4thICAAAE 2013 SEPTEMBER 22-25, Hammamet Tunisia
4th International Conference of the African Association of Agricultural Economists
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A choice modeling approach

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Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia

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Abstract
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. Complementing these reports, this study was undertaken to provide valuable information to researchers and policy makers on consumer criteria for selecting alternative types of rice in Togo. Using a multiple correspondence analysis on 336 respondents in 15 prefectures in Togo, the results highlighted the features cleanness, whiteness and taste as the first, second and third purchasing criteria respectively for non-parboiled imported rice while the choice of non-parboiled local rice was based on taste, swelling capacity and, again, taste as the first, second and third selection criteria, respectively. These results were reinforced by using a random utility model to perform the consumer utility analysis and their willingness-to-pay for the most important purchasing criteria of rice types. The results clearly showed that the surveyed consumers preferred non-parboiled imported rice to the non-parboiled local rice; the average utility of non-parboiled imported rice (2.198) was considerably greater than that estimated for non-parboiled local rice (-0.197) in the first purchasing criteria. To have the same level of utility provided by non-parboiled imported rice by consuming non-parboiled local rice, the surveyed consumers were willing to pay more for cleanness (231.2 FCFA/kg) and whiteness (263.5 FCFA/kg) in the first and second purchasing criteria categories, respectively. Although these results might have some limitations due to errors and inaccuracies in the consumer responses to the survey questionnaire, they do have implications for research and policy makers in Togo and the rest of West Africa.

Keywords: Conditional logit model, consumers' preference for rice attributes, willingness to pay, average utility.

1. **Introduction**

The 2008 food crisis highlighted the need for policy measures for alleviating the impact of soaring prices of staple foods, particularly rice, which has become a strategic food for West Africa (Calpe, 2006: 1; Seck *et al*., 2010: 405). Since that crisis, policy measures have been introduced by governments to stimulate domestic production (Seck *et al*., 2010: 405), which increased by 10.13% per year during 2007-2010 compared to 4.61% for 2001-2007 (AfricaRice, 2012: 26). In addition, despite the high volatility in prices recorded in 2008, the rate of rice consumption in West Africa has increased by almost 3.52% in terms of volume between 2007 and 2010 (AfricaRice, 2012: 30). This growth is due to the combined effects of urbanization, population growth, income and other factors such as relative ease of storage and preparation when compared to other foods (AfricaRice, 2011: 10; USAID, 2009: 6; Calpe, 2006: 14). These results clearly show that the demand for rice is increasing in the sub-Saharan Africa (SSA) countries. With rice consumption growing at a much faster annual rate than production, SSA has been importing large volumes of rice, around 40% of total consumption. This high level of rice import needs to be curtailed by improving domestic rice system production in SSA. This will encourage the consumption of locally produced rice which will increase in production with demand. Therefore, it is necessary to identify consumer demand in respect of the qualitative characteristics of rice consumed in order to promote locally produced rice.

However, neither the debate on policy and economics of rice nor rice breeding has considered consumer taste or responsiveness to the locally grown varieties that are expected to replace imported varieties (Ross, 1983: 336). Indeed, rice breeding is yet to incorporate desirable consumption attributes and non-yield traits into new varieties (Dalton, 2004: 150). In its recent West Africa rice value chain report, the United States Agency for International Development has reiterated the call for demand-focused research, arguing that support for research into consumer demand and preference for local rice should be prioritized (USAID, 2009: 54).

It is apparent that urban consumers in West Africa, and specifically in Togo, have developed a marked preference for imported rice and associated purchasing and eating habits (Rutsaert *et al.*, 2011:1). As pointed out in the case study of the rice value chain in Ghana, it is an error to assume that marketing of local rice would automatically lead to consumer willingness to substitute imported rice with local rice (Cadilhon and Even, 2012: 4). It is also clear that the resultant increase in rice importation into West Africa seriously compromises the effort of governments to increase local rice production. There is, therefore, a need for measures that could address the quality and marketing of local rice in order to reverse this trend to the benefit of local rural producers. In order to sustain the impact of the investments already made in rice production, the quality of locally produced rice should compete favorably with that of imported rice.

Several attributes have been identified that influence the consumers' decision to purchase local or imported rice. These attributes include rice characteristics that are either intrinsic (such as taste, texture, swelling, easiness of preparation), or extrinsic (such as color, packaging, brand, label or price) (Rutsaert *et al.*, 2011: 4; USAID, 2009: 19; Lançon *et al.*, 2004: 110). Using an

experimental auction method in several West African countries, Demont *et al*. (2012: 20) showed that local rice can be competitive vis-à-vis imported rice if quality is tailored to consumer preference and that intrinsic quality attributes and extrinsic quality cues can serve as drivers for developing and strengthening rice value chains in this region. Fofana et al. (2011: 1821) 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 Kendall's coefficient of concordance, Tetteh Anang et al. (2011: 67) found rice attributes such as taste, cooking quality, cooking time and aroma as the most preferred by surveyed consumers in Tamale metropolis in Ghana. To overcome the problem of poor quality locally produced rice, continual support of agricultural research would help to better define the quality criteria preferred by consumers.

This study was undertaken to provide valuable information to researchers and policy makers on consumer selection criteria of alternative types of rice. The data used were collected in 2010 and covered 336 respondents in 15 prefectures in Togo. First, the three most important selection criteria of the rice types were mapped using a multiple correspondence analysis (MCA). MCA is a potentially useful exploratory or complementary research tool which can enable relationships between two or more variables that may be of empirical interest, to be described (Kaciak and Louviere, 1990: 455). Next, choice modeling based on random utility models was applied to estimate the preference of consumers for alternative rice types as a function of rice attributes. The choice modeling is an econometric approach which proposes that consumer (i) choose alternative (j) among (J) alternatives that yield the greatest utility (e.g. Green, 1974: 61; Burton *et al.*, 2001: 481). From the results of choice modeling, the marginal willingness of consumers to pay for the most important selection criteria for alternative types of rice, such as locally produced and imported rice, and consumers' average utility for each type of rice were estimated. The notion of willingness to pay is a key concept and forms the foundation of applied welfare economics. The one important willingness measure is compensating variation which is the amount of 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: 123). Compensating variation thus focuses on the initial level of welfare that the consumer held prior to price and/or income changes.

This paper is organized as follows. Section 2 describes choice modeling followed by the willingness to pay (WTP) empirical specification for the welfare analysis. Section 3 describes the survey data used and analyzes the maps of the three most important purchasing criteria for each rice types elaborated from the multiple correspondence analysis. Section 4 provides econometric results and discusses the preferred attributes that determine consumer choice for each type of rice using a conditional logit model. The estimates of marginal willingness-to-pay and the average utility recovered are also discussed in this section. Concluding remarks are presented in section 5.

2. Theoretical framework

2.1. Modeling consumer selection criteria for alternative types of rice

Choice modeling (CM) is an econometric approach based on random utility theory which proposes that consumer i choose alternative j among J alternatives that yield the greatest utility U_j. The conceptual microeconomic framework for CM lies in Lancaster's (1966: 135) characteristics theory of value which assumes that consumer utility for goods can be decomposed into utilities for composing characteristics such as the deterministic element (v_j), which is observable, and a stochastic element (e_j), which represents the unobservable characteristics affecting consumer choice. Thus, assuming a linear presentation of the utility U_j, this can be expressed as follows:

$$U_{ij} = v_{ij} + e_{ij} \quad (1)$$

where U_j is the indirect utility function for consumer i from alternative j, with $j = 1, \dots, J$. The probability that any particular consumer chooses option j over an alternative option k can be expressed as the probability that the utility associated with the alternative j exceeds that associated with all other alternatives:

$$\mathrm{P}[(\mathrm{U}_{ij} > \mathrm{U}_{ik}) \forall\, j \neq k] = \mathrm{P}[(v_{ij} - v_{ik}) > (\mathrm{e}_{ik} - \mathrm{e}_{ij})] \quad (2)$$

According to McFadden (1974: 111), a typical assumption is that the random part $\mathrm{e_{ij}}$ of the consumer utility ($\mathrm{U_{ij}}$) according to the j alternatives are independently distributed with a type I extreme value distribution specified as follows:

$$\mathrm{F}(e_{ij}) = exp[-exp(-e_{ij})] \quad (3)$$

where F denotes the cumulative distribution function and e_{ij} is normally distributed. The above distribution of error term implies that the probability of consumer i choosing alternative j conditionally to a set of observable elements (v_{ij}), is expressed in terms of the logistic distribution (McFadden, 1974: 110) as follows:

$$\mathrm{Prob}(\mathrm{y}_{ij} = j | v_{ij}) = \frac{\exp(\gamma v_{ij})}{\sum_{j=1}^{\mathrm{J}} \exp(\gamma v_{ij})} \quad (4)$$

where y_{ij} is an indicator variable denoting the choice made by consumer i. This indicator takes the value of 1 if consumer i chooses alternative j and the value of zero otherwise, and v_{ij} are the choice attributes. The term γ 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 (Hanley *et al.*, 2001: 439; Adamowics and Boxal, 2001: 13).

This specification is possible through the independence of irrelevant alternatives (IIA) property assumption which implies that adding another alternative h does not change the relative odds between two alternatives j and h with $j \neq h$. So, the relative probabilities for any two

alternatives depend only on attributes of those two alternatives. This implication is implausible with similar alternatives. If a violation of the IIA is observed, a more accurate model in this case would lead to the relaxation the IIA assumption assuming a multivariate normal distribution of the J terms of the unobservable parts (ε_{ij}) of the consumer with an arbitrary correlation between ε_{ij} and ε_{ih}. This can be a multinomial probit (MNP) model that allows the odds of choosing one alternative over another to depend on the remaining alternatives. The test of violation of the IIA assumption will be done using a test developed by Hausman and McFadden (1984: 1225).

As noted by Wooldridge (2002: 501), the conditional logit model can include individual specific variables by allowing them to have separate effects on the latent utilities. However, Vriens *et al*. (1996: 74) and Fennell *et al*. (2003: 223) demonstrated that this approach in general may be unsatisfactory in a discrete choice model, especially when specific rather than categories of products are involved. Hence, this approach will not be attempted in this study.

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 and form the foundation of applied welfare economics (Just *et al*., 2004: 123). The willingness to pay is defined as the amount of income that must be taken away from a consumer after a price change to restore the consumer's original welfare level (Just *et al*., op. cit.). Compensating variation focuses on the initial level of welfare that the consumer held prior to price and/or income changes. The WTP for a specific attribute (selection criterion) and for a particular alternative j (type of rice) can be derived from the estimation of individual parameters in the choice modeling. Thus, by including price as one of the selection criteria for each type of rice in the choice modeling, the willingness to pay can be indirectly recovered from the consumer's choice (Hanley *et al.*, 2001: 484). Following Pearsons and Kealy (1992: 104), Hanley *et al*. (2001: 436), Burton *et al.* (2001: 484) and Hu *et al.* (2012: 504), we consider the linear form of Equation 1 including price p_j as follows:

$$U_{ij} = \beta_k x_{kj} + \beta_p p_j + e_{ij} \quad (5)$$

where β_k is a parameter of unknown part-worth utilities associated with the selection criteria of type of rice x_{kj}, and e_{ij} is the i.i.d. random component of utility. The question of how much the consumer would be willing to pay (WTP) for the selection criteria to maintain the initial level of utility noted U_{ij}^0 while moving from the initial choice to the alternative (e.g. from the consumption of imported rice to local rice) with the utility noted U_{ij}^1, and with everything else equal, implies that $U_{ij}^0 = U_{ij}^1$. This condition is possible if the consumer accepts an additional amount (WTP) on the initial product price p_j^0 with the condition that this product has the same selection criteria as the initial choice and has the same level of utility. This WTP is given by the ratio of the coefficients given by Equation 6.

$$U_{ij}^0 = \beta_k . 1 + \beta_p p_j^0 + e_{ij}^0$$

$$U_{ij}^{1} = \beta_k . 0 + \beta_p p_j^1 + e_{ij}^1$$

$$U_{ij}^{0} = U_{ij}^{1} \Leftrightarrow \beta_k + \beta_p p_j^0 + e_{ij}^0 = \beta_p (p_j^0 + \text{wtp}) + e_{ij}^1, \text{ with } p_j^1 = p_j^0 + \text{wtp}.$$

$$\Leftrightarrow \beta_k + e_{ij}^0 = \beta_p \text{wtp} + e_{ij}^1$$

$$\Leftrightarrow E(\text{wtp}) = \frac{\beta_k}{\beta_p} \quad (6)$$

where β_k is the coefficient on any of the selection criteria. The estimates of WTP provide an insight into the value that consumers place on its preferred attribute $x_{kj.}$

3. Exploratory analysis of survey data using Multiple Correspondence Analysis

The Multiple Correspondence Analysis (MCA) is a potentially useful exploratory data analysis technique that can be used to identify patterns in data (Kaciak and Louviere, 1990: 456). In this study, MCA is used to conduct preliminary analyses in order to identify categories of consumers that have similar selection criteria (preferred attributes) for type of rice.

3.1. Descriptive statistics of survey data

The data used in this study came from a survey on consumer preference conducted in 2010 in 15 prefectures in Togo by AfricaRice in collaboration with the National Agricultural Research System *Institut Togolais de Recherche Agronomique* (ITRA) and the National Agricultural Statistics Systems (NASS). There were originally 568 respondents although this analysis was carried out on 336 respondents in 15 prefectures where available data were complete and of acceptable quality. Information was collected on socio-demographic characteristics of consumers and their selection criteria for four types of rice - non-parboiled local rice, parboiled local rice, non-parboiled imported rice and parboiled imported rice. Table 1 describes the socio-demographic characteristics of consumers for the selected types of rice. This table crosses each socio-demographic variable with each type of rice. The results show that non-parboiled local rice was chosen by 40% of consumers (88.1% male and 11.9% female) while the non-parboiled imported rice was chosen by 48.51% of consumers (85.1% male and 14.9% female) in the selected 15 prefectures. In what follows, we focus on non-parboiled local and imported rice as they have higher rates of respondent (40% and 48.51% respectively) than parboiled local rice (7.14% of respondents) and parboiled imported rice (3.57% of respondents).

Moreover, the monthly average income of consumers that chose non-parboiled local rice (36,135 FCFA) was lower than that of those who chose non-parboiled imported rice (52,620 FCFA). Consequently, consumers that have lower revenue tend to consume non-parboiled local rice and those having relatively higher revenue tend to consume non-parboiled imported rice. Among the highly-educated consumers, the numbers who chose non-parboiled imported rice (31.3%) were more than double those that chose non-parboiled local rice (12.9%). When consumers were compared according to prefectures, non-parboiled imported rice was mostly chosen in Wawa

(89.58%) and Golfe (70%), mostly in urban areas in the Maritime region, while non-parboiled local rice was more popular in Ogou (91%), Bassar (60%), Kozah (56.18%) and Binah (41.18%), mostly in rice producing areas. The remaining variables were distributed more-or-less equally.

Table 1. Socio-demographic characteristics of consumers

Type of rice	Non-parboiled local	Parboiled local	Non-parboiled imported	Parboiled imported
Number of respondents	135	24	163	14
Average household income distribution (monthly)	36,135	29,492	52,620	47,321
Gender (column %)				
Male	88.1	52.2	85.1	57.1
Female	11.9	47.8	14.9	42.9
Age distribution (column %)				
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
Main activity distribution (column %)				
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
Education distribution (column %)				
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
Prefecture (row %)				
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
Household size distribution column (%)				
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

3.2. Maps of the three most important selection criteria for types of rice

The purpose of this section is to use MCA to highlight, from the map of consumer selection criteria (attributes) of rice type, the most important attributes. In MCA, consumers can be represented in a multidimensional space, although it is not possible to observe the points in a space with more than three dimensions. Therefore, a new orthogonal set of factor axes (or factors) is found to maximize the inertia (information) of the projected points onto the new axes. These axes, called factor axes, define a two-by-two factor plane and are associated with eigenvalues. Eigenvalues are defined as the difference between the total number of modalities (*K*) of the variable and the total number of variables (*Q*) themselves divided by the total number of variables [*(K-Q)/Q*]. Each modality of selection criteria contributes to the construction of factor axes.

Within a plane, each modality is represented by a point. The point locations indicate that a category point with low frequency will be plotted near the origin of the graph (center of gravity), while a category with high frequency will be plotted away from the origin of the graph. Since consumers have different attitudes towards each rice type due to 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. Thus, in the graph, the sub-group formed by attributes which are close to each other will be considered as similar to each other. In the Togo consumers' questionnaire, 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).

Table 2. List of selection criteria for types of rice

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

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 (active variables) for alternative types of rice. The type of rice and the prefectures in which the consumer resides is associated with each active variable. For even more precision, the class of consumer revenue (e.g. Rev in the graph) as an illustrative variable is projected onto the maps in order to identify the consumer profile associated with each sub-group containing the most important selection criteria. The modality 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[1]. The first map (for the first

[1] The contributions describe the share of each modality in the total inertia of the axis. For example, to interpret an axis, the modalities that have the highest contributions will be selected.

selection criterion, Figure 1) shows that the first plane amounts to 27.37% of the total inertia (total information). In this plane, Axis 1 is determined by two sub-groups of attributes, one with positive values and the second with negative values. In the negative sub-group, the modality c***leanness*** (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 sub-group, the modality ***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 sub-group is associated with non-parboiled local rice and the prefectures of Bassar and Cinkasse in the Savane region while the negative sub-group is associated with non-parboiled imported rice and Golfe and Wawa prefectures in the Maritime region.

On Axis 2 in the same plane, the graph also highlights two sub-groups with the same two attribute modalities as the most important first selection criteria for the non-parboiled local rice in the negative sub-group and for non-parboiled imported rice in the positive sub-group. Overally, by considering both axes together, there is clear opposition between cleanness/non-parboiled imported rice sub-group and the taste/non-parboiled local rice sub-group. By including additional information regarding consumer revenue as illustrative variables, it can be seen that consumers who chose non-parboiled local rice because of its taste have a monthly income lower than 30,000 FCFA and live mostly in the Binah and Bassar prefectures in the Savane region. These prefectures are located in rural rice producing zones. By contrast, consumers that prefer non-parboiled imported rice due to its cleanness earn monthly incomes of 30,000 to 65,000 FCFA or greater than 82,000 FCFA. These consumers reside in the Golfe and Wawa prefectures in the Maritime region. This region is more urban than rural. These results confirm those obtained from descriptive statistics and corroborate findings by USAID (2009: 2700) that imported rice is mostly sold in urban markets while local rice is mainly consumed in rural areas, often close to the area of rice production. The results are also similar to those of Lançon et al. (2003: 42) who showed that local rice responds to the needs of certain groups of consumers in Nigeria because of its lower price and taste.

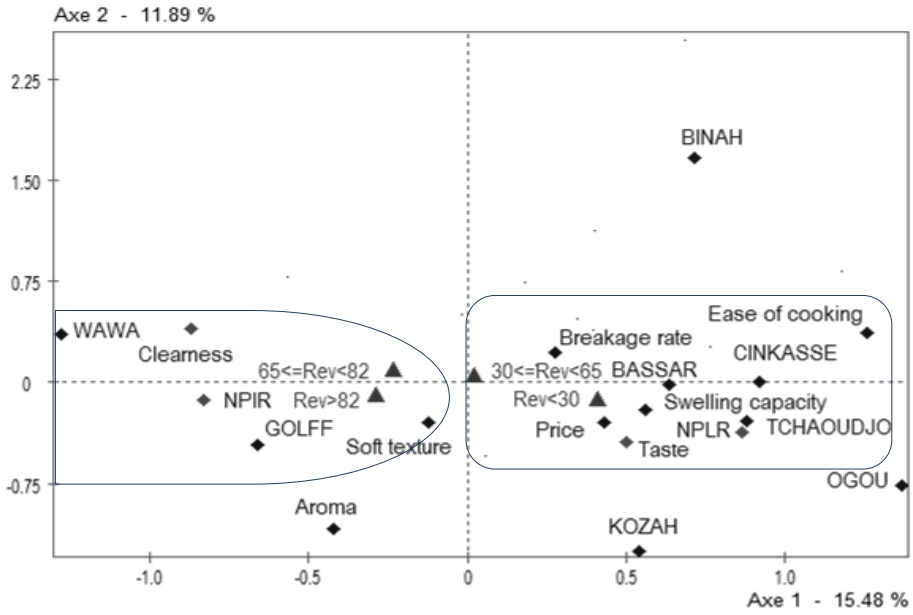

Figure 1. The first most important selection criteria for types of rice in Togo

The graph of the second selection criteria is presented in Figure 2. The first axis explains 12.56% of the variance and the second axis explains 10.08% of the variance (total = 22.64%). In this plane, the first axis is determined by a sub-group of attributes related to non-parboiled local rice in the positive values and the second sub-group is related to non-parboiled imported rice in the negative values. Here, the modality ***swelling capacity*** (Axis 1: contribution = 9.82, Axis 2: contribution = 1.1; distance = 3.97) is the second most important selection criterion for non-parboiled local rice while the modality ***whiteness*** (Axis 1: contribution = 0.19, Axis 2: contribution = 2.19; distance = 2.98) is shown as the second most important selection criteria for the non-parboiled imported rice. On the second axis, the same two selection criteria on the negative side are also considered as the second important selection criteria of the selected types of rice. The graph clearly shows an opposition between non-parboiled local rice with the modality s***welling capacity*** and non-parboiled imported rice with the modality ***whiteness***. Moreover, non-parboiled local rice associated with s***welling capacity*** is selected by consumers living mostly in the Bassar prefecture (Savane region) and with monthly revenues lower than 30,000 FCFA or between 30,000 FCFA and 65,000 FCFA. However, non-parboiled imported rice associated with ***whiteness*** is preferred by consumers who live in the Golfe and Wawa prefectures (Maritime region) and have monthly revenues of 65,000 FCFA to 82,000 FCFA or higher. Here, non-parboiled imported rice is preferred by urban consumers with higher revenue while poorer consumers living in rice-producing areas prefer non-parboiled local rice.

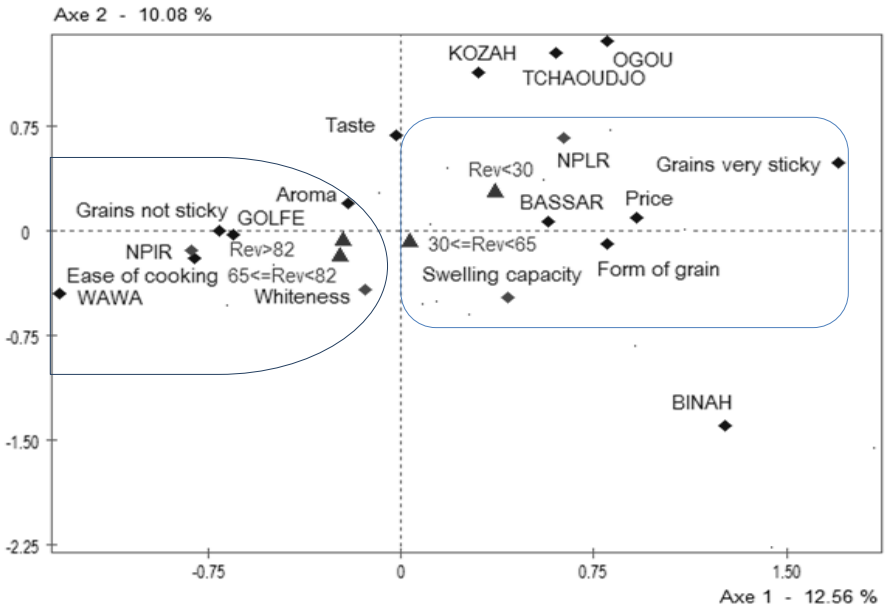

Figure 2. The second most important selection criteria for types of rice

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 sub-groups of attributes associated with non-parboiled local rice and those associated with non-parboiled imported rice can be seen. In this plane, the modality ***taste*** (Axis 1: contribution = 0.42, Axis 2: contribution = 2.14; distance = 2.33) in a negative value on both axes 1 and 2 is highlighted as the third most important selection criterion for non-parboiled local rice while the modality ***swelling capacity*** (Axis 1: contribution = 5.24, Axis 2: contribution = 4.17; distance = 3.03) in a positive value on both Axes 1 and 2 is the third important selection criterion for non-parboiled imported rice.

Furthermore, non-parboiled local rice related to ***taste*** is selected by consumers living mostly in the Bassar and Cinkasse prefectures (Savane region); Kozah (Kara region); Tchaoudjo (Central region) and Ogou (Plateau region) who have monthly revenues lower than 30,000 FCFA or between 30,000 FCFA and 65,000 FCFA. Conversely, non-parboiled imported rice associated with ***swelling capacity*** is preferred by consumers in the Golfe prefecture (Maritime region) who have monthly revenues higher than 82,000 FCFA or ranged between 65,000 FCFA and 82,000 FCFA. As before, non-parboiled imported rice is preferred by urban consumers with higher revenue while rural dwellers with lower revenue prefer non-parboiled local rice.

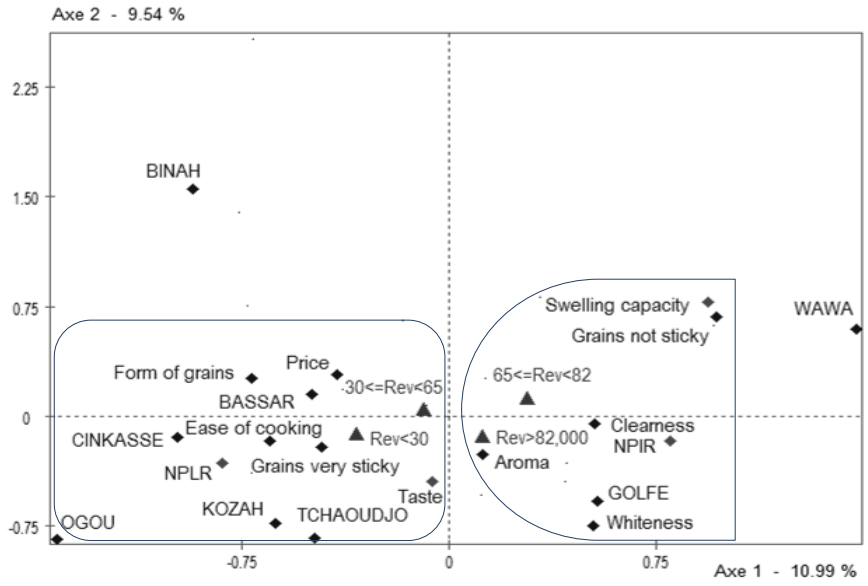

Figure 3. The third most important selection criteria for types of rice

4. Estimate results from choice modeling

4.1. Parameters estimated from conditional logit model

A conditional logit model was used to estimate the parameter associated with each modality of each selection criterion for each rice type. For the model estimation, we considered the four rice types (non-parboiled local rice, non-parboiled imported rice, parboiled local rice and parboiled imported rice) although, due to the low frequencies of the parboiled local rice (sample size =24) and parboiled imported rice (sample size =14), the results are presented for only non-parboiled local rice and non-parboiled imported rice.

The model estimate for each selection criterion associated with each rice type is highly significant (*P<0.000*) (Table 3). The results for the first and second selection criteria of non-parboiled local rice show that only two extrinsic attributes respectively c***leanness*** and ***whiteness*** are statistically significant but with an unexpected sign. Therefore, these two attributes are not a selection criterion of non-parboiled local rice respectively in the first and second selection criteria. For non-parboiled imported rice, attributes such as ***cleanness***, ***taste***, ***swelling capacity*** and ***storage after cooking*** (for the first selection criteria); ***ease of cooking***, ***taste***, ***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 of non-parboiled imported rice. For each sub-group 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.

Table 3 Conditional logit model parameter estimates

	Non-parboiled local rice			Non-Parboiled Imported rice		
Exogenous variable	Criteria 1	Criteria 2	Criteria 3	Criteria 1	Criteria 2	Criteria 3
Price/kg	-0.0047***	-0.0051***	-0.0049***	-0.0050***	-0.0057***	-0.0055***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Cleanness	-1.098*	-1.072	13.38	2.924***	1.635*	2.607**
	(0.589)	(0.795)	(1,270)	(1.131)	(0.908)	(1.254)
Whiteness	0.125	-1.353**	0.119	1.310	1.474**	0.609
	(0.740)	(0.627)	(0.590)	(1.241)	(0.601)	(0.662)
Breakage rate	-0.266	-0.361	0.791	1.894	1.028	-13.86
	(0.809)	(0.827)	(0.838)	(1.360)	(0.820)	(978.4)
Form of grain	-0.130	-0.357	0.363	1.607	-14.94	-0.571
	(0.907)	(1.023)	(0.684)	(1.495)	(2,180)	(0.674)
Ease of cooking	0.310	-0.300	0.204	0.894	1.640***	-0.212
	(0.648)	(0.539)	(0.468)	(1.266)	(0.611)	(0.509)
Taste	0.0786	0.0495	-0.251	4.493***	2.429***	1.028*
	(0.547)	(0.468)	(0.436)	(1.408)	(0.844)	(0.619)
Aroma	-0.285	-0.511	-0.690	1.182	1.639***	-0.284
	(0.616)	(0.542)	(0.494)	(1.150)	(0.577)	(0.477)
Storage after cooking	0.0398	-0.326	0.0879	2.315*	1.557***	-0.412
	(1.601)	(0.817)	(1.090)	(1.182)	(0.592)	(0.480)
Swelling capacity	0.679	0.640	-0.812	3.554**	0.697	0.720
	(0.839)	(0.600)	(0.615)	(1.529)	(0.746)	(0.487)
Pseudo R^2	0.242	0.244	0.231	0.346	0.333	0.344
Prob. > chi2	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

4.2. Results for consumer utility for types of rice

Table 4 presents results of the average utility estimated for Togo consumers with gender disaggregated. Average utilities are estimated according to each selection criterion and each type of rice. For the three selection criteria groups (first, second and third, respectively), the average utilities estimated for non-parboiled imported rice have a positive value while, for non-parboiled local rice, they have a negative value. The average utility estimated for non-parboiled imported rice (only for the first selection criteria) has significant positive values (2.198) while that computed for non-parboiled local rice (for the first selection criteria for comparison) has non-significant negative values (-0.197). Both female and male consumers in Togo prefer non-parboiled imported rice to non-parboiled local rice due to the features which were recorded among the first selection criteria. However, female consumer average utility (2.204) is slightly higher than that of male consumers (2.163), probably because the women are mostly responsible for purchasing the household's food.

Table 4. Togo consumer utility for rice type estimates by gender

	Non-parboiled local rice			Non-parboiled imported rice		
	Criteria 1	Criteria 2	Criteria 3	Criteria 1	Criteria 2	Criteria 3
Male	-0.211	-0.292	-0.110	2.163**	0.428	-0.185
	(0.385)	(0.320)	(0.211)	(1.014)	(41.14)	(23.59)
Female	-0.195	-0.366	-0.0352	2.204**	1.025	-0.0933
	(0.387)	(0.290)	(3.227)	(1.005)	(13.14)	(18.08)
Global	-0.197	-0.358	-0.0433	2.198**	0.929	-0.108
	(0.386)	(0.292)	(2.876)	(1.006)	(17.64)	(18.97)
Number of observations	302	302	302	352	398	398

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

4.3. Results for consumers' willingness to pay for attributes of rice

From the conditional logit model estimates, willingness-to-pay (WTP) as a compensating variation welfare measure was estimated for a marginal change in any attribute by applying Equation (6). The average WTP computed for each attribute related to non-parboiled local rice compared to non-parboiled imported rice is presented in Table 5 (according to each selection criterion). The results show that the surveyed consumers are willing to pay more for the following attributes in non-parboiled local rice - cleanness, breakage rate, form of grain and aroma (among the first selection criteria); whiteness, breakage rate, form of grain, aroma and conservation after cooking (among the second selection criteria); and aroma and swelling capacity (among the third selection criteria). However, among these attributes, only the WTP for ***cleanness*** *(p<0.05)* and ***whiteness*** *(P<0.01)* were statistically significant in the first and second selection criteria, respectively. This means that, to have the same level of utility provided by non-parboiled imported rice by consuming non-parboiled local rice, the surveyed consumers in Togo's 15 prefectures were willing to pay 231.2 FCFA/kg more for cleanness and 263.5 FCFA/kg for whiteness. These findings corroborate the report by USAID (2009: 10) that especially, 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: 406) who highlighted the factors behind the poor quality of locally produced rice.

Table 5. Average willingness to pay estimates for attributes of types of rice (FCFA/kg)

	Non-parboiled local rice			Non-Parboiled Imported rice		
Attribute	Criteria 1	Criteria 2	Criteria 3	Criteria 1	Criteria 2	Criteria 3
Cleanness	231.2*	208.8	-2,687	-582.1**	-286.5*	-473.0**
	(131.3)	(156.5)	(255,156)	(256.8)	(158.6)	(234.1)
Whiteness	-26.27	263.5**	-23.84	-260.8	-258.4**	-110.5
	(156.2)	(131.7)	(118.7)	(253.2)	(111.4)	(121.0)
Breakage rate	56.07	70.23	-158.8	-377.1	-180.1	2,515
	(170.4)	(160.9)	(169.2)	(280.6)	(147.7)	(177,489)
Form of grain	27.35	69.61	-72.88	-319.9	2,619	103.6
	(191.1)	(200.2)	(139.4)	(303.4)	(382,168)	(123.6)
Ease of cooking	-65.33	58.40	-41.06	-177.9	-287.4**	38.48

	(137.6)	(106.0)	(94.06)	(256.4)	(113.1)	(92.22)
Taste	-16.56	-9.633	50.51	-235.3	-287.2***	51.56
	(115.3)	(91.29)	(87.59)	(235.9)	(107.0)	(86.77)
Aroma	60.09	99.51	138.7	-460.9*	-272.9**	74.82
	(131.6)	(105.9)	(101.8)	(247.1)	(109.6)	(87.99)
Storage after cooking	-8.383	63.51	-17.66		-	-
	(337.4)	(160.6)	(218.9)			
Swelling capacity	-142.9	-124.6	163.1	-707.4**	-122.2	-130.7
	(178.7)	(116.4)	(127.0)	(332.2)	(132.3)	(90.66)
Number of observations	302	302	302	352	398	398

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

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 to the literature by showing 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 the surveyed consumers are prepared to add in order to purchase locally produced rice. These objectives were achieved by using Multiple Corresponding Analysis (MCA) and a random utility model. The results from MCA highlighted attributes such as cleanness, whiteness and taste as being the first, second and third most important purchasing selection criteria, respectively, for non-parboiled imported rice compared to taste (first selection criteria), swelling capacity (second selection criteria) and taste again (third selection criteria) for non-parboiled local rice. By differencing consumers into rice producing and urban prefectures, the exploratory analysis revealed that non-parboiled imported rice is consumed mostly in urban areas while non-parboiled local rice is consumed mostly in rice-producing areas.

The above exploratory results were reinforced by calculating consumer utility for each rice type and consumer willingness-to-pay for the most important selection criteria related to these types of rice. The results clearly showed that the surveyed consumers preferred non-parboiled imported rice to non-parboiled local rice as the average utility of the imported rice was considerably greater than that estimated for the local rice. The results also showed that the surveyed consumers were willing to pay more for extrinsic features such as cleanness and whiteness. These two physical characteristics were clearly the first priority for the surveyed consumers in their decision to buy local rice.

These findings raise the issue of the use of appropriate rice mills 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, factsheets 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.

In addition, although these results might have some limitation due to errors and inaccuracies in the consumer responses to the survey questionnaire, they have implications for research and policy makers in Togo and the rest of West Africa. While creating new rice varieties, the researchers should take into account the preferred intrinsic (for instance, aroma 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 sub-Saharan Africa. As pointed out by Seck *et al.* (2010: 406), 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 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.

The rice value chain report concluded that the private sector in Burkina Faso, Ghana, Nigeria, and Tanzania showed a willingness to invest in small scale milling (Rogers, 2012:2). 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.

Acknowledgements

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. We also gratefully acknowledge financial support from the Japan government and European Union. The paper benefited from the authors' discussions with Moussa Sie and Jean Moreira on the implications of the findings.

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