

## Assessing the Effect of Consumer Purchasing Criteria for Types of Rice in Togo: A Choice Modeling Approach

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### ABSTRACT

This study analyses rice consumer preferences in Togo and estimates consumers' willingness to pay (WTP) for the quality attributes of locally produced rice. For that purpose, a random utility model is applied to elicit the WTP for the most important rice purchase criteria. The model is estimated using a survey of consumers from 15 prefectures in Togo. The results show that imported rice is largely preferred to local rice, especially in urban areas. Cleanness and whiteness appear to be the most preferred attributes, especially for imported rice. Togolese consumers are willing to pay a premium of up to 46% of the actual price for cleanness and 53% for whiteness in locally produced rice. Also, taste and swelling capacity play an important role in the preference for locally produced rice. The results might be useful for breeders and policy makers in the ongoing effort to improve the competitiveness of local rice in West Africa both from quality and price perspectives. [EconLit citations: D120, C250, O550]. © 2014 Wiley Periodicals, Inc.

### 1. INTRODUCTION

The 2008 food crisis and its consequences, in both developed and developing countries, stressed the need for strong policy actions to prevent the recurrence of surges in the price of staple foods. It also highlighted the need for importing countries to develop effective strategies to reduce their food dependency and alleviate the impact of soaring prices of staple foods. This applies particularly to rice in West African countries where it has become a strategic food and its consumption depends largely on importation (Calpe, 2006; Seck, Tollens, Wopereis, Diagne, & Bamba., 2010). Between 2007 and 2010, rice consumption in West Africa increased at a rate of 3.52%, despite the upsurge in rice price during the food crisis. This strong demand for rice could be explained by the combined effects of urbanization, population growth, higher incomes, and other factors such as relative ease of storage and preparation of rice compared to other foods (AfricaRice, 2011; Calpe, 2006; USAID, 2009).

Rice consumption in West Africa is higher than its production, leading to a relatively low self-sufficiency ratio estimated at 60% (AfricaRice, 2012). Relying on importation is a risky strategy for food security. Laroche, Dupraz, and Postolle (2013) report that long-term food security cannot depend on food imports but must be built on the development of domestic production, with enough barrier protection against world price fluctuations and unfair trading. In this vein, FAO (2012) recommends that market policies should be designed to exercise the rights of a country to protect its domestic market from cheap imports. It is also clear that the steady increase in rice importation into West Africa seriously compromises the effort of governments to increase local rice production.

Since the food crisis, most African governments have implemented important policy measures to stimulate domestic production (Seck et al., 2010). For instance, 19 African countries

(including Togo), supported by international partners grouped within the Coalition for African Rice Development (CARD), have developed and are implementing National Rice Development Strategies (NRDS) with the goal of doubling rice production in sub-Saharan Africa (SSA) within 10 years (2008–2018) (AfricaRice, 2011). As a result of these policies, domestic rice production in Africa increased by 10.13% per year during 2007–2010 compared to 4.61% in 2001–2007 (AfricaRice, 2012). Although emphasis has been on increasing rice production, the competitiveness of local rice in terms of production cost and processing in SSA has been identified as a major constraint to the consumption of locally produced rice and consequently supporting domestic production (Stryker, 2013). This is also true for most primary commodities in Africa, despite Africa's comparative advantage of natural resources and human capital endowments (World Bank, 2008). Seck et al. (2013) and AfricaRice (2011) showed that local rice production systems are competitive and make efficient use of domestic resources. Stryker (2013) showed that there is a ready market for good-quality local rice as a substitute for imported rice, especially if this rice enters the market chain at the same point as the imported rice. Thus, it will be optimal to allocate more resources to address value-adding and demand-lifting investments and thereby increase the competitiveness of domestic rice against imported rice (Demont, 2013; USAID, 2009).

The consequence of the currently low capacity for processing local rice in Africa is that locally produced rice is marginally less valued than imported rice and receives a lower price (Lançon & David-Benz, 2007). This is at least partly because of perceived differences in quality (Seck, Toure, Coulibaly, Daigne, & Wopereis, 2013; Stryker, 2013). In order to have easy access to urban markets, domestic rice needs to compete in terms of price and both intrinsic and extrinsic attributes (Demont, 2013). Addressing the quality of locally produced rice will encourage its consumption, especially in urban areas. This upward demand shift will also drive domestic production and reduce import dependency. That is why considerable attention is being paid today to understanding the attributes that consumers value in different markets. Understanding consumer preferences and demand with respect to the qualitative characteristics of rice is essential both for rice research and processors, and for promoting locally produced rice that meets the quality requirements of the market. In its 2009 report on the West Africa rice value chain, the United States Agency for International Development reiterated the call for demand-focused research, arguing that support for research into consumer demand and preference for local rice should be a priority (USAID, 2009).

Togo is currently taking steps to address the competitiveness of the domestic rice sector. As clearly stated in its NRDS, the country aims to double its rice production by 2018, and strengthening the local rice sector through quality improvement is a critical component of the NRDS. In partnership with international rice research centers, such as AfricaRice, a number of studies are being conducted in Togo, as in most African countries, to better understand the attributes that determine consumers' choice of alternative types of rice. A first step in preference studies is to elicit detailed information on rice quality attributes. In this regard, a consumer baseline survey was conducted in 2010 to collect data on consumer preference for various domestic and imported rice attributes. This article exploits the baseline data and aims to provide an insight into the valuation of rice attributes by rice consumers in Togo.

The literature on consumer preference is relatively abundant. In West Africa, most studies have found that urban consumers have developed a marked preference for imported rice and associated purchasing and eating habits (Demont, 2013; Demont, Rutsaert, Ndour, & Verbeke, 2013a; Lançon, Erenstein, Toure, & Akpokedje, 2004; Rutsaert, Demont, & Verbeke, 2013). This is also true in Togo where 70% of the rice consumed is imported (USDA, 2013). Based on their study of the rice value chain in Ghana, Cadilhon and Even (2012) argue that it is erroneous to believe that marketing of local rice, without properly addressing quality competitiveness issues, would automatically lead to consumer willingness to substitute imported rice with local rice. Tomlins, Manful, Gayin, Kudjawu, and Tamakloe (2007) compared consumer acceptance, affordability, and market value of prototype parboiled local rice with three local samples and a high-value imported rice in Ghana and showed that sensory attributes associated with quality were positively correlated with market price. This shows that quality goes with market price and

quality can be considered as an important selection criterion for consumers. Several attributes have been identified in the literature as influencing consumers' decision to purchase local or imported rice. These attributes include rice characteristics that are either intrinsic (such as taste, texture, swelling and ease of preparation) or extrinsic (such as color, packaging, brand, label, or price). Fofana et al. (2011) indicated that most Beninese prefer imported rice over locally produced rice due to several factors including variations in physical characteristics, presence of foreign matter, nutritional quality and cooking behavior. Using an experimental auction method in several West African countries, Demont et al. (2013a, 2013b) showed that local rice can be competitive *vis-à-vis* imported rice if quality is tailored to consumer preferences and that intrinsic quality attributes and extrinsic quality cues can serve as drivers for developing and strengthening rice value chains. Based on these findings, the authors suggest that investment in post-harvest grain quality tailored to consumers in urban rice markets is the first step that needs to be undertaken in order to enable local rice to compete against imported rice. Their argument is supported by the fact that some local rice types processed using an appropriate modern mill and flowing into similar market channels, seem to compete very well with imported rice in terms of quality and price. Local brands, such as *Riz DELICE*, *Riz NATI*, and *RIVALOP*, are examples in Benin. To overcome the problem of poor quality of locally produced rice, continuous and intensive consumer research is needed to improve knowledge on the quality characteristics preferred by rice consumers in West African.

This article intends to contribute to the ongoing research effort to understand consumer preferences for rice attributes. It combines the use of data reducing and choice modeling methods to estimate consumer willingness to pay for various rice attributes, using data from the baseline survey conducted in Togo in 2010. A key contribution of the study is that it is, to our knowledge, the first of its kind in Togo after the food crisis. First, the article uses multiple correspondence analysis (MCA) to map the most important of the 14 selection criteria included in the survey. MCA is a potentially useful exploratory and complementary data dimension reducing technique for detecting and representing underlying structures among relatively large numbers of categorical variables (Kaciak & Louviere, 1990). Next, it uses the choice modeling approach based on random utility models to estimate the preference of consumers for alternative rice types as a function of rice attributes utility (e.g., Burton, Rigby, Young, & James, 2001; Green, 1974). Finally, using the results of the choice model, it estimates the marginal willingness of consumers to pay for the most important rice selection criteria and consumers' average utility for alternative types of rice.

The article is organized as follows: Section 2 describes the choice modeling approach and the estimation of the willingness to pay. Section 3 presents the survey data and analyzes the maps of the three most important purchasing criteria for each rice type elaborated from the multiple correspondence analysis. Section 4 presents the econometric results and discusses the most important attributes that determine consumer choice for each type of rice using a conditional logit model. It also discusses the estimation of the marginal willingness to pay and the recovered average utility. The last section concludes and discusses the implications of the results.

## 2. THEORETICAL FRAMEWORK

### 2.1. Modeling Consumer Selection Criteria for Alternative Types of Rice

Choice Modeling (CM) is a family of survey-based methodologies for modeling the decision process of an individual in order to understand his or her preferences for goods described in terms of their characteristics (Hanley, Wright, & Mourato, 2001; Louviere & Hensher, 1982; Louviere & Woodworth, 1983). The good's characteristics approach to consumer demand was pioneered by Lancaster (1966) and is extensively used to model the effects of products' intrinsic attributes on consumer choices (see for example Deaton & Muelbauer, 1980; Hensher, 1994; Ladd, 1982; Rosen, 1974). The characteristic space is also the choice set in models of product differentiation used in industrial organization theory (Dixit & Stiglitz, 1977;

Mas-Collel, Whinston, & Green, 1995; Spence, 1976; Tirole, 1998). In line with Lancaster's (1966, 1971) characteristics theory of value, we assume that rice the consumer ( $i$ ) derives utility from the bundle of attributes of rice. The indirect utility for a particular attribute  $j$  is decomposed into an observable deterministic component  $V_{ij}$ , and an unobservable stochastic component  $e_{ij}$ . Under the assumption that the deterministic utility can be a linear index of the attribute  $X_{ij}$ , the consumer ( $i$ ) utility of the rice attribute  $j$  can be expressed as follows:

$$U_{ij} = V_{ij} + e_{ij} = \beta X_{ij} + e_{ij} \quad (1)$$

where  $U_{ij}$  is the indirect utility function for consumer  $i$  from alternative  $j$ , with  $j = 1, \dots, J$  and  $J$  the total alternatives and  $\beta$  is a vector of unknown parameters.

In this framework, a consumer chooses a particular type of rice  $j$  if he/she expects to derive the highest utility over the other alternatives. That is  $U_{ij} > U_{ik}, \forall k \neq j$ . The probability to choose rice type  $j$  can be expressed as follows:

$$P(d_{ij} = 1) = P(U_{ij} > U_{ik} \forall k \neq j) = P(e_{ik} - e_{ij} < U_{ij} - U_{ik}) \quad (2)$$

Where  $d_{ij}$  is an indicator variable equal to 1 if the consumer chooses rice type  $j$  with the characteristics  $X_{ij} = (x_1, \dots, x_K)$  which are related to the rice consumer's choice attributes.

To derive the expression of this probability, following McFadden (1974), we assume that the random utility  $e_{ij}$  is independently and identically distributed with a type I extreme value distribution. Under this assumption, McFadden (1974) shows that the probability of choosing type of rice  $j$  over the  $J$  others, conditional on consumer choice attributes  $X_{ij}$  can be expressed in terms of conditional logistic distribution. The resulting distribution is termed as conditional logit and is expressed as follows:

$$P(d_{ij} = 1|x_i) = \frac{\exp(\gamma \beta x_{ij})}{\sum_{h=1}^J \exp(\gamma \beta x_{ih})} \quad (3)$$

The parameter  $\beta$  is estimated using the maximum likelihood procedure:  $\gamma$  is a scale parameter which is inversely proportional to the standard deviation of the error term. This scale parameter cannot be separately identified and is therefore assumed to be 1 (Adamowicz & Boxal, 2001; Hanley et al., 2001).

An additional assumption for estimating the model defined by specification (2) and (3) is termed the independence of irrelevant alternatives (IIA) assumption (Hanley et al., 2001; Luce, 1959; McFadden, 1974). It implies that adding or removing a rice type  $h$  among the choice set does not change the relative odd between a given two alternative types of rice  $j$  and  $h$  with  $j \neq h$ . So, the relative probabilities for any two alternatives depend only on the attributes of those alternatives. Hausman and McFadden (1984) developed a procedure to test the violation of the IIA. If the IIA assumption is violated, a more accurate model that relaxes IIA is needed. These models include the multinomial probit (MNP) model that allows the odds of choosing one alternative over another to depend on the remaining alternatives (Hausman & Wise, 1978); nested logit (McFadden, 1978) and mixed logit (Train, 1998).

## 2.2. Measuring Consumer Willingness to Pay for the Most Important Selection Criteria

The notion of willingness to pay (WTP) and the associated compensation criteria are key concepts in applied welfare economics (Just, Hueth, & Schmitz, 2004). WTP measures the income that must be taken away from a consumer after a price change to restore the consumer's original welfare level (Just et al., 2004). WTP for a specific attribute (selection criterion) and for a particular alternative  $j$  (type of rice) can be indirectly recovered from the estimation of individual parameters in the choice model by including price  $p_j$  as one of the selection criteria

(Hanley et al., 2001, Hu, Batte, Woods, & Ernst, 2012; Pearsons & Kealy, 1992). Thus, equation (1) can be rewritten as follows:

$$U_{ij} = \beta X_{ij} + \beta_p p_j + e_{ij} \quad (4)$$

where  $\beta_p$  is the coefficient associated with price included as an additional characteristic and  $\beta$  the parameter of unknown part-worth utilities associated with the vector of attributes  $X = (x_1, \dots, x_n, \dots, x_N)$  of type of rice  $j$ . WTP answers the question of how much, everything else being equal, the consumer would be willing to pay for a given selection criterion to maintain his/her initial level of utility  $U_{ij}^0$  while moving from an initial choice to the alternative one (e.g. from the consumption of imported rice to local rice) providing him/her the utility noted  $U_{ij}^1$ . It is derived as follows:

$$E(WTP) = -\frac{\beta_n}{\beta_p} \quad (5)$$

where  $\beta_n$  is the coefficient of the rice attribute and  $\beta_p$  the associated coefficient of the price. The estimation of WTP provides an insight into the value that consumers place on its most important attributes  $x_n$ .

### 3. DATA AND EXPLORATORY ANALYSIS USING MULTIPLE CORRESPONDENCE ANALYSIS

#### 3.1. Survey Data

This study used data from a survey on consumer preference conducted in 2010 in 15 “prefectures”<sup>1</sup> in Togo by the Africa Rice Center in collaboration with the Togolese National Agricultural Research System (Institut Togolais de Recherche Agronomique – ITRA) and National Agricultural Statistics System (NASS). This survey was part of a larger Africa-wide project for analyzing “Rice and improved post-harvest technology” funded by the Government of Japan and implemented by the Africa Rice Center. The main goal of the project was to sensitize rice sector stakeholders in Africa on the need to increase the competitiveness of locally produced rice through improving its quality. The project surveyed all actors along the rice value chain (farmers, consumers, traders and processors). However, this study used only data on consumers in Togo.

The survey adopted a two-stage stratified sampling method to ensure a fair representation of all regions in Togo. There were five strata (Maritime, Plateau, Central, Kara and Savannah). Within each stratum, rural or urban prefectures were randomly selected and 568 consumers were then randomly selected in rural and urban prefectures. However, complete data were obtained for only 336 consumers (respondents). The selected households were interviewed using a structured questionnaire. In each survey area, a focus group interview was conducted to prepare a list of all rice names or brands<sup>2</sup> and their attributes in each prefecture. Subsequently, all brands were classified into four types, namely *nonparboiled local*, *parboiled local*, *nonparboiled imported*, and *parboiled imported*. In most African countries, including Togo, the purchasing and cooking of food is primarily done by women. For this reason, the brand list was checked by women in each prefecture and then cross checked by Togolese researchers and traders to confirm the correct classification of the brands. Within a selected household, women, preferably spouses of the household heads, were the primary respondents to the survey questions. The survey collected detailed sociodemographic and rice consumption data. Respondents were

<sup>1</sup>The region and prefecture are respectively the first and second administrative subdivisions in Togo

<sup>2</sup>Here the word “brand” stands for the name used by consumers and traders to identify a specific rice type. It does not correspond with the definition of a brand by the American Marketing Association Dictionary as a “name, term, design, symbol, or any other feature that identifies one seller’s product distinct from those of other sellers.”

TABLE 1. Socio-demographic characteristics of surveyed rice consumers in Togo

Type of rice	Nonparboiled local	Parboiled local	Nonparboiled imported	Parboiled imported
Number of respondents	135	24	163	14
Average household income distribution (monthly)	36,135	29,492	52,620	47,321
<b>Gender (column%)</b>				
Male	88.1	52.2	85.1	57.1
Female	11.9	47.8	14.9	42.9
<b>Age distribution (column%)</b>				
20–35	22.4	26.1	29.4	21.4
35–45	33.6	34.8	36.2	42.9
45–55	33.6	30.4	28.8	35.7
55 and older	10.4	8.7	5.5	0
<b>Main activity distribution (column%)</b>				
Agriculture	37.6	21.7	20.4	21.4
Household work	1.5	4.3	0	0
Commerce	12.8	43.5	11.7	28.6
Handicrafts	12.11	13	13.06	14.3
Workman	5.3	0	1.2	0
School pupil	2.3	4.3	0.6	0
Other	32.3	13	53.1	35.7
<b>Education distribution (column%)</b>				
Junior high school	20.5	26.1	14.4	28.6
Senior high school	32.6	30.4	22.5	21.4
Lycée	13.6	8.7	25.6	21.4
High school	12.9	0.0	31.3	7.1
Koranic	4.5	0.0	2.5	0.0
No level	10.6	4.3	3.8	7.1
Adults education (Literate)	5.3	30.4	0.00	14.3
<b>Prefecture (row%)</b>				
Golfe	24.49	2.04	70.41	3.06
Ogou	90.91	0.00	9.09	0.00
Wawa	8.33	2.08	89.58	0.00
Tchaoudjo	72.73	0.00	27.27	0.00
Kozah	56.18	0.00	40.00	4.00
Bassar	60.00	11.43	28.57	0.00
Binah	41.18	33.33	9.80	15.69
Cinkasse	88.24	0.00	0.00	11.76
<b>Household size distribution (column%)</b>				
Small [1–3 members]	11.2	43.5	15.3	35.7
Medium [4–6]	54.5	52.2	58.9	57.1
Large > 6	34.3	4.3	25.8	7.1

asked about their awareness of each rice brand on the list. Less than 1% of the respondents were not aware of any brand of rice showed to them. For each type of rice, respondents were asked whether they had ever bought it or not and what were their preferences for the different attributes. They were also asked about the price of each brand and the information provided by them was checked and appeared to be consistent with the price in the local markets – 501 FCFA/kg (1.05 USD/kg) for nonparboiled local rice; 595 FCFA<sup>3</sup> /kg (1.24USD/kg) for parboiled local rice; 511 FCFA/kg (1.07USD/kg) for nonparboiled imported rice; and 621 FCFA/kg (1.30USD/kg) for parboiled imported rice.

Table 1 describes the sociodemographic characteristics of consumers for the different types of rice selected. Nonparboiled local rice was chosen by 40% of consumers while nonparboiled

<sup>3</sup> 1 Dollar US (USD) = 477.630 FCFA (XOF) (September, 2010)

TABLE 2. List of selection criteria for types of rice

Extrinsic characteristics	Intrinsic characteristics		Type of rice
Breakage rate	Ease of cooking	Cleanness	Nonparboiled local rice (NPLR)
Size of grain	Grains very sticky	Whiteness	Parboiled local rice (PLR)
Price	Grains not sticky	Conservation after cooking	Nonparboiled imported rice (NPIR)
	Taste	Swelling capacity	Parboiled imported rice (PIR)
	Aroma	Hard texture	
		Soft texture	

imported rice was chosen by 48.51%. Among households that chose nonparboiled local rice, 88.1% were headed by men and 11.9% by women; the ratio for nonparboiled imported rice was 85.1% male-prefer parboiled local (47.8%) and parboiled imported (42.9%) rice to nonparboiled local (11.9%) and nonparboiled imported (14.9%) rice. A possible explanation for these results is that women appreciate the proven positive health benefits of parboiled rice (Behrens, Heinemann, & Lanfer-Marquez, 2007; Heinemann, Behrens, & Lanfer-Marquez, 2006; Tomlins et al., 2007). The preference for parboiled local rice (7.14%) and parboiled imported rice (7.14%) was relatively low. It is likely that many consumers confused parboiled rice with imported rice. For this reason, and because we have not found any significant coefficient in these two rice types in the conditional logit models, we abandoned the additional attribute of parboiling and focused the study on “local” and “imported” rice with the understanding that “local” rice means nonparboiled local rice and “imported” rice means nonparboiled imported rice.

The monthly average income was lower for consumers that chose local rice (36,135 FCFA (75.65USD)) than for those who chose imported rice (52,620 FCFA (110.17 USD/kg)). One could infer from this that consumers who have lower revenue tend to consume local rice while those who have relatively high revenue tend to consume imported rice. The descriptive analysis also shows that the more highly educated consumers prefer imported rice (31.3%) than local rice (12.9%). Nonparboiled imported rice was mostly chosen in Wawa (89.58%) and Golf (70%) (urban areas in the Maritime region), whereas nonparboiled local rice was more popular in Ogou (91%), Bassar (60%), Kozah (56.18%), and Binah (41.18%) (rice producing rural areas). These results are not surprising because, as explained by Saverimuttu and Rempel (2004), in countries where the primary urban center is also a port (as is the case with the Maritime region in Togo, especially Lomé), with easier access to food imports than food grown in the country's hinterland, the food purchases of this nonagricultural population will be biased towards imports. So, because of the proximity of the Lomé port, imported rice is readily available in most of the markets in the Maritime region. The remaining variables were distributed more-or-less equally.

### 3.2. Maps of the Three Most Important Selection Criteria for Types of Rice

The purpose of this section is to highlight the most important attributes of rice types, using Multiple Correspondence Analysis (MCA), from the map of consumer selection criteria (attributes). During the survey, consumers were asked to indicate in a decreasing order of preference the three most important selection criteria (attributes of rice) for each alternative type of rice. The questionnaire listed 14 modalities of selection criteria (Table 2).

Given the number (14) of characteristics that consumers were presented to choose from, they can be represented in a multidimensional space. This relatively high number of variables cannot be included in a regression, given the sample size. A solution could be to simply select a few attributes and leave out others. This will obviously omit some relevant information. Instead, we prefer to use all the information but reduce the dimension of the characteristics space as suggested by Kaciak and Louviere (1990). The objective of the MCA is to exploit

the information contained in the choice of 14 characteristics to reduce the dimensionality of the characteristics space to an acceptable number, say three for instance. To do this, the MCA found a three orthogonal axis, also termed as factors, on which the 14-space can be projected geometrically while maximizing the information content (inertia). Each factor defines a new criterion summarizing the information contained in the initial 14 criteria. Interestingly, the information on the three criteria is exclusive because the axes that represent them are orthogonal. Thereby, we have richer models as we can now analyze the choice modeling for these three criteria for each type of rice.

Further descriptions of the identified criteria can be conducted by mapping in a two dimensional graph, defined by any couple of factors, with respect to the initial 14 criteria. Within a plane, each category for the selected multinomial variables is represented by a dot. A category with a low number of households for most criteria will be plotted near the origin of the graph (center of gravity), whereas a category with a high number of households will be plotted away from the origin. The distance between points indicates the level of differences between categories. Two categories plotted close to each other are statistically similar with regard to the pattern of relative frequencies whereas two categories plotted far away from each other are dissimilar (Greenacre, 1992). Because consumers have different attitudes towards each type of rice because of differences in attributes, these attitudes are grouped within their own distinct profiles. Therefore, two consumers can be assumed to have the same preferences if they selected almost the same attributes or have a similar degree of preference. In the graph, the subgroup formed by attributes which are close to each other will be considered as similar to each other.

Based on the sample surveyed, attribute maps were prepared with the first two principal factors (Axes 1 and 2) of MCA by considering the first, second, and third purchasing selection criteria for alternative types of rice. The type of rice and the prefectures in which the consumer resides are associated with each active variable. For even more precision, the class of consumer revenue as an illustrative variable is projected onto the maps in order to identify the consumer profile associated with each subgroup containing the most important selection criteria. The category of each selection criterion with the highest contribution to the construction of the factor axes and the minimal distance to the center of gravity will be considered as the best purchasing selection criteria.<sup>4</sup>

MCA helps to reduce the dimension of all characteristics and to identify the three most important selection criteria according to all consumers surveyed without substantial loss in the information contained in the initial 14 characteristics. A common problem with the MCA is that it has a low explanatory power, at least compared to the principal component analysis (PCA). In fact, MCA creates too many new binary variables for each multinomial variable. As a consequence, the total inertia is inflated and the percentage of explained inertia (or explanatory power) by the first dimension is severely underestimated (20–30% is an acceptable explanatory power) (Abdi & Valentin, 2007; Greenacre, 1992). The first map (for the first selection criterion; Figure 1) shows that the first plane amounts to 27.37% of the total information in the 14-dimension space of all initial characteristics. In this plane, Axis1 is determined by two subgroups of attributes, one with positive values and the second with negative values. In the negative subgroup, the category “cleanness” (Axis 1: contribution to explained variance = 12.8, Axis 2: contribution = 4.6; distance = 1.47) is the most important attribute among the first selection criteria. In the positive subgroup, the category “taste” (Axis 1: contribution = 2.06, Axis 2: contribution = 2.11; distance = 2.33) is the most important attribute among the first selection criteria. In each area of the graph, consumers with the same profile are associated with each type of attribute category. The graph shows that the positive subgroup is associated with local rice in Bassar and Cinkasse prefectures of the Savannah region whereas the negative subgroup is associated with imported rice in Golf and Wawa prefectures in the Maritime region.

On Axis 2 in the same plane, the graph also highlights two subgroups with the same two attribute modalities as the most important selection criteria for local rice in the negative

<sup>4</sup>The contributions describe the share of each category in the total inertia of the axis. For example, to interpret an axis, the modalities that have the highest contributions will be selected.

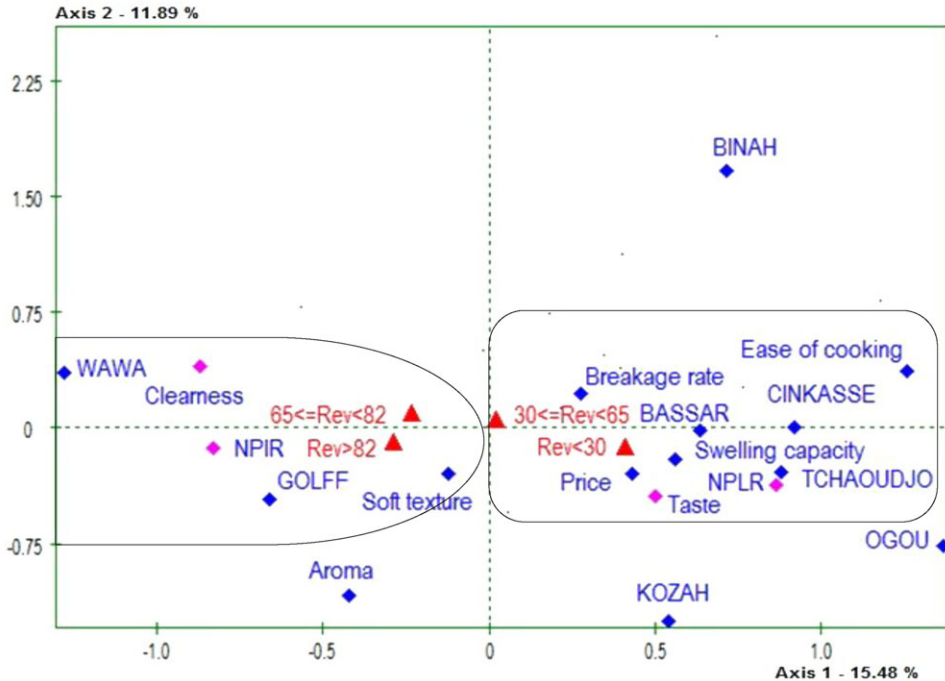


Figure 1 A biplot displaying the first most important selection criteria of types of rice and how they relate with range of household revenue and regions of residence in Togo.

subgroup and for imported rice in the positive subgroup. Overall, if we consider both axes together, there is a clear contrast between cleanness and the imported rice subgroup and the taste and local rice subgroup. If we plot the consumer revenue on the plan defined by these two axes, it can be seen that consumers who choose local rice because of its taste have a lower monthly income (less than 30,000 FCFA (62.81USD)) and live in Binah and Bassar prefectures in the Savannah region. These prefectures are located in rural rice producing zones. By contrast, consumers who prefer imported rice due to its cleanness have a monthly income higher than 30,000 FCFA (62.81USD). These consumers reside in Golf and Wawa prefectures in the Maritime region which is an urban zone. These results confirm those obtained from the descriptive analysis and corroborate the findings by USAID (2009) that imported rice is mostly sold in urban markets while local rice is mainly consumed in rural areas, often close to the rice production area. The results are also similar to those of Lançon et al. (2003) who showed that local rice responds to the needs of certain groups of consumers in Nigeria because of its lower price and taste.

The graph of the second selection criteria is presented in Figure 2. The first axis explains 12.56% of the information in the 14-dimension space of the initial characteristics. The second axis explains 10.08% of the initial information. Thus the plane defined by these two axes explains about 22.64% of the initial information. In this plane, the first axis is determined by a subgroup of attributes related to local rice in the positive values and the second axis is related to imported rice in the negative values. The category "swelling capacity" (Axis 1: contribution = 9.82, Axis 2: contribution = 1.1; distance = 3.97) is the second most important selection criterion for local rice while the category 'whiteness' (Axis 1: contribution = 0.19, Axis 2: contribution = 2.19; distance = 2.98) appears to be the second most important selection criteria for imported rice. The graph clearly shows an opposition between local rice with the swelling capacity attribute and imported rice with the whiteness attribute. Moreover, local rice

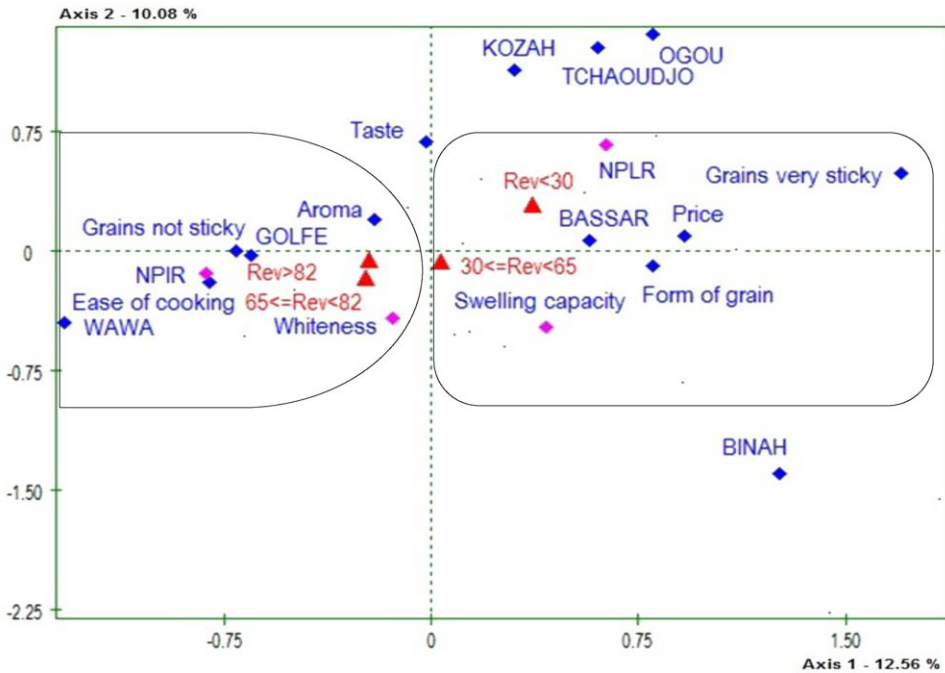


Figure 2 A biplot displaying the second most important selection criteria of types of rice and how they relate with household revenue class and regions of residence in Togo.

associated with swelling capacity is selected by consumers living mostly in Bassar prefecture (Savannah region), which is a rural area, and have a monthly income less than 65,000 FCFA (136.09 USD). This result emphasizes the fact that consumers with low income would be drawn by the rice type that swells well. Swelling is a quantitative attribute like price and very important to price-sensitive or poorer consumers. This result is in line with Dalton (2004) who showed that swelling capacity is an important attribute relating to the amount of rice prepared and the amount that can effectively feed a household. However, imported rice associated with whiteness is important to consumers who live in Golf and Wawa prefectures (Maritime region) and have monthly revenues of 65,000 FCFA (136.09USD) to 82,000 FCFA (171.68 USD) or higher. Here, imported rice is more important to urban consumers with higher revenue while poorer consumers living in rice-producing areas prefer local rice.

The graph for the third selection criteria is presented in Figure 3. The first axis explains 10.99% of the variance and the second axis explains 9.54% of the variance (total = 20.53%). A clear opposition between the subgroups of attributes associated with local rice and those associated with imported rice can be seen. In this plane, the category taste (Axis 1: contribution = 0.42, Axis 2: contribution = 2.14; distance = 2.33), on the quadrant III, is highlighted as the third most important selection criterion for local rice while the category swelling capacity (Axis 1: contribution = 5.24, Axis 2: contribution = 4.17; distance = 3.03), on quadrant I, is the third important selection criterion for imported rice.

Furthermore, taste in local rice was selected by consumers who live in Bassar and Cinkasse prefectures (Savannah region), Kozah (Kara region), Tchaoudjo (Central region), and Ogou (Plateau region) and who have monthly revenues lower than 30,000 FCFA (62.81USD) or between 30,000 FCFA (62.81USD) and 65,000 FCFA (136.09 USD). Conversely, imported rice associated with swelling capacity appears to be more important to consumers in Golf prefecture (Maritime region) who have monthly revenues higher than 82,000 FCFA (171.68 USD) or between 65,000 FCFA (136.09) and 82,000 FCFA (171.68 USD). As already stated

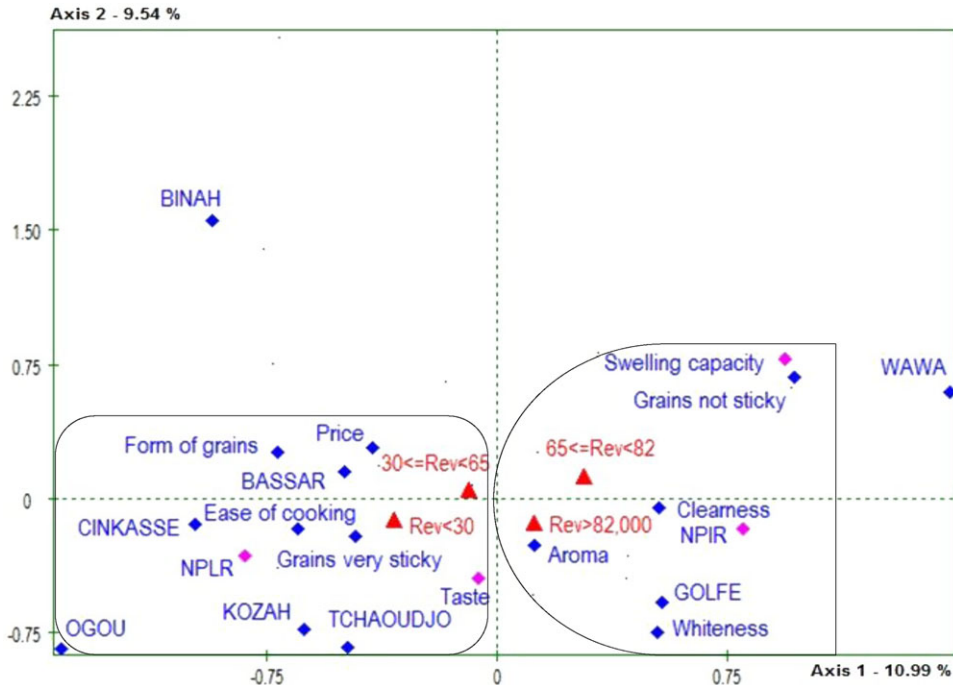


Figure 3 A biplot displaying the third most important selection criteria for types of rice and how they relate with household revenue class and regions of residence in Togo.

above, imported rice is more important to urban consumers with higher incomes while rural dwellers with lower incomes prefer local rice.

In summary, three attributes (taste, swelling capacity and taste) of local rice and three others (cleanness, whiteness and swelling capacity) of imported rice are the most important criteria that determine consumers' choice of types of rice. These results corroborate many findings in the literature. In Nigeria, 71% of consumers identified cleanness among the three most important attributes valued in imported rice relative to locally produced rice (Lancon et al., 2003). In Senegal, the absence of impurities and the whiteness of rice, both associated with post-harvest handling, were significantly correlated with high retail prices (Fall & Diagne, 2008). The results of experimental auctions show that consumers value carefully cleaned and sifted Senegal River Valley rice more than imported rice (Demont et al., 2012).

#### 4. ESTIMATE RESULTS OF CHOICE MODELING

##### 4.1. Parameters Estimated from Conditional Logit Model

The utility function parameters are estimates for each selection criterion, and for each type of rice, using the conditional logit model. For the model estimation, we considered the two rice types (nonparboiled local rice and nonparboiled imported rice). The Hausman test of independence of irrelevant alternatives (Table 3) does not reject the conditional logit estimation,  $p > 0.05$ . Thus, the results of this estimation can be used to derive the marginal contribution of rice attributes to consumer utility and their WTP.

The models estimated for each selection criterion associated with each rice type are presented in Table 4. All models are globally significant. The results for the first and second selection criteria for local rice show that only two intrinsic attributes – cleanness and whiteness – are

TABLE 3. McFadden and Hausman Tests of independent and irrelevant alternatives test results

Model	Local rice	Imported rice
First selection criteria model	0.00 (1.00)	0.00 (1.00)
Second selection criteria model	5.12 (0.88)	0.93 (0.99)
Third selection criteria model	3.48 (0.97)	2.36 (0.99)
Global model	0.00 (1.00)	0.00 (1.00)

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$   
 Prob > Chi<sup>2</sup> in parentheses; df = 10  
 Evidence for Ho (IIA)

TABLE 4. Conditional logit model parameter estimates

Exogenous variable	Local rice			Imported rice		
	Criterion 1	Criterion2	Criterion3	Criterion1	Criterion2	Criterion3
Price/kg	-0.0047*** (0.000)	-0.0051*** (0.000)	-0.0049*** (0.000)	-0.0050*** (0.001)	-0.0057*** (0.000)	-0.0055*** (0.000)
Cleanness	-1.098* (0.589)	-1.072 (0.795)	13.38 (1,270)	2.924*** (1.131)	1.635* (0.908)	2.607** (1.254)
Whiteness	0.125 (0.740)	-1.353** (0.627)	0.119 (0.590)	1.310 (1.241)	1.474** (0.601)	0.609 (0.662)
Breakage rate	-0.266 (0.809)	-0.361 (0.827)	0.791 (0.838)	1.894 (1.360)	1.028 (0.820)	-13.86 (978.4)
Size of grain	-0.130 (0.907)	-0.357 (1.023)	0.363 (0.684)	1.607 (1.495)	-14.94 (2,180)	-0.571 (0.674)
Ease of cooking	0.310 (0.648)	-0.300 (0.539)	0.204 (0.468)	0.894 (1.266)	1.640*** (0.611)	-0.212 (0.509)
Taste	0.0786 (0.547)	0.0495 (0.468)	-0.251 (0.436)	4.493*** (1.408)	2.429*** (0.844)	1.028* (0.619)
Aroma	-0.285 (0.616)	-0.511 (0.542)	-0.690 (0.494)	1.182 (1.150)	1.639*** (0.577)	-0.284 (0.477)
Conservation after cooking	0.0398 (1.601)	-0.326 (0.817)	0.0879 (1.090)	2.315* (1.182)	1.557*** (0.592)	-0.412 (0.480)
Swelling capacity	0.679 (0.839)	0.640 (0.600)	-0.812 (0.615)	3.554** (1.529)	0.697 (0.746)	0.720 (0.487)
Pseudo R <sup>2</sup>	0.242	0.244	0.231	0.346	0.333	0.344
Prob. > chi <sup>2</sup>	0.000	0.000	0.000	0.000	0.000	0.000
Log likelihood	-81.237	-81.104	-82.445	-83.433	-95.961	-95.868
Number of observations	302	302	302	352	398	398

Standard errors in parentheses  
 \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

statistically significant. However, their sign seems counter-intuitive at a first glance. The unexpected sign of the parameters for these two variables could mean that they are not priority selection criteria for local rice in the first and second selection criteria. The Togolese consumers' choice could be guided by other factors such as household incomes, availability of local rice in the prefecture, etc. For imported rice, attributes such as cleanness, taste, swelling capacity, and conservation after cooking (for the first selection criteria), ease of cooking, taste, aroma, storage after cooking, whiteness and cleanness (for the second selection criteria), and cleanness and taste (for the third selection criteria) are statistically significant at conventional threshold levels with the expected sign. Therefore, these attributes contribute significantly towards the choice

TABLE 5. Togo consumer utility for rice type estimates by region and gender

Variable	Local rice			Imported rice		
	Criterion 1	Criterion 2	Criterion 3	Criterion 1	Criterion 2	Criterion 3
<b>Region</b>						
Maritimes	-0.333 (0.371)	-0.417 (0.327)	0.146 (16.04)	2.074** (1.002)	1.010 (14.88)	-0.222 (25.59)
Plateaux	-0.157 (0.386)	-0.520 (0.329)	-0.0523 (0.189)	2.401** (1.050)	0.802 (20.57)	-0.0934 (23.59)
Centrale	0.0113 (0.405)	-0.214 (0.268)	-0.119 (0.200)	2.228** (0.942)	1.329*** (0.436)	0.228 (0.270)
Kara	-0.232 (0.392)	-0.309 (0.278)	-0.104 (0.203)	2.003** (0.901)	0.561 (41.79)	-0.0206 (0.270)
Savannah	-0.117 (0.454)	-0.174 (0.305)	0.136 (0.329)	2.252** (1.070)	1.204*** (0.418)	0.121 (0.274)
All	-0.197 (0.386)	-0.358 (0.292)	-0.0433 (2.876)	2.198** (1.006)	0.929 (17.64)	-0.108 (18.97)
<b>Gender</b>						
Male	-0.211 (0.385)	-0.292 (0.320)	-0.110 (0.211)	2.163** (1.014)	0.428 (41.14)	-0.185 (23.59)
Female	-0.195 (0.387)	-0.366 (0.290)	-0.0352 (3.227)	2.204** (1.005)	1.025 (13.14)	-0.0933 (18.08)
Number of observations	302	302	302	352	398	398

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ 

of imported rice. For each subgroup of attributes formed within each selection criterion (i.e., first, second and third), the price attribute contributes significantly with the expected negative sign to the choice of both rice types.

#### 4.2. Results for Consumer Utility for Types of Rice

Table 5 presents the results of the estimation of consumers' average utility by region and gender according to each selection criterion and type of rice. The results suggest that, with respect to the first and second most important selection criteria analyzed, consumers derived on average a higher utility from imported rice than from locally produced rice. For the first selection criteria, the estimated utility disaggregated by region and gender for this type of rice has all significant positive values while that computed for local rice has all nonsignificant negative values. This figure is similar for the utility estimated when considering the second selection criteria but only for Central and Savannah regions. In summary, we can say that across region and by gender, consumers in Togo prefer imported rice to local rice due probably to the features which were recorded among the first and second selection criteria. The results also show that female consumers' average utility (2.204) was slightly higher than the males' (2.163). This could be explained by the fact that, in Togo and most African countries, women are primarily responsible for purchasing the household's food. These results are not surprising because imported rice is more dominant in urban regions (Maritime region in Togo) due to their proximity to the port. This is also true for other regions when there is a good transport network.

In addition, consumers in urban areas are more demanding on quality. Many authors have shown that consumers in urban regions prefer imported rice because it contains fewer impurities (foreign matter) and more white grains. Naseem, Saneliso, Diagne, Adegbola, and Midingoyi (2013), using a discrete-choice logit model, showed that in the south of the Benin, consumers prefer imported rice to locally produced rice because of its higher quality, especially its physical attributes such as color and absence of impurities. Demont (2013) showed from household surveys that consumers in Douala and Yaoundé in Cameroon prefer imported rice due to its

superior quality. From the results of field experiments, Demont et al. (2013b) conclude that Senegalese consumers' preference for imported rice is primarily due to the product's superior grain quality and those consumers are willing to pay quality premiums for local rice.

### 4.3. Results for Consumers' Willingness to Pay for Attributes of Rice

From the conditional logit model estimation, the willingness to pay (WTP) as a compensating variation in welfare measure was estimated for a marginal change in each attribute in local rice using equation (5). Table 6 shows that, among the selected attributes of local rice, only the WTP for cleanness,  $p < 0.05$ , in the first selection criteria and whiteness,  $p < 0.01$ , in the second selection criteria were statistically significant. According to Table 7, only the WTP for cleanness, whiteness, ease of cooking and taste are statistically significant,  $p < 0.05$ .

These results imply that, to have the same level of utility from imported rice by consuming local rice, the surveyed consumers in Togo's 15 prefectures would be willing to pay an additional 231.2 FCFA/kg = 0.48 USD or 46% of the average price of 501 FCFA = 1.05 USD of local rice) for cleanness and 263.5 FCFA/kg = 0.55 USD or 53% of the average price 501 FCFA = 1.05 USD of local rice) for whiteness. In contrast, in order to obtain the same utility from consuming local rice, consumers who choose imported rice need to be pay 582 FCFA (1.22 USD) for cleanness (first selection criteria), 258.4 FCFA (0.54 USD) for whiteness (second selection criteria), 287 FCFA (0.68 USD) for ease of cooking and taste (second selection criteria), and 273 FCFA (0.57 USD) for aroma. Consumers' willingness to shift from imported to local rice because of the above criteria need to pay 35 to 114% of the price of imported rice. This huge sacrifice is a challenge to rice value chain actors and to the competitiveness of local rice.

The explanation for our results is that consumers are predisposed to pay an additional amount for clean, white rice because locally produced rice is criticized for its low physical grain quality. Our results seem to be higher than those from earlier studies. This kind of result is normal with household survey data; in Cameroon imported rice is preferred by urban consumers due to its superior quality. In addition, experimental evidence suggests that improvement of processing technologies can help quality-differentiating local from imported rice in Cameroon (Akoa Etoa et al., under review). Moreover, field experiments have shown that consumers in the Gambia were willing to pay 19–36% for locally produced rice when compared to imported rice (Demont, Ndour, & Zossou, 2013cb). Rice consumers in Senegal were willing to pay 17% more for quality premium local rice compared to low quality local rice, a premium of 35% greater quality local rice, and a premium of 41% if the source of the locally produced rice was known to them (Demont et al., 2013a). Similarly, an experimented auction in Tanzania, where local rice is preferred to imported rice (Minot, 2010), revealed the potential of a local rice (*Kalamata*) to compete favorably with presumably the most preferred local rice (Supa<sup>5</sup>) (Mujawamariya, Fiamohe, Achandi, & Ndour, 2014). In marketing studies conducted in Ghana, Cadilhon and Even (2012) showed that real opportunities existed for local rice and more than 90% of consumers surveyed in Ghana were ready to support local production by buying local rice if quality and price were comparable to imported rice.

Our findings also corroborate the report by USAID (2009) that cleanness is the most important purchasing criterion for imported rice for urban consumers in Nigeria who value convenience due to their busy work schedules. The results also support Seck et al. (2010) who highlighted the factors behind the poor quality of locally produced rice.

## 5. CONCLUSIONS

Many reports on consumer preference in West Africa indicate that consumers prefer imported rice to locally produced rice due to the inferior grain quality of the latter. This study contributes

<sup>5</sup>Supa is considered the best local rice in terms of its aroma, cleanliness, freshness, and low percentage of breakage.

TABLE 6. Average estimates of willingness to pay for attributes of local rice (FCFA/kg)

Attribute	Average price	criterion 1	Criterion 1 (%)	Criterion 2	Criterion 2 (%)	criterion 3	Criterion 3 (%)
Cleanness	501	231* (131)	46%	209 (156.5)	42%	-3 (255)	-536%
Whiteness	501	-26 (156)	-5%	264** (131.7)	53%	-24 (119)	-5%
Breakage rate	501	56 (170)	11%	70 (160.9)	14%	-159 (169)	-32%
Size of grain	501	27 (191)	5%	70 (200.2)	14%	-73 (139)	-15%
Ease of cooking	501	-65 (137)	-13%	58 (106.0)	12%	-41 (94)	-8%
Taste	501	-16 (115.3)	-3%	-10 (91)	-2%	51 (88)	10%
Aroma	501	60 (131)	12%	100 (106)	20%	139 (102)	28%
Conservation after cooking	501	-8 (337)	-2%	64 (161)	13%	-18 (219)	-4%
Swelling capacity	501	-142 (178)	-29%	-125 (116)	-25%	163 (127)	33%
Number of observations		302		302		302	

Standard errors in parentheses

\*\*\*,  $p < 0.01$ , \*\*,  $p < 0.05$ , \*  $p < 0.1$ 

1 USD = 477.630 FCFA (September, 2010)

TABLE 7. Average estimates of willingness to pay for attributes of imported rice (FCFA/kg)

Attribute	Average price	Criterion 1	Criterion 1 (%)	Criterion 2	Criterion 2 (%)	Criterion 3	Criterion 3 (%)
Cleanness	505	-582.1** (256.8)	-114%	-286.5* (158.6)	-56%	-473.0** (234.1)	-93%
Whiteness	505	-260.8 (253.2)	-51%	-258.4** (111.4)	-51%	-110.5 (121.0)	-22%
Breakage rate	505	-377.1 (280.6)	-74%	-180.1 (147.7)	-35%	2,515 (177,489)	492%
Size of grain	505	-319.9 (303.4)	-63%	2,619 (382,168)	513%	103.6 (123.6)	20%
Ease of cooking	505	-177.9 (256.4)	-35%	-287.4** (113.1)	-56%	38.48 (92.22)	8%
Taste	505	-235.3 (235.9)	-46%	-287.2*** (107.0)	-56%	51.56 (86.77)	10%
Aroma	505	-460.9* (247.1)	-90%	-272.9** (109.6)	-53%	74.82 (87.99)	15%
Conservation after cooking	505	-707.4**	-138%	-122.2	-24%	-	-26%
Swelling capacity	505	(332.2)		(132.3)		(90.66)	
Number of observations		352		398		398	

Standard errors in parentheses

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ 

1 USD = 477.630 FCFA (September, 2010)

to the literature by determining the most important selection criteria of surveyed consumers in 15 prefectures in Togo for locally produced and imported rice. The study also presents consumer utility for each rice type and the price premium which the surveyed consumers are willing to add in order to purchase locally produced rice with quality similar to that of imported rice. These objectives were achieved by using Multiple Corresponding Analysis (MCA) and a random utility model. The results from MCA highlight cleanness, whiteness, and swelling capacity as being the first, second and third most important purchasing selection criteria, respectively, for imported rice compared to taste (first selection criteria), swelling capacity (second selection criteria) and taste (third selection criteria) for local rice. By differentiating consumers into rice producing and urban prefectures, the exploratory analysis revealed that imported rice is consumed mostly in urban areas whereas local rice is consumed mostly in rice-producing areas.

The above exploratory results were reinforced by the estimated consumer utility for each rice type and their willingness to pay for the most important selection criteria related to these types of rice. The results clearly showed that the surveyed consumers prefer imported rice to local rice as the average utility of imported rice was substantially greater than that of local rice. The results also showed that the surveyed consumers would be willing to pay more for extrinsic features such as cleanness and whiteness.

These findings raise the issue of the use of appropriate rice mills, particularly post-milling sorting and grading which can produce clean rice, particularly for urban consumers who value convenience due to their busy work schedules. There is also a need for training in order to enhance the production of good quality paddy for processing that will meet market demand. Ideally, fact sheets should be produced for each released variety, including the best practices for harvesting and post-harvest handling. Rice farmers can then be trained on such technical aspects through participatory varietal selection (PVS). Poor access to good quality seeds of the improved rice varieties contributes to lowering the quality of locally-produced rice. The consistent use of good quality seed by farmers is essential for producing good quality paddy and ensuring the supply of rice in adequate quantity and quality that can effectively compete with imported rice in West Africa's urban markets.

The limitations of this study are as follows: (a) There could be some errors and inaccuracies in the consumer responses to the survey questionnaire. (b) The price data reflect willingness and might be different from the actual price paid by consumers when buying the rice. Despite these limitations, the findings in this article are valid and suggest several implications for research and policy making in Togo and the rest of West Africa. While developing new rice varieties, breeders should take into account the most important intrinsic (for instance, taste and swelling capacity) and extrinsic (cleanness and whiteness) attributes highlighted by the MCA and random utility model in this study. This will lead to new promising markets for locally produced rice which can favorably compete with imported rice.

A lot of improvement is needed in post-harvest handling of rice in subSaharan Africa. As pointed out by Seck et al. (2010), rice is still dried along the roadsides where it gets mixed with stones and other impurities. Rice is milled either by individuals or by farmer cooperatives although most mills are unable to clean or de-stone the milled rice. Additionally, the mills are not adapted to rice husking because of the absence of rubber rollers which can reduce the amount of grain breakage. Polishers and graders are also often missing in these rice mills. The support services necessary to facilitate upgrading by the farmers and individual millers are still very weak. The ability of farmers and millers to purchase suitable processing equipment is limited by the lack of access to appropriate finance and a poor understanding of the return on an investment that could be gained through the use of appropriate equipment.

A rice value chain report by Rogers (2012) concluded that the private sector in Burkina Faso, Ghana, Nigeria, and Tanzania showed a willingness to invest in small scale milling. Involving private sector stakeholders would, therefore, be beneficial for the rice processing sector. However, the entry of private sector stakeholders will require an incentive environment, including easy access to attractive financial products and services in order to drive rice processing towards the improvement of the physical quality of locally produced rice in Togo as well as in the wider West African region.

## ACKNOWLEDGMENTS

The authors appreciate the invaluable comments of Olupomi Ajayi on the first draft that greatly improved this manuscript. We are grateful to Eyram Amovin-Assagba for his assistance with the descriptive statistics, all staff of the AfricaRice Policy, Innovation Systems and Impact Assessment Program for their valuable comments and to Tsatsu Domenyo for the survey coordination. The article also benefited from discussions the authors had with Moussa Sie on the implications of the findings. We gratefully acknowledge financial support from the Government of Japan and the European Union.

Finally, we thank the Editor-in-Chief of *Agribusiness* and anonymous reviewers for their constructive comments which have enhanced the quality of our arguments.

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