumers are the beginning of the value chain from which the flow of information about food preference moves back to retailers, manufacturers and to farmers and scientific laboratories. The importance of understanding consumer preference has been advocated by many other researchers. Boehlje (1999), for example, emphasized the importance of information in the value chains. He explained the fact that customer information is the resource that can be used to understand market systems better. Researchers, extension staff and NGO personnel need a way to identify the bean traits that they should focus on. Hedonic pricing methods provide a systematic, formal mechanism for estimating the strength of bean preferences.

Following the identified information gap, the general objective of this study is to estimate the premiums and discounts negotiated by consumers for various visual characteristics of beans in traditional open markets in Tanzania. This objective is achieved by testing the hypotheses that bean consumers in the urban markets of Dar es Salaam and Morogoro;

i. are willing to pay a premium for larger sized bean grains,
ii. discount damaged bean grains that result from bruchid holes,
iii. are willing to pay a premium for bean grains with shiny skin,
iv. discount beans with higher a percentage of discolored grains, and
v. discount beans with a higher percentage mix.

Methodology

Retail level bean samples were purchased monthly in two markets in the Dar es Salaam region and in two markets in the Morogoro region in Tanzania. The markets in Dar es Salaam were the Buguruni and Tandika markets. The markets in Morogoro were the Central and Sabasaba markets. The Buguruni market is located in the suburbs of Dar es Salaam and handles almost all kinds of agricultural commodities. For the bean trade, both wholesale and retail business is conducted in the Buguruni market. The Tandika market is mainly a grain market located also in suburbs of Dar es Salaam. Compared to the Buguruni market, the Tandika market is much larger and carries a wider range of merchandise, from food to household goods.

The Central Market in Morogoro is located right at the centre of the Morogoro municipality. Apart from agricultural commodities traded in the Central Market, there are also other household items. The Sabasaba market is located in the suburbs of Morogoro municipality. This market mostly caters to low income consumers in Morogoro; agricultural commodities business being the major activity of the market.

Hedonic price estimation techniques have been applied to a wide range of economic issues ranging from determining optimal production mix to marketing issues (Kawamura 1999; Walburger and Foster 1994; Parker and Zilberman 1993; Espinosa and Goodwin 1991; Unnevehr 1986; Brorsen *et. al.* 1984, Langyintuo, *et. al*. 2004, Mishili *et. al*. 2009). In this study, hedonic analysis is used to analyze the consumer preferences for bean grain quality characteristics. A good way of understanding the hedonic analysis framework is to view each good in terms of the set of characteristics it possesses (Ladd and Suvannut, 1976). For any given good, beans for example, let the set of characteristics be ordered and denoted by $x = (x_1, \ldots\ldots, x_k)$. It is then assumed that the preference of consumers in the market for a particular good is solely

determined by its corresponding characteristics vector. In addition, it is assumed that there is a functional relationship between the price of the good, p, and its characteristic vector x in the form of equation p = f(x). This functional relationship specifies the hedonic relationship or hedonic regression typical for the good in the market (Hans, 2003).

Empirical estimation, using hedonic price analysis, then takes the form of:

(1) $$P_C = \sum_{j=1}^{m} X_{Cj} \beta_{Cj} + \varepsilon$$

where, P_C is the per kilogram price of beans and ε is random error. The dependent variable P_C will vary for the different bean characteristics. The independent variables, the X_{Cj}, should explain variance in price per kilogram of beans, and the parameter estimates (β_{Cj}'s) give the implicit values of grain characteristics.

From the general function, the regression model that was estimated for this research was of the form:

(2) $$P_{it} = \alpha_{io} + \sum \gamma_{ir} Y_{irt} + \sum \Psi_{ik} M_{ikt} + \sum \beta_{ij} X_{ijt} + \varepsilon_{it}$$

Where: P_{it} is the per kilogram price of beans in US$ (equivalents of local currencies in Tanzania) market i (i = 1, 2, 3 and 4) at time t (t = 1, 2, …… ,T). Y_{irt} is Yearly dummy (r = 1, 2, ..,N), and M_{ikt} is Monthly dummy (k = 1, 2, …., 11) to account for the effect of time in price variability. X_{ijt} referred to the beans characteristics (j = 1, 2, …., J), size of the bean grains (weight of 100 grains), grain damaged by bruchids, percentage discolored grains and percentage mix. α is constant term, β, Ψ, and γ are parameters estimated, and ε is a stochastic error term. Separate equations were estimated for each of the four markets because of different sample size between the Dar es Salaam and Morogoro markets. Seemingly Unrelated Regression (SUR) technique was used for each city separately to capture the correlation of prices at different markets in the same region (Zellner, 1962).

The price variable is reported as market price per kilogram. The monthly dummy variables are important to account for the seasonal variation in bean prices noted above and the month of July was used as the reference month in all the markets. The yearly dummy variables account for the different market conditions in each market year. The yearly dummy variables were constructed as seasonal years where the year was considered to start during the harvest time for rainfed production from March to February of the following year, and seasonal year 2004 was used as a reference year for Morogoro while year 2007 was used as reference year for Dar es Salaam markets. The number of holes per 100 grains was entered in the model as an absolute value. Grain appearance (shininess) and common bean type (variety) were entered as dummy variables. The grain appearance dummy variable took the value one for natural grains and zero for grains that have been treated with cooking oil and shined by rubbing with a cloth. A value of one was assigned for each bean type (variety) when that bean type was considered, and zero otherwise. There were four bean types, namely Soya Kablanketi, Red Canadian Wonder, Yellow (Kigoma), and Mixture, and the Soya Kablanketi was used as a reference group.

This analysis uses samples from a multiyear period in each region. Dar es Salaam data was collected between March, 2006 and June, 2007. Morogoro data was collected from March, 2003 to June, 2007. The sample selection and data collection procedure followed a common protocol in all four markets. Samples were purchased each month on a predetermined day (e.g. third

Thursday) and at a common time. Target markets were visited between 10:00 a.m. and 12:00 noon of the selected day. The number of bean traders in the market was determined by head count (without drawing the attention of the traders to the counting process; this means that they were counted discreetly as one walked through the market). To choose the five traders to interview, the total number of grain traders in the particular market was divided by five (because the target sample size was five) and rounded to the nearest whole number. For example, if there were 27 grain traders, the figure required was 5 (27/5 = 5.4). The first grain trader near one end of the line in which traders sat was selected [In cases of multiple lines, any one line was chosen as starting point]. The remaining four traders were selected by every other *nth* trader, where *n* was the value obtained in above (i.e. every 5^{th} trader). A bowl of beans was bought from each of the 5 traders. Separate containers were used for each of the 5 transactions. Each trader was interviewed and secondary information such as source of the beans and season harvested was recorded. The five samples of beans were then taken to the laboratory where data on 100 grain weight, number of bruchid holes, percentage discolored, percentage mix, grain cleanness and other physical and chemical characteristics were recorded. Data collection was done once every month. On subsequent visits, the same procedure was followed but the starting point was changed (the location that the first grain trader was selected was different). The buyer was instructed to bargain just as he or she would in making any purchase in a traditional African market.

To make the results of this study more robust, the model transformation procedure was employed in order to compare the model functional forms and decide on the more appropriate model for this study. The Box and Cox transformation analysis was used which is basically a modified power transformation (Sakia, 1992). For generalizing linear model, the Box-Cox transformation is of the form

(3) $$x^{(\lambda)} = \frac{x^{\lambda} - 1}{\lambda}$$

In the linear model the analysis can be done conditionally. For a given value of λ, the model is

(4) $$y = \alpha + \sum_{k=1}^{k} \beta_k x_k^{(\lambda)} + \varepsilon$$

Often, the least square values of λ is between -2 and 2 (Greene, 2003).

The Box-Cox model can be extended to applications in which both the dependent and the set of independent variables are transformed in the same way (SHAZAM, 1997). The functional form for the same transformation is written as

(5) $$Y^{(\lambda)} = X^{(\lambda)}\beta + \varepsilon$$

which means the same value of lambda transforms all the variables in the model.

Results and Discussion

The results reported in this section is for the four bean markets in Tanzania; two markets located in the Dar es Salaam region and two in the Morogoro region. To make the results more meaningful for readers outside Tanzania, the prices and values were converted to US dollar from Tanzanian shillings. The exchange rate used for this study followed a conversion rate of 1 dollar to 1143.40 Tanzania shillings, and the official rates were quarter averages covering the period between the first financial quarter of 2003 to the second financial quarter of 2007 (IFS, 2008).

From the descriptive statistics in Table 1, the results show that there was no large bean price difference within the regional markets and across the regional markets. However, the

common bean prices in Morogoro were less variable than bean prices in Dar es Salaam. In all markets in Dar es Salaam and Morogoro, the bean prices were very similar across the market categories. Nonetheless, the Mixture category prices were lower in Morogoro markets in comparison with pure bean varieties in the same markets (Table 1).

Table 1: Average Bean Grain Characteristics (Standard Deviation in Parentheses)

Region		Prices ($kg-1)[1]	Grain Damage (No. of holes in 100 grains)	Grain size (Weight of 100 grains (g))	Percentage discolored (%)	Percentage mix (%)
Dar es Salaam			Buguruni market			
	Soya Kablanketi	0.65 (0.09)	0 (1)	43.0 (4.8)	9 (5)	5 (5)
	Red Canadian Wonder	0.58 (0.10)	2 (3)	39.9 (6.7)	9 (4)	1 (3)
	Yellow (Kigoma)	0.60 (0.08)	0 (1)	35.2 (3.7)	10 (6)	2 (3)
	All types	0.61 (0.10)	1 (2)	39.5 (6.1)	9 (5)	3 (4)
			Tandika market			
	Soya Kablanketi	0.67 (0.09)	1 (1)	41.8 (4.0)	10 (7)	5 (6)
	Red Canadian	0.59 (0.07)	5 (12)	42.2 (7.4)	9 (6)	3 (4)
	Yellow (Kigoma)	0.57 (0.15)	1 (2)	35.3 (2.8)	10 (6)	5 (9)
	All types	0.61 (0.11)	2 (7)	40.0 (6.0)	10 (7)	4 (7)
Morogoro			Central market			
	Soya Kablanketi	0.66 (0.14)	1 (3)	42.6 (7.2)	7 (6)	3 (5)
	Red Canadian Wonder	0.62 (0.16)	1 (2)	45.7 (7.8)	7 (8)	1 (1)
	Yellow (Kigoma)	0.60 (0.15)	1 (2)	40.1 (6.2)	7 (6)	3 (4)
	Mixture	0.58 (0.15)	1 (2)	40.3 (8.1)	4 (3)	100 (0)
	All types	0.62 (0.15)	1 (3)	42.5 (7.6)	7 (6)	14 (32)
			Sabasaba market			
	Soya Kablanketi	0.67 (0.13)	0 (2)	45.5 (5.8)	7 (7)	2 (4)
	Red Canadian Wonder	0.64 (0.15)	1 (2)	44.4 (6.1)	7 (5)	1 (3)
	Yellow (Kigoma)	0.62 (0.16)	1 (2)	40.1 (6.5)	7 (6)	3 (5)
	Mixture	0.60 (0.16)	1 (2)	42.8 (5.7)	6 (7)	100 (0)
	All types	0.64 (0.15)	1 (3)	43.3 (6.4)	7 (6)	14 (32)

Source: Tanzania country study SUA-Bean/Cowpea CRSP project March 2003 – June 2007

[1]. Exchange rates used were the average exchange rate (in US$) between Jan 2003 and June 2007

In Morogoro markets, the damage levels were very similar within and across the markets and across the bean varieties. The damage level was slightly different for Dar es Salaam markets compared to the Morogoro markets. Red Canadian Wonder bean variety seemed to have modestly higher damage levels relative to the other bean varieties in the same market. The problem of higher damage levels for Red Canadian Wonder beans was more pronounced in the Tandika market than in the Buguruni market in Dar es Salaam. The reason for such a trend could be because Dar es Salaam is the coastal region with higher humidity, so we expect the bruchid insect infestations to be higher than in the Morogoro region, which is an upcountry region with cooler and dryer climate conditions.

The beans in the Morogoro markets were larger than in Dar es Salaam. In addition, the grain sizes varied across the bean types and across the markets. This phenomenon might be due to the fact that the beans in all markets come from different sources across Tanzania.

The percentage of discolored grains was very similar across the markets in each region and across bean varieties (Table 1). Likewise, the percentage of grain mix in all markets was similar across the bean market categories.

Table 2 reports the sugar levels in common beans across the markets and across bean types. The sucrose data series is the only subset of the overall data series, hence was not used in hedonic analysis. The percentage of sugar content ranged between 1.49% and 1.70% in all four markets and for all four bean varieties. From Table 2 it is evident that no particular bean variety has higher average sugar content than other bean variety across all four markets.

Table 2: Sugar Levels in Different Bean Varieties in Tanzanian Markets 2006/07

Market	Variety (as per TZ markets)	Sample Size (n)	Percentage Sucrose (%)	
			Mean	Std. Dev.
Central	1. Soya Kablanketi	36	1.52 (0.58 – 2.56)	0.49
	2. Red Canadian Wonder	32	1.61 (0.76 – 2.42)	0.42
	3. Yellow (Kigoma)	36	1.70 (0.64 – 2.72)	0.57
	4. Mixture	12	1.63 (1.04 – 2.36)	0.52
Sabasaba	1. Soya Kablanketi	34	1.70 (0.86 – 2.54)	0.48
	2. Red Canadian Wonder	34	1.62 (1.20 – 2.68)	0.35
	3. Yellow (Kigoma)	36	1.63 (0.34 – 2.38)	0.53
	4. Mixture	12	1.65 (1.12 – 2.48	0.48
Buguruni	1. Soya Kablanketi	28	1.50 (0.72 – 1.92)	0.34
	2. Red Canadian Wonder	30	152 (1.06 – 2.54)	0.37
	3. Yellow (Kigoma)	28	1.59 (1.16 – 2.16)	0.28
Tandika	1. Soya Kablanketi	30	1.52 (1.02 – 2.10)	0.32
	2. Red Canadian Wonder	28	1.49 (0.94 – 2.04)	0.33
	3. Yellow (Kigoma)	28	1.65 (0.80 – 2.44)	0.42

Source: Tanzania country study SUA-Bean/Cowpea CRSP project March 2003 – June 2007

Note: The numbers in parentheses are minimum and maximum values respectively.

The observed trend of having bean sugar content so similar across the bean types and across the markets is not a surprise result. This phenomenon could occur due to the fact that bean sources of

supply to all four markets are the same. Therefore one should expect to see similarities in physical and chemical properties across the bean markets.

Table 3 reports the average cooking time, in hours, for different bean varieties. Cooking time is one of the important bean quality characteristics that bean consumers care about. Like the sugar level variable, cooking time data series is only a subset of the overall data series, hence was not included in the hedonic price analysis.

Table 3: Bean Cooking Time by Bean Varieties (units in hours)

Bean type	Average	Minimum	Maximum	Std. Deviation
Soya Kablanketi	1:22	0:55	1:45	0:15
Red Canadian Wonder	1:29	0:10	1:55	0:33
Yellow (Kigoma)	1:15	0:38	1:49	0:26

Source: SUA-Bean/Cowpea survey in Tanzania 2006/2007

The average cooking time of the three common bean varieties ranged from 1 hour and 15 minutes to 1 hour and 29 minutes (Table 3). Among the three varieties, Yellow bean variety has the lowest average cooking time but a bit higher average cooking variant compared to the Soya Kablanketi variety. The Soya Kablanketi variety has an average cooking time of 1 hour and 22 minutes with a very narrow cooking time variant relatively. Beans consumers in Dar es Salaam markets may prefer Soya Kablanketi because of its low average cooking time and narrow average cooking variant. Notice that in Dar es Salaam, cooking fuels (charcoal and fire wood) are expensive, especially for the low income households, therefore these results potentially explain why consumers will prefer common beans with lower average cooking time.

The Seemingly Unrelated Regression (SUR) analysis results are reported in Table 4 for all four markets. Notice that because of the difference in sample size between Dar es Salaam and Morogoro markets, the SUR was implemented in blocks. Thus, two blocks were created; one for Dar es Salaam data sets and the other block for Morogoro data sets. Despite having different data set blocks with different sample sizes, the results are consistent across the blocks.

Table 4: Estimated Regression Coefficients for Dar es Salaam and Morogoro Markets

	Markets			
	Dar es Salaam		Morogoro	
	Buguruni (n = 98)	Tandika (n = 98)	Central (n = 335)	Sabasaba (n = 335)
Variable name				
Grain size	0.0007	0.0022	0.0006	0.0003
Grain damage	-0.0138***[1]	-0.0014	0.0018	0.0001
Percentage discolored	-0.0028*	0.0010	-0.00001	0.0002
Percentage mix	-0.0009	-0.0018	-0.0025**	-0.0021**
Soya Kablanketi	ref	ref	ref	ref
Red Canadian wonder	-0.0443**	-0.0658***	-0.0498***	-0.0288***
Yellow (Kigoma)	-0.0799***	-0.0830***	-0.0577***	-0.0395***
Mixture	NA	NA	0.1940*	0.1507
Natural beans	0.0612***	0.0392*	0.0143	0.0054
Month dummies				
January	0.1152***	0.1036*	0.0314	0.0601***
February	0.0625	0.0779	0.0582***	0.0693***
March	0.1746***	0.1002**	0.0146	0.0020
April	0.1392***	0.0701	0.0305	-0.0029
May	0.0598	0.0615	0.0067	-0.0006
June	0.0728*	-0.0181	0.0246	0.0167
July	ref	ref	ref	ref
August	0.0555	-0.0134	-0.0951***	-0.1034***
September	0.0603	0.0046	-0.0900***	-0.0723***
October	0.0759	0.0325	-0.0639***	-0.0549***
November	0.0362	0.0663	-0.0179	0.0794***
December	0.1411***	0.0410	0.0161	0.0197
Year dummies				
2003	NA	NA	-0.0370***	-0.0456***
2004	NA	NA	ref	ref
2005	NA	NA	0.0551***	0.1141***
2006	0.0713***	-0.0572**	0.2438***	0.2388***
2007	ref	ref	0.2996***	0.3295***
Constant	0.4897***	0.5495***	0.5494***	0.5587***
R-square	0.48	0.46	0.77	0.78

Source: Tanzania country study SUA-Bean/Cowpea CRSP project March 2003 – June 2007

[1]Statistical Significance (*** = 1%; ** = 5%; * = 10%)

NA = Not available in this market

Data for Dar es Salaam markets was collected only for two years 2006/2007.

In the Buguruni market in Dar es Salaam, bean consumers discount the damaged bean grains and the results were statistically significant. As in cowpea hedonic pricing studies in West and Central Africa, estimating a damage effect is complicated by the fact that many grain retailers sort and clean their stock, so it is difficult to observe the full effect of damage levels. The result in all four markets had an expected positive sign for grain size variable but the results were not statistically significant in any market. These results are similar with the preliminary analysis of

Tanzania bean data by Temu and Lowenberg-DeBoer, (2005) who reported that consumers in Morogoro markets were willing to pay premium for large bean grains and the results were statistically significant. The consumers in the Buguruni market discount for discolored grains and the results are statistically significant (Table 4). Bean consumers in Morogoro markets discount for mixed grain and the results are statistically significant. When a comparison is made across varieties, consumers in all markets in Dar es Salaam and Morogoro discount for Red Canadian wonder and Yellow (kigoma) compared to Soya Kablanketi with the same size, damage level and skin appearance, and the results are statistically significant (Table 4). Bean consumers in Central market are willing to pay a premium for Mixture beans. In Buguruni and Tandika markets in Dar es Salaam, bean consumers are willing to pay a price premium for natural (not shiny) beans (Table 4). The premium for natural beans is opposite of the hypothesis. This premium may be due to the fact that beans may be shined with oil that has previously been used for cooking or is otherwise low quality. The oil may also attract dust and make the beans difficult to clean before cooking. While use of oil to shine beans appears to have declined in Tanzania in recent years, the suspicion that oil may have been used may be enough to trigger a premium for natural beans. Dummy variables for months and years were incorporated in the model analysis to capture the seasonality effect across the month and in subsequent years of research.

To see that the correct model specification was used, Box-Cox analysis was implemented to check the validity of the model forms. Table 5 reports the results of the Box-Cox transformation procedure. Column two of Table 5 reports the suggested power of transformation for the both sides Box-Cox model with same parameters. Also, Table 5 reports the likelihood ratio tests for the hypotheses that the Box-Cox parameter is -1, 0 and 1.

Table 5: Box-Cox Transformation Results

		P-value Test H_o: for λ = -1, 0, 1			
Region/market	Model (λ)	(λ = -1)	(λ = 0)	(λ = 1)	Suggested Model forms (at conventional 5%)
Dar es Salaam					
Buguruni	1.0**[1]	0.000	0.039	0.979	Linear
Tandika	2.5***	0.000	0.000	0.000	Inconclusive
Morogoro					
Central	0.5***	0.000	0.009	0.002	Inconclusive
Sabasaba	0.2	0.000	0.348	0.000	Inconclusive

Note: The Box-Cox implemented was "both sides Box-Cox model with the same parameter". The test statistic is based on the restricted log likelihood model. P-vales reported are for LR statistics.

[1]Statistical Significance of the model λ coefficient (*** = 1%; ** = 5%; * = 10%)

The hypotheses testing for the Buguruni market corresponds to no transformation at all, and in our application cannot be rejected at the conventional five percent level, indicating that that there is no evidence that we need to transform the models. The Box-Cox results in the other markets are unclear as to what model transformation is best. It was observed that with different functional forms, there was no advantage of increasing the explanatory power of the model. Therefore, this study used the linear regression model in all four markets to analyze the relationship between price and quality characteristics.

Implication of Results

Since the units of measure of regression coefficients are different, there was a need to standardize the results so that we can have a comparison across the quality characteristics. The standardization adopted in this study is the percentage of price per unit change of each of the quality characteristics relative to the average price of the season (Table 6). In Dar es Salaam markets, bean consumers received a discount of 2.3% of the average bean grain price per kilogram for every hole per 100 bean grains. In all four markets, the range of price discounts is between 4.5% and 13.6% if an additional kilogram of bean variety other than Soya Kablanketi is sold. In Central market, the Mixture category has a positive coefficient (31.3% of average price) compared to Soya Kablanketi, but the overall effect of mixed beans is negative because the Mixture category is 100% mixed and each percent mix carries a 0.3% to 0.4% discount in Morogoro.

The range of price premiums for natural (not shiny) beans in the Dar es Salaam market ranges between 0.8% to 10.0% of average price (Table 6), with the 6.4% and 10% estimates statistically significant. In Buguruni market in Dar es Salaam, consumers received a statistically significant discount of up to 0.5% per kilogram for every additional discolored grain in the 100 bean grains. For every additional off type grain in 100 beans in the Morogoro market, consumers discounted the price in the range between 0.3% and 0.4% of average bean price per kilogram.

Table 6: Estimated Percentage Price Change per Kilogram as Change in one unit of Independent Variable in Dar es Salaam and Morogoro Markets

	Markets			
	Dar es Salaam		Morogoro	
	Buguruni (n = 98)	Tandika (n = 98)	Central (n = 335)	Sabasaba (n = 335)
Variable name	Percentage Change (%)			
Grain size	0.1	0.4	0.1	0.04
Grain damage	-2.3***[1]	-0.2	0.3	0.02
Percentage discolored	-0.5*	0.2	-0.002	0.03
Percentage mix	-0.2	-0.3	-0.4**	-0.3**
Red Canadian wonder	-7.3**	-10.8***	-8.0***	-4.5***
Yellow (Kigoma)	-13.1***	-13.6***	-9.3***	-6.2***
Mixture	NA	NA	31.3*	23.6
Natural beans	10.0***	6.4*	2.3	0.8

Source: Tanzania country study SUA-Bean/Cowpea CRSP project March 2003 – June 2007

[1]Statistical Significance (*** = 1%; ** = 5%; * = 10%)

NA = Not available in this market

Data for Dar es Salaam markets was collected only for two years 2006/2007

Percentage values were calculated as (β_i / Av. Price in Market i) x 100

Conclusions

The results of this study are supported with all hypotheses of the study. Preferences for pure bean varieties were statistically significant for all bean varieties. In the Central market in Morogoro, the premium for the Mixture category is 31.3% per kilogram, but the overall mixed bean effect is usually negative because the discount for every percentage of off category beans ranged from 0.3% to 0.4% of average price. For Red Canadian wonder and Yellow (Kigoma) the price difference compared to Soya Kablanketi is a discount of between 4.5% and 13.6% of average price. None of the coefficients for the grain size were statistically significant, but all the coefficients for grain size had expected positive signs. Only in one market in Dar es Salaam were the coefficients for bruchid damage statistically significant. The discount per bruchid hole for this market was 2.3% of average price per kilogram.

In some senses, consumer preferences for common beans in Tanzania are comparable to cowpea preferences in West African markets reviewed in section 5. Consumers have strong local preferences for bean and cowpea color. They tend to favor larger grain size, though that evidence

is stronger for cowpea than for common bean. Discounts for storage damage is hard to document in both cases because of merchant sorting, but in some markets statistically significant reductions are noted for bruchid holes. Both markets have strong seasonal price patterns.

The common bean hedonic pricing analysis for Buguruni, Tandika, Central and Sabasaba markets reported here suggests that efforts to improve common bean markets in Tanzania, and probably in the region, should target bean varieties preferred by consumers and simple storage technologies such as triple bagging to reduce storage damage. Consumers in this study almost universally preferred the Soya Kablanketi bean variety. Estimation of damage discounts is difficult because of grain sorting by merchants, but this study shows that damage can have a statistically negative effect on prices. Effective chemical and non-chemical storage technologies (Murdock *et. al.*, 2003) could help farmers and merchants reduce damage discounts, and the need to discard damaged grains. Polishing beans with cooking oil should be avoided. Consumers are willing to pay a premium for natural (not shiny) bean, probably because of concerns about the quality of the cooking oil used and difficulty in cleaning the shiny beans before cooking. Researchers and technology transfer organizations should offer a portfolio of bean varieties to fit local preferences.

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