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Abstract

The production and trade of cowpea (Vigna Uniculata), called "blackeyed peas" in the US, are a growing business for farmers and merchants serving the rapidly expanding urban areas of West and Central Africa. Cowpea fits the needs of the urban poor. It is an inexpensive source of protein that does not require refrigeration. A better understanding of consumer preferences for cowpea is essential to market development. The main objective of the study was to determine the cowpea grain quality characteristics that command a price premium or provoke a discount in Ghanaian, Malian and Nigerian markets. Specifically, the study looked at the impact of the grain size, texture, color, eye color, and bruchid-damaged grains on cowpea market prices.

The data for the study were collected from six markets in Ghana; four markets were in the capital city of Accra and two markets in Kumasi. In Mali, two markets were surveyed, Marché de Sabalibougou and Marché Medine. In Nigeria three markets were surveyed, Iddo in Lagos; Monday, in Maiduguri; and Dawanau in Kano. Hedonic pricing methods provide a statistical estimate of premiums and discounts.

The results of the study indicated that cowpea consumers in Ghana, Mali and Nigeria are willing to pay a premium for large cowpea grains. Cowpea consumers discount grains with storage damage from the very first bruchid hole. The impact of price on other cowpea quality characteristics such as skin color and texture, and eye color varies locally.

Implications for development of the cowpea value chain include: 1) breeders and cowpea production researchers should identify cost-effective ways to increase cowpea grain size because larger grain size is almost universally preferred, and 2) entomologists and storage experts should develop and transfer improved storage technologies to reduce damage discounts, and 3) serving local markets requires a portfolio of grain skin color, eye color and skin texture combinations.

Keywords: Cowpeas market chains, consumer preference, hedonic price analysis

JEL codes: D12, Q13

I. Introduction

Cowpeas (*Vigna unguiculata*), also known as black-eyed peas in the United States, are the most important indigenous grain legume in West and Central Africa. They are grown by small scale farmers throughout the region and because cowpeas are naturally drought tolerant they are extremely important in semi-arid areas. Cowpeas are important to small scale farmers because they are a cash crop, as well as providing high protein food for family consumption. The rapidly expanding urban populations of West Africa create an opportunity for cowpea producers and merchants. Farmers and merchants in traditional markets usually have a good sense for the preferences of their immediate customers, but a regional understanding of consumer preferences is needed to support expanded trade. In particular, researchers developing higher yield cowpea production systems and non-governmental organizations (NGOs) doing technology transfer lack information on these cowpea preferences. The objective of this study is to measure the preferences of urban cowpea consumers in selected West African cities. Cowpea samples were purchased monthly over a multi-year period. Premiums and discounts for grain size, damage levels and other characteristics were estimated using hedonic pricing techniques. The study provides essential information for everyone involved in developing the cowpea value chain in West Africa, from cowpea breeders to national extension staff and policy makers.

In West Africa cowpea grain passes through a well established value chain with regional trade flowing mainly from the semi-arid production areas in the Sahel to the more urbanized coastal zones (Langyintuo et al., 2003). The international research and development community has recognized the importance of cowpea to the development of West and Central Africa. The Bean Cowpea Collaborative Research and Support (CRSP) program funded by the United States Agency for International Development (USAID) has conducted research on production,

marketing and utilization of cowpea in West Africa for over 20 years. The cowpea marketing team of the Bean/Cowpea CRSP has good linkages with local and international organizations with cowpea market research program including International Institute of Tropical Agriculture (IITA) and it's Cowpea Project for Africa (PRONAF). The importance of understanding markets and market chains has been recognized by national agricultural research systems and by non-governmental organizations throughout West Africa, including World Vision (www.wvi.org), the National Agricultural Research Institute of Niger (INRAN), the Rural Economics Institute (IER) of Mali; and the Institute for Agricultural and Environmental Studies (INERA) of Burkina Faso.

The following section of this paper highlights key characteristics of the study region. The role of cowpeas in the economy and particularly with respect to development is also described. Section III contains a description of the cowpea value chain and highlights previous research that has provided insight on the operations and effectiveness of cowpea markets. The fourth section of the paper discusses the motivation for the research and states specific hypotheses. The research methodology is then presented followed by a presentation of the results. Implications and suggestions for further research form the final section of the paper.

II. West Africa and the Importance of Cowpeas

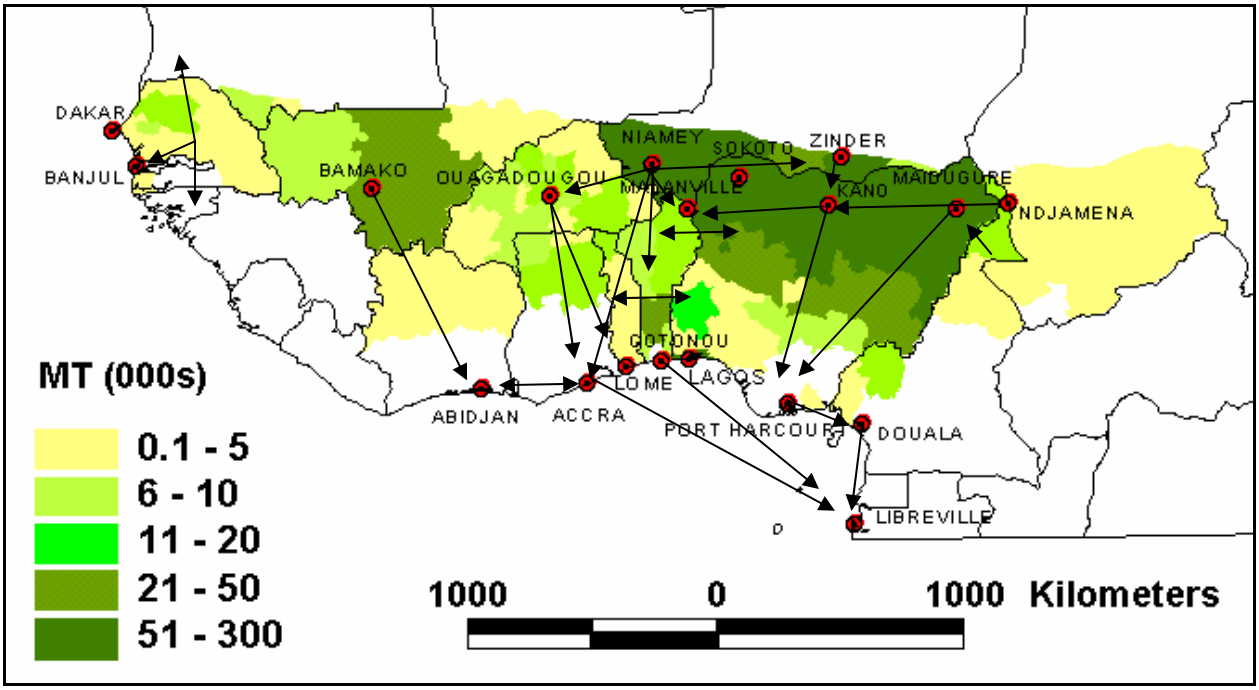
In West and Central Africa cowpeas are big business. In the 1990s about 2.6 million tons of cowpea were produced on 7.8 million hectares annually (Lanygintuo et al, 2003). Depending on the location, year, and time of year, the retail price of cowpea varies from about US$200/ton to over US$1000/ton. At a conservative value of US$500/ton, the retail value of cowpea in West and Central Africa is US$1.3 billion per year. Cowpea production in West and Central Africa represents almost 70% of world production of cowpea and about 80% of world cowpea

production area. Official sources record a regional cowpea grain trade of almost 300,000 metric tons annually in the late 1990s. The unofficial trade is probably much larger. The largest cowpea exporting country in the region (and in the world) is Niger. Nigeria is the largest cowpea producer in the world with an annual production of almost 1.7 million metric tons in the 1990s. With about 25% of the population of Sub-Saharan Africa, Nigeria is also the largest importer of cowpea in the region.

Cowpea production is concentrated in the drier areas of West and Central Africa (Figure 1). The northern limit of production is approximately the 300 mm rainfall isohyte almost the Sahara Desert. In general cowpea trade flows from the drier inland areas to the more humid and densely populated coastal areas. The largest cowpea market in the world is Dawanau Market in Kano in northern Nigeria. Cowpea storage capacity in Dawanau Market exceeds 200,000 metric tons. Merchants from the Dawanau Market finance a network of cowpea buyers throughout Niger and the neighboring countries. Merchants from southern Nigerian cities come to Kano to purchase cowpea. A similar pattern occurs at a smaller scale in other coastal countries.

Although cowpea grain is two or three times as expensive as maize, rice or other cereals, it is relatively cheap compared to other protein sources (e.g. milk, meat, eggs). Because cowpea grain can be stored it is an important protein source for poor people who do not have access to refrigeration. Cowpea is often call the “poor man’s meat.” Cowpeas are used both for food preparation at home and for production of street foods. At home cowpeas are often added to sauces and stews. Cowpea fritters, called “kosai” in some inland areas and “akara” in many coastal countries, are one of the most common street foods. Informal observation suggests that in West Africa the income elasticity of cowpea consumption is positive and relatively high. In West

and Central Africa, when the incomes of poor people grow they often increase cowpea consumption.



Source: Lanygintuo et al, 2003.

Figure 1. Distribution of cowpea production and movement in West and Central Africa. Arrows indicate the major movement of cowpea grain trade.

While the countries of West Africa are poor by any standard, their markets are growing (Table 1). Population growth averages between 2% and 3% per year. That population is increasingly urban. Urban population is increasing by 3% to 5% annually. Incomes are low. Gross Domestic Product (GDP) per capita is in the $200 to $400 range for the inland countries and in the $200 to $900 range for coastal countries. But some markets have seen remarkable growth. For example, cell phone use has spread rapidly in the region from almost nothing a decade ago to over 10% of the population in some countries (Table 1). For some countries rising prices for energy (ie. oil in Nigeria, Cameroon and Tchad, uranium in Niger) provide an

economic engine for increased demand. In other countries agricultural product exports (e.g. cocoa, cotton) provide the impetus toward economic growth. Selling to consumers in West Africa is an opportunity for the local and international entrepreneurs who understand their preferences and develop ways to serve them.

Table 1. Market Potential Indicators for West and Central African Countries, 2004

	GDP -Per Capita $US	Population in millions	Pop. Growth rate (%)	Percent Urban Pop. (%)	Cell Phones per 1000
Benin	498	8.2	2.73	39.7	NA
Burkina Faso	376	12.8	3.00	17.9	31
Cameroon	897	16.0	2.04	53.7	96
Cote D'Ivoire	866	17.9	2.03	44.6	86
Gambia	281	1.5	2.84	53.0	118
Ghana	409	21.7	2.07	47.1	78
Guinea	421	9.2	2.63	32.6	NA
Guinea Bissau	182	1.5	2.07	29.6	NA
Mali	371	13.1	2.63	29.9	30
Mauritania	515	3.0	2.88	40.3	175
Niger	228	13.5	2.92	16.7	11
Nigeria	560	128.7	2.38	47.3	71
Senegal	683	11.4	2.34	41.3	90
Sierra Leone	202	5.3	2.30	39.9	22
Tchad	447	9.4	2.80	24.8	13
Togo	344	6.0	2.72	39.4	NA

Source: United Nations, Human Development Report, 2006
NA = not available

III. The Cowpea Value Chain

Cowpeas are consumed regularly in virtually every household in West Africa. Although some cowpeas are purchased as green pods at harvest time and in some regions the leaves are eaten as greens, the majority of cowpeas are sold as grain in bulk form. Vendors display large bowls of cowpea that consumers can inspect before making their purchase. There are a number of visual characteristics of cowpeas that have been shown, at least anecdotally, to be preferred by consumers. For example, the main varieties available on the open markets in West Africa are white cowpeas seeds with black eye (Lambot, 2000), but in some areas red or black speckled cowpeas are preferred.

Cowpeas vary according to the size of the grain, color of the skin, texture of the skin, color of the eye, and amount of damage resulting from insects. The size of the grain is commonly measured by breeders by weighing 100 randomly selected grains. The color of the cowpeas (often referred to as skin color or testa color) varies and can be white, black, brown or red. Cowpea skin can be a uniform color or speckled. The skin or outer coating of the cowpeas can be rough or smooth. The color of the eye of the cowpeas can be black, grey or brown. It is important to note that while one advantage of cowpeas grain is that grains can be stored for use throughout the year, a major disadvantage is that cowpea grains are prone to insect damage. In particular, cowpea weevils (called bruchids) infest the cowpeas and eat holes in the grain. It is generally understood that consumers prefer cowpeas with less insect damage. Effective chemical and non-chemical storage methods are available, but West and Central African producers and merchants do not always use them (Murdock et al, 2003).

The cowpea value chain consists of traders and markets that ensure a movement of grain from rural markets to urban wholesale markets and finally to consumer markets. The cowpea

value chain begins with the production of cowpeas by small scale farmers throughout West Africa as shown in Figure 2. In the Sahelian countries of Niger, Burkina Faso and Mali, and in the inland areas of coastal countries, farmers typically sell their marketable surplus grains to rural assemblers, who in turn sell to urban wholesalers directly or through commission agents (Langyintuo, *et. al.*, 2003). Exports and imports of cowpea amongst the countries in West and Central Africa is substantial, with official sources recording regional cowpea grain trade of almost 300,000 metric tons annually in the late 1990s. Commission agents sell grain on behalf of their clients (rural assemblers), and provide storage but do not take any price risk associated with the storage function. Usually the commission fee paid to the commission agent by rural assemblers varies from country to country. The commission fee is often about 2% of the wholesale price depending on the country in question (Langyintuo, *et. al.*, 2003).

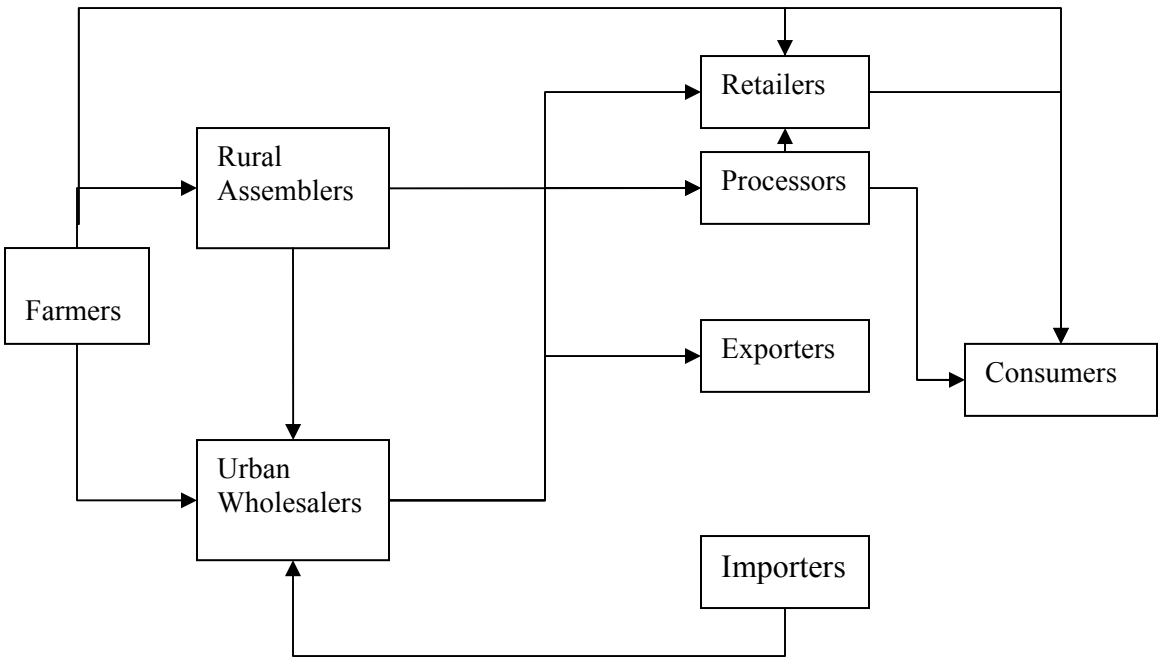


Figure 2: The Typical Within Country Cowpea Value Chain in West and Central Africa

In Nigeria, Ghana, Togo, Benin and Burkina Faso, grain traders have organized themselves into commodity based associations to promote marketing of grain and to put in place the guidelines for grain pricing (Langyintuo, *et. al.*, 2003). These associations provide a bridge between grain traders and government organizations.

Faye et al. (2006) report on a hedonic pricing analysis of data from six markets in Senegal. Larger grain size was statistically significant and positive at all markets, but the premium varied from 1% of average price in the Castors Market in Dakar for a one gram increase to 16% in the Mpal Market, in northern Senegal. The bruchid damage coefficient is negative and statistically significant only for the Tilene Market in Dakar. 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. However, there was an exceptional case in the Mokolo, Cameroon, and Wa, northern Ghana, markets where consumers prefer small-seeded traditional cowpea grains presumably because of the taste. 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 cowpeas grain with black eyes. However, cowpea consumers in Northern Cameroon discount cowpeas grains with black eyes. Langyintuo *et. al*. also reported that in northern Ghana, consumers pay a premium for white cowpeas.

As described above, market participants engage in moving, storing, grading and processing cowpeas in expectation that this will augment their value to consumers as they will be

able to supply or serve the market segments with needed produce at a particular time of the year. In West Africa all cowpea production occurs between October and December while consumption occurs throughout the year. The variation of cowpea prices are typical of a commodity where production occurs at one point in time and the product is stored for use throughout the year. Typically, prices are lowest during harvest. Prices rise steadily thereafter to a peak in the June, July, August period.

In addition to consumer preferences there are also other factors which influence cowpeas consumption in West Africa. Kormawa *et. al.* (2000), reported that in Nigeria the level of consumption of cowpea is determined by four major factors including: income level of consumers, taste of the product, market price of cowpea and of its close substitutes, and population density of towns. Further Kormawa *et. al.* reported that cowpeas prices are lower in December (harvesting season) in the Abuja, Kaduma, Kano and Ibadan markets. In addition, Kormawa *et. al.* report that generally consumers prefer brown colored cowpeas grain over white colored grains in the Nigerian markets they studied.

IV. Motivation for the Research

A better understanding of consumer preferences for cowpea grain is needed to understand the cowpea value chain and facilitate cowpea market development in West and Central Africa. Studies have shown that consumers are the beginning of the value chain whereby the flow of information about food preference moves back to retailers, manufacturers and to farmers and scientific laboratories (Kinsey, 2001). Likewise, Boehlje, 1999 accentuated the importance of information in the value chains. He elucidates the fact that customer information is the resource that can be used to understand markets better.

While consumer preferences in some cowpea markets near production areas have been studied (Langyintuo et al, 2004; Faye 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 cowpea traits that they should focus on. Hedonic pricing methods provide a systematic, formal mechanism for estimating the strength of cowpea preferences.

As noted above, the general objective of this study is to measure the premiums and discounts negotiated by consumers for various visual characteristics of cowpea grain. This objective is achieved by testing the hypotheses that cowpea consumers in urban markets in Nigeria, southern Ghana and Mali;

i. are willing to pay a premium for larger sized cowpea grains,
ii. are willing to pay a premium for white cowpea grains,
iii. discount damaged cowpea grains that result from bruchid holes,
iv. are willing to pay a premium for cowpea grains with rough skin, and
v. are willing to pay a premium for cowpea grains with black eyes.

V. Methodology

Retail level cowpea samples were purchased monthly in three markets in Nigeria, two markets in Mali and six markets in southern Ghana. In Nigeria the markets studied were Iddo (Lagos), Monday (Maiduguri) and Dawanau (Kano). Lagos is the largest city in Nigeria and represents important urban consumers, while Dawanau Market in Kano is the largest wholesale cowpea market in the world. Truck loads of cowpea come from all over West Africa to Dawanau

Market, which also has a substantial retail clientele. Maiduguri market is located in northeast Nigeria close to the Niger and Cameroon borders. In Bamako, the capital city of Mali, samples were purchased in Marché de Médine and Marché de Sabalibougou. Marché de Médine is a mixed market where both wholesalers and small-scale retailers operate and is located in northeast part of downtown Bamako. Marché de Sabalibougou is a retail market in a suburb of Bamako. Cowpeas sold in the market come in directly from production areas, as well as through resellers from the main markets in town. Markets studied in Ghana include the Makola, Kaneshie, Malata and Nima markets in Accra and the Central and Asafo markets in Kumasi. Makola market is the central and major market of Accra, where all types of consumer goods (foodstuff, provisions, clothing, etc) are sold, largely at the retail level. Female traders are major actors in retail trade in the Makola market. Kaneshie market is a modern market with relatively better facilities however it is smaller than Makalo market. Generally speaking Kaneshie is the retail market and female traders dominate the cowpea trade. The Malata Market started largely as a foodstuff market but has developed to include other products. Wholesale trade of foodstuffs is also a part of the trade in Malata. Both males and females are involved in wholesale trade however female traders are mainly involved in retail business. Nima market is a small market that largely serves people of northern Ghana origin who reside in Nima. The importance of cowpeas in this market is the result of the importance of this crop in the diet of the people of Nima (northern Ghanaians). Central market is the major market serving Kumasi where all types of consumer goods are sold. Both wholesale and retail trade is carried out; wholesale trade is done by both males and females. However females dominate the retail trade. Asafo market is a smaller market and less patronized compared to the Central market. Although Asafo market is less than 2 km (≈1.243 miles) from the Central market, the prices in Asafo market are perceived

by consumers to be higher than in the Central market. Cowpea trade in Asafo market is mainly retail trade and female traders dominate in the retail trade.

Hedonic price estimation techniques have being applied to a wide range of economic issues ranging from determining optimal production mix to marketing issues (Walburger and Foster 1994; Brorsen *et. al.* 1984; Unnevehr 1986; Espinosa and Goodwin 1991; Parker and Zilberman 1993; Kawamura 1999). In this study, hedonic analysis is used to analyze the consumer preferences for cowpea 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, say cowpea, 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 good's price, 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:

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

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

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

$$P_{it} = \alpha_{io} + \sum \gamma_{ir} Y_{irt} + \sum \Psi_{ik} M_{ikt} + \sum \beta_{ij} X_{ijt} + \varepsilon_{it} \quad \ldots. \quad (3)$$

Where: P_{it} is the price of cowpea in US$ (equivalents of local currencies in which they were collected) per kilogram at market i (i = 1, 2, 3….., N) 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 cowpeas' characteristics (j = 1, 2, …., J), size of the cowpea grains (weight of 100 grains), grain damaged by bruchids, skin texture, skin color and eye color. 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 markets.

The price variable is reported as market price per kilogram. The monthly dummy variables are important to account for the seasonal variation in cowpea prices noted above. The yearly dummy variables account for the different market conditions in each market year. The number of holes per 100 grains was entered in the model as an absolute value. Grain eye color, grain skin color, and skin texture were entered as dummy variables. The approach to create dummies for skin color was to assign a value of one for the white colored grains and zero otherwise. A value of one was assigned to black eye color and zero otherwise. A value of one was assigned for rough skin texture and zero otherwise.

This analysis uses samples from a multiyear period in each location. Nigeria data were collected between October 1998 and October 2001. Southern Ghana data were collected from May 2000 to April 2002, and Mali data were collected from October 1999 to December 2001. The sample selection and data collection procedure followed a common protocol in all three counties. Samples were purchased each month on a pre-determined day (e.g. third Thursday) and a common time (between 10:00 A.M. and noon). A common protocol to ensure a random selection of five vendors was utilized in all of the markets. A researcher or technician purchased

cowpea from each of the five vendors using the common local unit of measurement (often called a tin). The buyer was instructed to bargain just has he or she would in making any purchase in a traditional African market. The five samples of cowpea were taken to the laboratory where data on 100 grain weight, number of bruchid holes, skin color, skin texture, eye color and other characteristics were recorded.

VI. Results and Discussion

Comparison is made between the cowpea markets in the three countries of Nigeria, Southern Ghana and Mali. To facilitate cross country comparisons, local currencies were converted to $US (1 US$ = 107.4 Naira(Nigeria) = 6725.5 Cedi(Ghana) = 732.17 FCFA(Mali)) at the average exchange rate for the period May 2000 to Oct. 2001 (IFS, 2006). . The results show that the cowpea prices were lower in the Mali markets relative to the southern Ghana and Nigeria markets (Table 2). Average cowpea price in the Mali markets was $0.33 per kilogram. For southern Ghana, the average cowpea price over the six markets was $0.54 per kilogram. In southern Ghana, prices varied across the markets and cities. In Nigeria, the average cowpea price in three markets was $0.36 per kilogram. On average cowpea prices were higher in the Accra markets than in the Kumasi markets (Table 2). The variation of prices between Accra and Kumasi markets could be due to geographical location and levels of economic activities of these cities. Accra being the capital and also a coastal city has more economic activities and higher population density compared to Kumasi. Although the per kilogram price of cowpea was lower in Mali, than Ghana and Nigeria, the standard deviation of price was lowest in Mali. This suggests price stability in the markets in Mali compared to the markets in southern Ghana and Nigeria.

On average, the cowpea markets surveyed in Mali had more damaged cowpea grains compared to the southern Ghana and Nigeria markets (Table 2). Marché de Sabalibougou had an average of 15 holes per every 100 grains which was slightly higher than Marché de Médine. In southern Ghana, the average grain damage was 13 holes per 100 grains. Notice that the Makola and Malata markets in Accra had the highest damage levels in Southern Ghana. This could be due to the fact that Accra is coastal city with higher humidity levels which can affect grain damage level. Damage levels in the Nigerian markets averaged 9 holes per 100 cowpea grains.

It was observed that on average cowpea grains in Nigeria markets are larger than cowpea grains in southern Ghana and Mali markets (Table 2). On average, the weight of 100 cowpea grains in Nigeria markets was recorded to be 18.6 grams per 100 cowpea grain while for the southern Ghana and Mali markets, the average weight of 100 cowpea grains was 14.5 and 12.0 grams respectively. From Table 2 notice that the size of cowpea grains in the Mali and Nigeria markets are more consistent than cowpea size in southern Ghana markets.

Table 2: Average Cowpea Grain Characteristics (Standard Deviation in Parentheses)

Country / Data	Market	Prices ($kg-1)[1]	Holes/100 grains	100 grain Weight (g)
Southern Ghana	Makola (Accra)	0.59 (0.17)	14 (22)	15.1 (8.6)
	Kaneshie (Accra)	0.60 (0.17)	11 (15)	14.9 (4.4)
	Malata (Accra)	0.57 (0.17)	16 (26)	14.3 (4.0)
	Nima (Accra)	0.59 (0.17)	10 (13)	14.6 (4.2)
	Central (Kumasi)	0.42 (0.09)	12 (16)	13.6 (3.0)
	Asafo (Kumasi)	0.46 (0.09)	12 (16)	14.4 (3.7)
	All Markets	0.54 (0.14)	13 (18)	14.5 (4.7)
Mali	Marché de Sabalibougou	0.33 (0.09)	15 (12)	11.8 (3.1)
	Marché de Médine	0.33 (0.07)	14 (12)	12.2 (3.4)
	All Markets	0.33 (0.08)	15 (12)	12.0 (3.3)
Nigeria	Iddo (Lagos)	0.43 (0.13)	9 (6)	18.7 (3.8)
	Monday (Maiduguri)	0.29 (0.09)	9 (6)	18.6 (4.5)
	Dawanau (Kano)	0.37 (0.08)	8 (5)	18.4 (3.4)
	All Markets	0.36 (0.10)	9 (6)	18.6 (3.9)

Source: Nigeria, southern Ghana and Mali studies (Mishili, 2005; Jamal, 2005; Shehu, 2003)
[1]. Exchange rates used were the average exchange rate (in US$) between May 2000 and October 2001

In the analysis of the cowpea market data for this study, the weight of 100 grains of cowpeas was used as proxy value for size in Mali and Ghana. Regression analysis for Nigerian cowpea market data considered cowpea grain size as a dummy variable with the value of 1 assigned for large cowpea grains and 0 otherwise. Regression analysis results are reported in Table 3.

In the markets in southern Ghana, Mali and Nigeria consumers paid a premium for large size cowpea grains as evidenced by the fact that the coefficients for grain size are positive and statistically significant in all markets except Central and Lagos (Table 3). For a one gram increase in the 100 grain weight consumers paid between $US 0.0057 and $US 0.025 per kilogram extra in the southern Ghana markets. In Mali consumers paid between $US 0.0033 and $US 0.0042 per kilogram extra for every gram increase in 100 grain weight. Nigerian consumers paid between US$0.0042 and US$0.0043 more per kilogram for large compared to small sized cowpea. It is not surprising for the grain size coefficient to be not statistically significant in the Lagos market. Lagos is cosmopolitan city (Langyintuo *et. al.*, 2003) where demand for all sizes and types of cowpea grains exists for various household uses.

Table 3: Estimated Coefficients for Selected Markets in Nigeria, Southern Ghana and Mali

Country / Market	Grain size	No. of Holes	Eye Color	Skin Texture	Skin Color	R^2
Southern Ghana						
Makola (Accra)	0.0057***[1]	-0.0030***	-0.0160	-0.0328	0.0118	0.46
Kaneshie (Accra)	0.0256***	0.0009	-0.0096	-0.1148***	-0.0269	0.65
Malata (Accra)	0.0239***	-0.0001	-0.0132	-0.0329	-0.0653*	0.71
Nima (Accra)	0.0179***	-0.0012	-0.0482*	-0.0809*	-0.0101	0.56
Central (Kumasi)	0.0035	0.0004	-0.0299*	-0.0059	-0.0233	0.57
Asafo (Kumasi)	0.0061**	-0.0002	0.0008	-0.0222	0.0014	0.58
Mali						
Marché de Sabalibougou	0.0033***	-0.0002	-0.0295	0.0098	-0.0221***	0.90
Marché de Médine	0.0042***	-0.0001	-0.0435***	-0.0076	-0.0186**	0.86
Nigeria[2]						
Iddo (Lagos)	0.0005	0.0008	0.0059	-0.0345*	-0.0232	0.91
Monday (Maiduguri)	0.0042***	0.0005	-0.0214	-0.0163	-0.0630***	0.71
Dawanau (Kano)	0.0043***	0.0008	-0.0040	-0.0096	-0.0249	0.85

Source: Individual Country Studies (Mishili, 2005; Jamal, 2005; Shehu, 2003)
1. Statistical Significance (*** = 1% ; ** = 5% ; * = 10%)
2. For Nigeria, grain size was entered in the model as dummy variable, 1 for large grain size and 0 otherwise.

Coefficients for grain damage, as measured by the number of bruchid holes per 100 cowpea grains, were expected to have a negative sign. The damage coefficient was negative and statistically significant for the Makola Market in Ghana and the Marche de Medine in Mali, and not significantly different from zero elsewhere. For Makola, the price dropped by US$0.003 per bruchid hole and for the Marche de Medine the price dropped by US$0.0435 per hole (Table 3). The relatively small number of markets with statistically significant coefficients for bruchid damage is consistent with previous studies (i.e. Langyintuo et al, 2005; Faye et al, 2006). Evidence suggests that cowpea merchants sort cowpeas to remove damaged grains. In West African markets it is common to see retailers sorting grains in between customers. The discount for damage also probably depends on the type of food being prepared. Bruchid holes would be visible in foods that use whole cowpea, but unnoticeable in products that use milled cowpea (e.g. kosai or akara).

Originally, it was hypothesized that West and Central African consumers were sensitive to storage damage only if the number of holes was over some threshold (e.g 30% of grains damaged). Statistically, accounting for damage thresholds did not improve the explanatory power of the models in any of the three countries. The best models assume that consumers expect a discount from the very first bruchid hole.

The coefficient for grain eye color was negative and statistically significant in the markets in southern Ghana and Mali. In southern Ghana, consumers in Nima and Central market pay US$ 0.0299 and US$ 0.0482 per kilogram more for black eye cowpea compared to other eye

colors. These results were statistically significant (Table 3). In the Marché de Médine market in Mali, consumers discount black eyed cowpeas by $US 0.0435 per kilogram.

Consumers in the markets studied preferred cowpeas with smooth skin. The coefficient for skin texture is negative and statistically significant for the Kaneshie, Nima and Iddo markets (Table 3). For the other markets skin texture was usually negative, but not significantly different from zero. Skin texture preferences are related to the food prepared. Smooth skinned cowpea are best for foods which use whole cowpea. Rough textured cowpea are easier to dehull and hence are preferred for foods requiring milling.

. Consumers discounted white cowpea grains everywhere except Makola. For the Malata, Marché de Sabalibougou, Marché de Médine and Maiduguri markets the coefficient for white skinned cowpea was negative and statistically significant (Table 3). The statistically significant discounts ranged from US$0.0221 to US$0.0653.

Table 4: Estimated Model Coefficients for Additional Variables in Nigeria Markets

Country / Market	Bowl wt	Eye Texture	Gender	New Variety	Imported Source
Nigeria					
Iddo (Lagos)	-0.1751***[1]	0.0067	0.0075	0.0969***	-0.0016
Monday (Maiduguri)	-0.1364***	0.0207	0.0595	0.0504*	-0.0046***
Dawanau (Kano)	-0.1389***	-0.0046	0.0008	0.0027	0.0374***

Sources: Shehu , 2003

1. Statistical Significance (*** = 1% ; ** = 5% ; * = 10%)

The cowpea market analysis in Nigeria included several variables not tested in other countries (Table 4). Bowl weight is the weight of the bowl or container that the merchant used to measure the quantity of cowpea purchased. The variables for eye texture, gender, new variety and imported source were entered as dummy variables. The coefficients for bowl weight were negative and statistical significant in all three markets in Nigeria, indicating that consumers pay a lower price per kilogram when they are purchasing a larger bowl size of cowpea. The

coefficients for new variety cowpea grains variable were positive in all three markets and statistically significant in the Lagos and Maiduguri markets. The coefficient for imported source was statistically significant in the Maiduguri and Kano markets. Imported cowpea were discounted in the Maiduguri and earned a premium in the Kano market.

In the analysis of the Mali data vendor scale was analyzed using a dummy variable with the value of one assigned when the vendor was a wholesaler and zero otherwise. In the Marché de Sabalibougou vendor scale (i.e. wholesaler) was an important factor in determining the selling price of cowpea in the market. The wholesaler coefficient for the Marché de Sabalibougou market was positive and statistically significant.

VII. Implication of Results

Because price levels differ from market to market, comparisons are facilitated by expressing the hedonic coefficients as a percentage of the average price in the market for the data period (Table 5). Consumers in southern Ghana paid a premium between 1.0% and 4.3% of the average cowpea grain price per kilogram for every increase of cowpea grain size by one gram per 100 grains. In Mali consumers paid a premium between 1.0% and 1.3% of the average cowpea grain price per kilogram for every increase of cowpea grain size by one gram per 100 grains. For Nigerian markets the range of price premiums is between 1.2% and 1.4% of the average cowpea grain price per kilogram for every increase of cowpea grain size by one gram per 100 grains.

For every additional bruchid hole in 100 cowpea grains in the Makola market, consumers discounted the price by 0.5% of average cowpea price per kilogram. Black eyed cowpea resulted in the price discount between 7.1% and 13.2% in the Nima, Central and Marché de Médine

markets (Table 5). Rough skin textured cowpeas resulted in a price discount of 19.1% of average cowpea price per kilogram in Kaneshie market. In Nima and Iddo markets, rough skin textured cowpea resulted in a discount of 13.7% and 8.0% of average cowpea price respectively. White skinned cowpea resulted in a price discount in the Mali markets between 5.6% and 6.7% of average cowpea price per kilogram. In the Malata market, white skinned cowpea resulted in a 11.5% discount.. In Maiduguri, white skinned cowpea grain resulted in a price discount of 21.7% of average cowpea price per kilogram.

Table 5: Percentage Price Change[1] per kg in southern Ghana, Mali and Nigeria Markets

Country / Market	Grain size	No. of Holes	Eye Color	Skin Texture	Skin Color
	Percentages (%)				
Southern Ghana					
Makola (Accra)	+1.0***[2]	-0.5***	-2.7	-5.6	+2.0
Kaneshie (Accra)	+4.3***	+0.1	-1.6	-19.1***	-4.5
Malata (Accra)	+4.2***	-0.02	-2.3	-5.8	-11.5*
Nima (Accra)	+3.0***	-0.2	-8.2*	-13.7*	-1.7
Central (Kumasi)	+0.8	+0.1	-7.1*	-1.4	-5.5
Asafo (Kumasi)	+1.3**	-0.03	+0.2	-4.9	+0.3
Mali					
Marché de Sabalibougou	+1.01***	-0.1	-9.0	+3.0	-6.7***
Marché de Médine	+1.3***	-0.02	-13.2***	-2.3	-5.6**
Nigeria					
Iddo (Lagos)	0.1	0.2	1.4	-8.0*	-5.4
Monday (Maiduguri)	1.4**	0.2	-7.4	-5.6	-21.7***
Dawanau (Kano)	1.2***	0.2	-1.1	-2.6	-6.7

Sources: Individual Country Studies (Mishili, Jamal, 2005; Shehu, 2003)

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

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

VIII. Conclusions

Consumers, in the Nigerian, Ghanaian and Malian markets studied, almost universally preferred larger cowpea grain size. For statistically significant coefficients, the premium for larger grain size ranged from 1% to 4.3% of the average price. Only in two of the markets were the coefficients for bruchid damage statistically significant. In those markets the discount per

bruchid hole was 0.02% to 0.5% of average price. Preferences for eye, skin and texture preferences varied widely from market to market.

The hedonic price analysis estimates for the variables of grain size and damage reported here for urban areas are similar to previous studies done in cowpea production areas. For example Langyintuo *et. al*. (2003) reported that consumers in the markets in northern Ghana pay a premium of $US 0.005 kg^{-1} per gram of 100 grain weight. This premium ranged from 1.2% and 1.4% of the average cowpea grain price. In the Bolgatanga market in northern Ghana, it was estimated (Langyintuo *et. al*., 2003) that price is discounted about 1.2% per bruchid hole. This discount in the Bolgatanga is approximately $US 0.0048 kg^{-1} for bruchid hole. In Senegal Faye et al. (2006) showed grain size premiums ranged from 1% to 16%, while the only statistically significant damage discount was about 0.37% of average grain price.

The cowpea hedonic pricing analysis for Nigeria, Ghana and Mali reported here suggests that efforts to improve cowpea markets in West Africa should target cowpea grain size and cowpea storage technology. Consumers in this and other studies almost universally preferred larger cowpea grains. 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. Researchers and technology transfer organizations should offer a portfolio of grain color, eye color and skin texture to fit local preferences.

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