

# Willingness to Pay for Enhanced Food Quality: Rice Parboiling in Benin

**MATTY DEMONT<sup>a</sup>, ESPÉRANCE ZOSSOU<sup>b,c</sup>, PIETER RUTSAERT<sup>d</sup>,  
MAÏMOUNA NDOUR<sup>a</sup>, PAUL VAN MELE<sup>c</sup> and WIM VERBEKE<sup>d</sup>**

<sup>a</sup> Africa Rice Center (AfricaRice), B.P. 96, Saint-Louis, Senegal

<sup>b</sup> Liège University, Gembloux Agro-Bio Tech, Belgium

<sup>c</sup> Africa Rice Center (AfricaRice), 01 B.P. 2031, Cotonou, Benin

<sup>d</sup> Ghent University, Department of Agricultural Economics, B-9000 Ghent, Belgium



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## **Abstract**

In Benin, traditional parboiling is still widely practiced among rice processors, resulting in inferior grain quality. A new parboiler was introduced to improve the milling yield and quality of local rice. We conducted Vickrey second price auctions followed by a consensus session to elicit rural Beninese consumers' willingness to pay for rice obtained through the new parboiler and two locally innovated parboilers. Relative to traditionally parboiled rice, consumers were willing to pay price premiums of 9–13% for rice obtained through a local parboiler using a container of which the bottom is a perforated metal, 27% for rice obtained through a local parboiler using wooden sticks at the bottom of the pot, and 25–34% for rice parboiled through the improved parboiler. Bids were influenced by the presentation order of the products according to perceived quality. Bids were also higher when participants had been informed on the benefits of improved parboiling techniques, a crucial insight for developing marketing and communication strategies for this improved quality product.

**Keywords:** sub-Saharan Africa; food processing; experimental auction; food quality

## **1. Introduction**

Rice is a staple food throughout West Africa and growth in rice demand as a preferred staple is so strong that production intensification and increasing yields will not be sufficient to bridge the widening gap between domestic supply and demand (Tollens & Demont, 2011). Rice consumption in Benin has increased since the 1960s according to an impressive annual growth rate of 21%, i.e. the highest rate recorded in sub-Saharan Africa (Rutsaert et al., 2011). In 2008, it reached the level of 218,000 tons, while domestic production only attained 65,000 tons of milled rice and, hence, satisfied only 30% of the country's demand (FAO, 2010). In addition, urban consumers have developed a preference for imported rice, mainly because of its superior perceived quality (Rutsaert et al., 2011). This has slowed down the development and implementation of policy measures to stimulate local rice production and processing. Measures that address the quality and marketing of local rice could reverse this trend to the benefit of local rural producers (Demont & Neven, 2011; USAID, 2009).

Parboiling is a transformation process that enhances the physical, chemical and organoleptic quality of rice. In Benin and many other West African countries, rice parboiling is exclusively done by women and girls from rice producing villages and surrounding areas. Rice production and processing tasks are divided on the basis of gender, with women being responsible for much of the work involved in processing (Norman & Kebe, 2006). Rice processing is a viable vehicle to empower women by providing them with livelihood and micro-enterprise opportunities. Thus, better processing technologies may directly improve the lives of women and advance their position and respect in rural communities.

However, the prevailing traditional methods result in low milling yield and poor quality (Houssou & Amonsou, 2004). To enhance the quality of parboiled rice, researchers from INRAB (the national agricultural research institute) and Africa Rice Center (AfricaRice, ex-WARDA) collaborated with local artisans and female rice processors to develop an improved parboiler with local materials and equipment. AfricaRice subsequently developed a video where rural women explain how to use this improved technology and its benefits (Van Mele, 2006). In 2006 four local non-governmental organizations (NGOs) publicly screened the video in 80 villages in central Benin. Two years later, surveys in 16 out of these villages indicated that exposure to the video convinced rice processors either to adopt the technology or to apply its principle of pre-cooking paddy with steam by innovating with locally available resources (Zossou et al., 2009). The two most frequently encountered local innovations to separate the paddy from the water during steaming were: (i) the use of a perforated base

adapted to a pan, hereafter referred to as the “perforated-base parboiler”, and (ii) the placement of wooden sticks at the bottom of the pot that are covered with a bag before putting paddy for parboiling, hereafter referred to as the “wooden-sticks parboiler” (Figure 1). The video proved a powerful medium for farmer-to-farmer extension, to expose rural communities to new ideas and practices and to stimulate the creation of their own innovations.



**Figure 1.** Alternative rice parboiling technologies used to process the rice auctioned during the experiment

Studies on consumer preferences and acceptability of parboiled rice are, however, scarce. Tomlins et al. (2005) investigated consumer preferences for locally produced versus imported parboiled rice and relate sensory attributes with consumer acceptability of rice through consumer surveys and sensory panels in three urban centers in Ghana. Heinemann et al. (2006) analyzed acceptability and consumer attitude towards parboiled rice in Brazil using sensory panels and consumer surveys. They concluded that the majority of consumers do not reject the parboiled rice solely based on its sensory properties, but for not being familiar with it and so, unaware of its characteristics and advantages. In a follow up study Behrens et al. (2007) used cluster and correspondence analysis to identify and profile consumer segments and observed that a positive attitude was a reflection of habit and liking, while a negative attitude seemed to be due to previous negative experience and misconceptions about the product. Their findings corroborate the need for marketing efforts and information campaigns in order to inform consumers about the nutritional value and convenience of parboiled rice.

However, previous consumer studies on parboiled rice are based on contingent valuation methods in which consumers state their preferences. Harrison and Rutström (2008) demonstrated that in stated preference methods participants typically overstate their true valuation. To avoid this positive bias, in this article we use an experimental auction market designed to elicit revealed preferences for alternative parboiled rice qualities. Because real products and real money are exchanged in an experimental setting, participants have increased incentives to reveal their true value for a product. Shogren *et al.* (1994) describe the basic procedure. See Lusk and Shogren (2007) for an extensive review of the methodology. To the best of our knowledge, consumer valuation of improved parboiled rice in Africa has never been assessed through experimental auctions. Therefore, the main objective of this study is to elicit rural Beninese consumers’ willingness to pay (WTP) for rice qualities obtained through alternative parboiling techniques, namely traditional parboiling, the two locally innovated parboilers, as well as the improved parboiler.

## 2. Material and methods

We selected the market of Glazoué, an important rural market in the Collines department in central Benin, where parboiling is a major economic activity (Zossou et al., 2009). In a first stage, we identified the most popular local rice variety in the test area, which is *gambiaka*. We used this variety for the entire experiment. A total of four women groups were selected to parboil the rice under the supervision of four facilitators. Rice was parboiled in the villages under local conditions using four methods. A total of 350 kg of *gambiaka* paddy rice was processed and resulted in four different types of parboiled rice (PBR), namely (i) 200 kg of “benchmark rice” through the traditional technology (PBR0); (ii) 50 kg through the local “perforated-base parboiler” (PBR1); (iii) 50 kg through the local “wooden-sticks parboiler” (PBR2); and (iv) 50 kg through the improved parboiler (PBR3). The four technologies are depicted in Figure 1. The obtained parboiled rice was de-husked and ready to be used in the experimental auctions.

We conducted 10 experimental auction sessions during five days, each day one session in the morning and one in the afternoon. The setting was a restaurant on the rural market of Glazoué. For each session, we randomly selected and invited women on the spot, who were going to or returning from the market, and as soon as we had assembled 10 volunteers, we started the session. We offered a participation fee of 2,000 FCFA (US\$4.1), which generated a participation rate of 51%.

We showed the four rice types in four baskets on a table in the front part of a separated room of the restaurant. The rice types were also presented on the participants’ tables in non-cooked form in four dishes (*tongolo*), each one containing one kilogram of rice. We ran three auctions simultaneously following Melton et al. (1996) and Roosen et al. (1998). Analogously to the latter, we used a fixed benchmark, i.e. traditionally parboiled rice. In terms of quality and price, this rice type is inferior to the three alternatives in the auction. Each participant was endowed with one kilogram of the benchmark rice and was presented three times with the option to upgrade this kilogram into an alternative rice type. Lusk et al. (2004) noticed a difference in participants’ bids between multiple-good and single-good valuation. We follow Alfnes and Rickertsen (2003) who argued that bidding on all alternatives simultaneously is an efficient method for eliciting WTP differences. A simultaneous multiple-good or side-by-side presentation protocol is also the most realistic and natural reflection of local market settings in which the limited number of available options are presented to the consumer side-by-side. We positioned the benchmark rice left on the front table and on the participants’ tables and lined up the alternative rice types right from the benchmark rice. In order to account for eventual presentation order (lining up) bias on WTP, we split the experiment in two parts. In the first five sessions, we lined up the three alternative rice types according to increasing quality, i.e. benchmark (PBR0), PBR1, PBR2, and PBR3. In the last five sessions we changed the presentation order to the setting presenting the benchmark (PBR0) at the left, followed by PBR3, PBR1, and PBR2. The latter configuration allows us to evaluate (i) how the value of the superior product (PBR3) is affected when positioned between two inferior products (benchmark and PBR1), and (ii) how the value of an inferior product (PBR1) is affected when positioned between the two superior products (PBR2 and PBR3).

We opted for the Vickrey (1961) second-price auction mechanism, because of its weakly dominant strategy for the participants to bid their true value for the good. Shogren *et al.* (2001) suggested that the random  $n^{\text{th}}$  price auction works better for off-margin bidders than the second price auction. However, in our context of low education levels (see further) and hence high illiteracy, we preferred the second price auction mechanism as it is easier to understand. We did not use any manuals or monitors and conducted the experiment verbally

in the language *Fon* with translation into the languages *Idatcha* and *Mahi*. The sessions took 103 minutes on average.

We paid considerable attention to explaining and training the mechanism. Following Shogren et al. (1994), we used commonly known brands of biscuits to familiarize the participants with the endow-and-upgrade method and the Vickrey auction. Each participant received a small package of biscuits and was asked to bid for two alternative superior types of biscuits. We conducted two rounds with an evaluation after each round to check whether the participants understood the system, and whether more clarification was needed. We learned from previous research that WTP difference estimates were more reliable after “calibration” (Rutsaert et al., 2010), i.e. before the first bidding round we posted the absolute market price of the benchmark rice, i.e. 350 FCFA/kg, but did not reveal and kindly asked the participants not to reveal any price information on the alternative rice types. In the biscuit trials we posted prices to explain the auction mechanism, but during the rice auctions we did not reveal any bidding information. Furthermore, we used the analogy of buying a new object in exchange for the old object, where only the price for “upgrading” is paid, a buying method which is commonly applied by Beninese women on the market. Both the calibration and the example of analogy considerably facilitated and enhanced the learning process of the endow-and-upgrade method.

Harrison, Harstad, & Rutström (2004) argued that multiple trials with posted prices may influence bids and advised to use just one round of bidding or multiple trials without posting prices. We limited the number of bidding rounds to two separated by a sensory test aiming at assessing the impact of experiencing post-cooking quality attributes (e.g. taste, aroma, swelling capacity and stickiness) on WTP. During the sensory test, each participant was offered four dishes side-by-side with cooked samples of the four rice types and was asked to taste the rice types in random order. Water was provided to the participants to rinse their mouths between tasting the different samples.

After the individual bidding rounds, we asked the participants to gather around a table and attempt to achieve a consensus on their collective WTP (CWTP) to upgrade the benchmark rice into each alternative rice type. CWTP values obtained through group consensus incorporate expertise from peers within the randomly recruited *ad hoc* group and provide useful information on socially acceptable prices. Following Bonner, Sillito, & Baumann (2007), groups were informed that they should reach consensus, but no specific method of doing so was imposed or proposed. After this instruction, groups were left alone during the discussion to avoid external influencing. The group discussions were very vivid and inclusive.

After the group session, we conducted a short survey using a one-page questionnaire to collect socio-demographic data. We planned the survey after the auction experiment to avoid revealing too much about the study’s objectives (Corrigan & Rousu, 2008). At the end of the experiment, like Roosen et al. (1998), we randomly selected one product and one bidding round as binding. We explicitly explained this during our introduction to avoid the substitution effect that could arise if participants could win more than one product which could compromise bidding their true value for the products.

### **3. Results and discussion**

#### *3.1 Descriptive statistics*

Table 1 shows some summary statistics of the socio-demographic characteristics of the sample. Women were on average 37 years old and could be categorized into two major ethnic groups, i.e. *Yoruba* (59%) and *Fon*, including *Mahi* and *Minan* (41%). The average monthly household income was 46,000 FCFA (US\$93) and was used to feed five individuals on

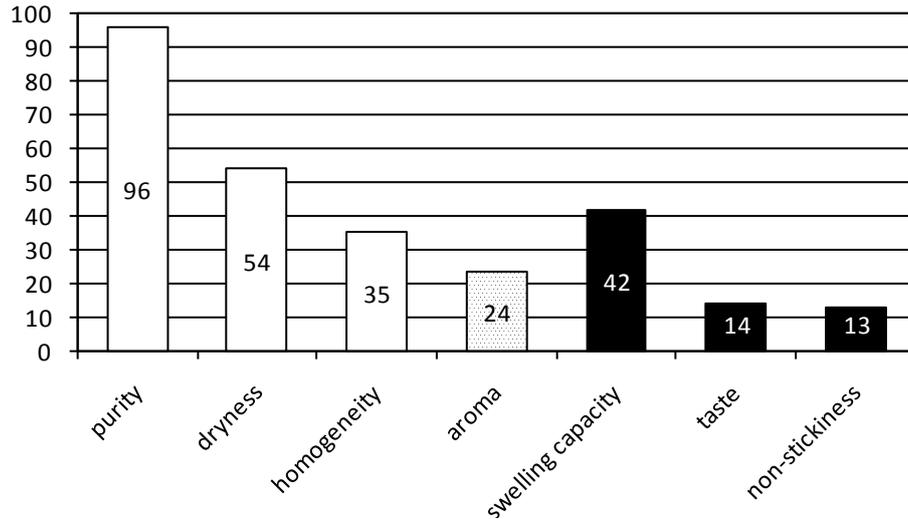
average. The education level was fairly low; only 12% had been educated beyond primary school. As discussed before, we accounted for the high illiteracy rate in our experimental design. The large majority of women (82%) were active in small trade which is clearly a women's business in Benin (Fafchamps et al., 2005), a minority in agriculture (10%) and other professions (8%). One out of ten women had a cooking housemaid and the average daily time spent on dinner preparation, including going to the market, preparation and actual cooking, was about two hours. A minority (14%) purchased rice on a daily basis but almost half (45%) consumed rice daily. In an attempt to capture the effect of the time of the day during which the experiment was conducted on the physiological/psychological state of mind of the participants (Menkhaus et al., 1992), we asked them whether they were hungry at the time of the experiment and whether they had been interrupted in their daily activities of preparing lunch or dinner. 35% of the women admitted they were hungry and 41% informed that they had been interrupted. About half (53%) of the women were member of an association and 22% had received information on improved parboiling, mostly through radio. Almost all women (91%) had a strong preference for parboiled rice relative to non-parboiled rice.

**Table 1.** Definition of variables and socio-economic profile of consumers in the experimental sample

Variable	Definition	Mean (std. dev.)
Age	Age in years	37.20 (10.32)
Household income	Monthly household income in 10 <sup>3</sup> FCFA <sup>a</sup>	46.05 (34.18)
Household size	Number of individuals in household	5.14 (2.37)
<i>Fon</i>	1 = <i>Fon</i> , <i>Mahi</i> and <i>Minan</i> ; 0 = <i>Yoruba</i>	0.41 (0.49)
Education	0 = none; 1 = local language; 2 = primary; 3 = intermediate; 4 = secondary; 5 = tertiary	1.32 (1.12)
Higher education	1 = intermediate, secondary or tertiary; 0 = otherwise	0.12 (0.33)
Trader	1 = trader as profession; 0 = otherwise	0.82 (0.39)
Farmer	1 = producer; 0 = otherwise	0.10 (0.30)
Cooking housemaid	1 = has a cooking housemaid; 0 = otherwise	0.10 (0.30)
Cooking time	Total time in hours spent on preparing dinner (market, preparation and cooking)	2.03 (0.65)
Buying frequency	1 = daily; 0 = otherwise	0.14 (0.16)
Eating frequency	1 = daily; 0 = otherwise	0.45 (0.20)
Hungry	1 = hungry; 0 = otherwise	0.35 (0.48)
Interrupted	1 = interrupted in preparing lunch or dinner; 0 = otherwise	0.41 (0.49)
Group membership	1 = member of a group; 0 = otherwise	0.53 (0.50)
Information	1 = received information on improved parboiling; 0 = otherwise	0.22 (0.42)
Preference	1 = prefers parboiled rice; 0 = prefers non-parboiled rice	0.91 (0.29)
Number of participants		100

<sup>a</sup> At the time of the experiments, i.e. May 2009, the currency rate was \$1 = 492 FCFA.

During our survey, we asked the participants to list the criteria they use to judge the quality of parboiled rice in relation to the values they bid during the two experimental auction rounds, i.e. before and after the sensory test. Figure 2 displays the consumer preferences through a bar chart. Each bar represents the number of participants that mentioned the criterion. Criteria which can be evaluated before cooking are represented through white bars; post-cooking criteria through black bars and criteria which can be judged before and after cooking (e.g. aroma) through dotted bars. The most important visual criteria were purity, mentioned by 96% of the participants, followed by dryness (54%), homogeneity (35%) and aroma (24%). The most important post-cooking criteria mentioned by the participants were swelling capacity (42%), aroma (24%), taste (14%) and non-stickiness (13%).



**Figure 2.** Criteria for evaluating parboiled rice used by participants in our experimental sample. The height of the bar and the number written in the bar represent the number of participants that have mentioned the criterion.

In Table 2, we report some descriptive statistics of individual (WTP) and collective (CWTP) bids for the alternative rice types. First, we find that group bids are not statistically significant from individual bids based on a Tukey test with unequal sample sizes and a significance level of 5%. This suggests that the individual WTP bids are within the socially acceptable quality premiums defined by the *ad hoc* groups. Secondly, we do not find any significant differences between pre- and post-sensory-experience WTP estimates based on a paired sample t-test. These findings are consistent with Tomlins et al. (2005) who did not find different patterns for predicting consumer acceptability between cooked and uncooked rice in Ghana. The insignificance of our sensory test and the length of the white bars in Figure 2 suggest that rural Beninese consumers focus predominantly on visual, pre-cooking evaluative criteria for valuing the quality of parboiled rice. Urban Senegalese consumers, in contrast, prefer non-parboiled broken rice and tend to focus more on post-cooking experience criteria such as taste, swelling capacity and ease of cooking (Fall et al., 2007). Sensory tests conducted in those markets using a similar procedure as in this study yielded a significant influence on WTP (Rutsaert et al., 2010).

**Table 2.** Descriptive statistics of WTP and CWTP for rice parboiled through alternative improved parboiling technologies

Rice type	Mean WTP (FCFA)			CWTP
	Before sensory test	After sensory test	Average	
PBR1	43 <sup>a</sup> (27)	43 <sup>a</sup> (41)	43 <sup>a</sup> (31)	45 <sup>a</sup> (16)
PBR2	97 <sup>b</sup> (36)	94 <sup>b</sup> (48)	95 <sup>b</sup> (45)	100 <sup>b</sup> (24)
PBR3	102 <sup>b</sup> (31)	102 <sup>b</sup> (45)	102 <sup>b</sup> (49)	110 <sup>b</sup> (38)

Notes: Different superscripts denote populations which are statistically significantly different based on an ANOVA F-test and a significance level of 5%. The price of the benchmark rice was about 350 FCFA/kg (US\$0.71) in May 2009 at an exchange rate of US\$1 = 492 FCFA. WTP = willingness-to-pay; CWTP = collective willingness-to-pay. Standard deviations are shown between brackets.

Thirdly, we find significant differences between the bids (both WTP and CWTP) for PBR1 and those for PBR2 and PBR3 with the ANOVA F-test, but not between PBR2 and PBR3. This suggests that purely based on visual and sensory characteristics, rural women are not able to distinguish between the end-products generated by the local “wooden-sticks parboiler” and the improved parboiler. Hence, relative to traditionally parboiled rice, consumers are willing to pay price premiums of 95–102 FCFA/kg (US\$0.09–0.21) for rice parboiled through

either technology, and 43 FCFA/kg (US\$0.09) for rice parboiled through the local “perforated-base parboiler”. Group consensus led to similar price premiums, i.e. 100–110 FCFA/kg (US\$0.20–0.22) for PBR2 and PBR3 and 45 FCFA/kg (US\$0.09) for PBR1.

### 3.2 Determinants of WTP

To identify the factors that influenced the bids, we estimate a random effects tobit model because WTP for upgrading is typically censored at zero. Analogously to Lusk et al. (2004), we adjust the tobit model to incorporate random effects to account for the panel structure of the data. Each participant submitted six bids, i.e. for three different rice types during two bidding rounds. The Tobit model, incorporating random effects is presented as follows:

$$(1) \quad WTP_{ijpr}^* = \boldsymbol{\alpha}' \mathbf{x}_{ijpr} + u_{ij} + v_{ijpr}$$

$$WTP_{ijpr} = \max[0, WTP_{ijpr}^*]$$

where  $WTP_{ijpr}^*$  is the auction bid for the  $i$ th consumer ( $i = 1, \dots, n = 10$ ) in the  $j$ th session ( $j = 1, \dots, k = 10$ ) for the  $p$ th rice type ( $p = \text{PBR1, PBR2, PBR3}$ ) in the  $r$ th bidding round ( $r = 0$  before tasting,  $r = 1$  after tasting), which is observed only at positive levels,  $\mathbf{x}_{ijpr}$  is a vector of independent variables including dummy variables identifying rice types, a dummy variable for the bidding round, and a vector of socio-demographic variables  $\mathbf{x}_v$  ( $v = 1, \dots, s = 12$ ),  $\boldsymbol{\alpha}$  is a conformable vector of coefficients to be estimated,  $u_{ij}$  is an individual specific disturbance for participant  $i$  in session  $j$ , and  $v_{ijpr}$  is the overall error term.

In Table 3 we present the determinants of the individual bids. First, consistent with our previous ANOVA tests (Table 2) and similar to evidence from urban Ghana (Tomlins et al., 2005), we observe that tasting or sensory experience does not significantly influence bids. The timing of the experiments, on the other hand, seems to be a determining factor; WTP is on average 15 FCFA/kg (US\$0.03/kg) higher during the morning sessions as compared to afternoon sessions. Our results are consistent with similar experimental evidence from Senegal (Rutsaert et al., 2010) and with Hoffman (1993), who rejected the hypothesis that bids are constant during the day. The morning-effect could have been caused by the fact that women are more likely to be hungry before lunch than after, or to the fact that women are more likely to be focused on rice purchase and preparation in the morning, especially in case the morning sessions entailed an interruption in their daily routine of going to the market and preparing lunch. However, our attempt to analyze the physiological/psychological causes of this effect through the variables “hungry” and “interrupted” failed because none of the variables explained the morning-effect better than the variable “morning” itself.

Secondly, our experimental evidence uncovers a significant income effect; women from more wealthy households are willing to pay significantly higher price premiums for rice parboiled through improved parboiling techniques. The positive correlation between income and quality premiums consumers are willing to pay for food products has been formally proved by Vandeplass et al. (2009). Households with a cooking housemaid, in contrast, tend to attribute a lower value to improved parboiled rice. This may be explained by the fact that women with a housemaid often send their housemaid to the market and, hence, are less acquainted with market prices. We further observe that older women and women from the ethnic group *Fon* exhibit a lower willingness to pay price premiums for any of the alternative rice types. In Benin parboiled rice is less appreciated in the South where *Fon* are in majority and more appreciated in the Center and the North where *Yoruba*, *Dendi* and *Bariba* are in majority.

Thirdly, a preference for parboiled rice does not seem to affect consumers’ valuation of improved parboiled rice, perhaps because our dataset does not display much variation in this variable as 91% of the participants preferred parboiled rice to non-parboiled rice (Table

1). Diffusion of information to create awareness of improved parboiling technologies seems to positively affect participants' WTP. This shows that current information and training campaigns (video, cinema van) do not only play an important role in informing rice processors, but also in making consumers aware of the value of the end-product.

**Table 3.** Determinants of WTP: Random effects Tobit estimates

Independent variables	Coefficient $\pm$ standard error	P >  z
Constant	130.957 $\pm$ 20.240	0.000
PBR1	-62.075 $\pm$ 4.841	0.000***
PBR3	-8.909 $\pm$ 4.802	0.064*
Lined up	-4.156 $\pm$ 7.240	0.566
Lined up*PBR1	13.324 $\pm$ 6.881	0.053*
Lined up*PBR3	31.904 $\pm$ 6.803	0.000***
Taste	-1.573 $\pm$ 2.797	0.574
Morning	14.718 $\pm$ 6.986	0.036**
Hungry	-4.006 $\pm$ 7.014	0.568
Interrupted	0.669 $\pm$ 7.518	0.929
Age	-0.566 $\pm$ 0.320	0.077*
Household income	0.211 $\pm$ 0.091	0.021**
Household size	-2.231 $\pm$ 1.448	0.123
<i>Fon</i>	-11.865 $\pm$ 6.158	0.054*
Higher education	-6.266 $\pm$ 9.542	0.511
Trader	-9.870 $\pm$ 8.511	0.246
Farmer	-11.959 $\pm$ 10.906	0.273
Cooking housemaid	-22.850 $\pm$ 10.474	0.029**
Cooking time	3.369 $\pm$ 4.764	0.479
Buying frequency	-20.835 $\pm$ 18.123	0.250
Eating frequency	-17.309 $\pm$ 15.020	0.249
Group membership	0.496 $\pm$ 6.089	0.935
Information	14.010 $\pm$ 7.991	0.080*
Preference	1.387 $\pm$ 10.206	0.892
Log likelihood	-2,862.686	
Number of observations	600	

Notes: \* denotes statistical significance at the 10%, \*\* at the 5%, and \*\*\* at the 1% level. At the time of the experiments, i.e. May 2009, the currency rate was \$1 = 492 FCFA. Not lined up = benchmark, PBR3, PBR1, PBR2; lined up = benchmark, PBR1, PBR2, PBR3.

Finally, our analysis enables identifying presentation order (lining up) effects of the auctioned rice types according to increasing quality as a determining factor of WTP. Lining up does not affect the bids for PBR2, but boosts the value of PBR1 and PBR3. Therefore we define PBR2 as the reference category and omit the dummy (Table 3). In other words, if the products are not lined up and the superior product (PBR3) is presented between two inferior products (benchmark and PBR1) it is not recognized as the superior product and is discounted. The opposite does not hold; if an inferior product (PBR1) is presented between two superior products (PBR3 and PBR2), its value is not upgraded, but discounted as well.

Hence, after controlling for all the socio-economic and experimental determinants discussed before, we find that the price premium consumers are willing to pay for PBR2 relative to PBR1 varies from 49 FCFA/kg (US\$0.10/kg) to 62 FCFA/kg (US\$0.13/kg), depending on the presentation order. Likewise, the price premiums consumers are willing to pay for PBR3 relative to PBR2 varies from a small weakly significant discount (negative premium) of 9 FCFA/kg (US\$0.02/kg) to a significantly positive premium of 23 FCFA/kg (US\$0.05/kg), depending on whether the three products are lined up according to increasing quality or not.

#### **4. Conclusions**

We conducted Vickrey second price auctions followed by a consensus session to elicit consumers' willingness to pay a price premium for rice obtained through a new parboiler and two locally innovated parboilers in Benin. We observed that, under experimental conditions, relative to traditionally parboiled rice, rural Beninese consumers were willing to pay price premiums of 9–13% for rice obtained through a local parboiler using a container of which the bottom is a perforated metal (PBR1), 27% for rice obtained through a local parboiler using wooden sticks at the bottom of the pot (PBR2), and 25–34% for rice parboiled through the improved parboiler (PBR3). The proportionate price premiums are calculated by applying the econometric estimates to the average price premium of 95 FCFA/kg (US\$0.19) for PBR2 (Table 2), and expressing the results as a percentage of the market price for traditionally parboiled rice, i.e. 350 FCFA/kg (US\$0.71) at the time of the experiments in May 2009.

Individual and collective bids were not significantly different, but were substantially influenced by the presentation order of the products according to perceived quality. This provides useful information for marketing and promotion strategies of enhanced quality parboiled rice. Different rice types could be presented on a degustation booth lined up according to quality and value. Visual presentation and lining up of the alternative rice types in order of quality could be sufficient for demonstrating value as our experimental evidence suggests that value is unaffected by the sensory experience.

Bids were also higher when participants had been informed on the benefits of improved parboiling techniques, an encouraging insight for developing marketing and communication strategies for this improved quality product. Our findings furthermore suggest that, in this particular setting, marketing efforts (such as degustation booths) and generic promotion programs (such as television and radio broadcasts) should be programmed during the morning when consumers exhibit a higher WTP for purchasing and trying out new rice products. Obviously, media campaigns should be aired prior to the women going out to the market. Since not all rice processors have access to the improved parboiler, the local innovations triggered by watching the video about parboiling should be further promoted. Based on the results of our experiment, AfricaRice included the example of the “wooden-sticks parboiler” in a radio script shared with rural radios across Africa. Considering the high illiteracy rate among rural women, audio and video-based communication strategies are the most promising ones for African settings (Gakuru et al., 2009). AfricaRice has over the years facilitated the translation of a series of rice videos into more than 30 African languages and experimented with numerous uptake pathways (Van Mele et al., 2010). Although showing the videos at public events, such as market days, reduces farmers' transaction costs in accessing information (see also Bentley et al., 2003), research in Bangladesh has shown that videos handed over to the communities may have the highest impact on rural women (Chowdhury et al., in press; Van Mele et al., 2007).

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#### **References**

Alfnes, F., & Rickertsen, K. (2003). European consumers' willingness to pay for US beef in experimental auction markets. *American Journal of Agricultural Economics*, 85, 396-405.

- Behrens, J. H., Heinemann, R. J., & Lanfer-Marquez, U. M. (2007). Parboiled rice: A study about attitude, consumer liking and consumption in São Paulo, Brazil. *Journal of the Science of Food and Agriculture*, 87, 992-999.
- Bentley, J. W., Boa, E., Van Mele, P., Almanza, J., Vasques, D., & Eguino, S. (2003). Going Public: A new extension method. *International Journal of Agricultural Sustainability*, 1, 108-123.
- Bonner, B. L., Sillito, S. D., & Baumann, M. R. (2007). Collective estimation: Accuracy, expertise, and extroversion as sources of intra-group influence. *Organizational Behavior and Human Decision Processes*, 103, 121-133.
- Chowdhury, A. H., Van Mele, P., Hauser, M. (in press). Contribution of farmer-to-farmer video to capital assets building: Evidence from Bangladesh. *Journal of Sustainable Agriculture*.
- Corrigan, J. R., & Rousu, M. C. (2008). Testing whether field auction experiments are demand revealing in practice. *Journal of Agricultural and Resource Economics*, 33, 290-301.
- Demont, M., & Neven, D. (2011). Tailoring African rice value chains to consumers. In M. C. S. Wopereis, D. Johnson, T. Horie, E. Tollens, & A. Jalloh (Eds.), *Realizing Africa's rice promise*. Wallingford, UK: CABI Publishing.
- Fafchamps, M., Gabre-Madhin, E., & Minten, B. (2005). Increasing returns and market efficiency in agricultural trade. *Journal of Development Economics*, 78, 406-442.
- Fall, A. A., Fall, C. A. K., Gningue, D. R., Ndir, B., & Ndour, M., 2007. Etude sur les critères de qualité et les modes de consommation du riz au Sénégal, Rapport Projet FNRAA, No. 010/AP03M010202, Fonds National de Recherches Agricoles et Agro-alimentaires (FNRAA), Dakar, Sénégal.
- FAO. FAOSTAT agriculture data, Accessed on October, 19, 2010 at <http://faostat.fao.org/>.
- Gakuru, M., Winters, K., & Stepman, F., 2009. Inventory of innovative farmer advisory services using ICTs, Forum for Agricultural Research in Africa (FARA), Accra, Ghana.
- Harrison, G. W., Harstad, R. M., & Rutström, E. E. (2004). Experimental methods and elicitation of values. *Experimental Economics*, 7, 123-140.
- Harrison, G. W., & Rutström, E. E. (2008). Experimental evidence on the existence of hypothetical bias in value elicitation methods. In C. R. Plott & V. L. Smith (Eds.), *Handbook of Experimental Economics Results, Vol. 1, Part 5* (pp. 752-767). New York, USA: Elsevier.
- Heinemann, R. J. B., Behrens, J. H., & Lanfer-Marquez, U. M. (2006). A study on the acceptability and consumer attitude towards parboiled rice. *International Journal of Food Science and Technology*, 41, 627-634.
- Hoffman, E., Menkhaus, D. J., Chakravarti, D., Field, R. A., & Whipple, G. D. (1993). Using laboratory experimental auctions in marketing-research: A case-study of new packaging for fresh beef. *Marketing Science*, 12, 318-338.
- Houssou, P., & Amonsou, E. (2004). Development on improved equipment for paddy rice in Benin. *Uganda Journal of Agricultural Sciences*, 9, 617-620.
- Lusk, J. L., Feldkamp, T., & Schroeder, T. C. (2004). Experimental auction procedure: Impact on valuation of quality differentiated goods. *American Journal of Agricultural Economics*, 86, 389-405.
- Lusk, J. L., & Shogren, J. F. (2007). *Experimental auctions: Methods and applications in economic and marketing research*. Cambridge: Cambridge University Press.

- Melton, B. E., Huffman, W. E., Shogren, J. F., & Fox, J. A. (1996). Consumer preferences for fresh food items with multiple quality attributes: Evidence from an experimental auction of pork chops. *American Journal of Agricultural Economics*, 78, 916-923.
- Menkhaus, D. J., Borden, G. W., Whipple, G. D., Hoffman, E., & Field, R. A. (1992). An empirical application of laboratory experimental auctions in marketing research. *Journal of Agricultural and Resource Economics*, 17, 44-55.
- Norman, J. C., & Kebe, B. (2006). African smallholder farmers: Rice production and sustainable livelihoods. *International Rice Commission Newsletter*, 55, 33-44.
- Roosen, J., Fox, J. A., Hennessy, D. A., & Schreiber, A. (1998). Consumers' valuation of insecticide use restrictions: An application to apples. *Journal of Agricultural and Resource Economics*, 23, 367-384.
- Rutsaert, P., Demont, M., Ndour, M., Verbeke, W., Seck, P. A., & Tollens, E. (2010). Paying for quality: Private versus collective valuation of Senegal River Valley rice. In P. Kiepe, M. Diatta, & D. Millar (Eds.), *Africa Rice Congress 2010: Innovation and partnerships to realize Africa's rice potential, Bamako, Mali, 22-26 March 2010* (pp. 128-129). Cotonou, Benin: Africa Rice Center.
- Rutsaert, P., Demont, M., & Verbeke, W. (2011). Consumer preferences for rice in Africa. In M. C. S. Wopereis, D. Johnson, T. Horie, E. Tollens, & A. Jalloh (Eds.), *Realizing Africa's rice promise*. Wallingford, UK: CABI Publishing.
- Shogren, J. F., Margolis, M., Koo, C., & List, J. (2001). A random nth-price auction. *Journal of Economic Behavior & Organization*, 46, 409-421.
- Shogren, J. F., Shin, S. Y., Hayes, D. J., & Kliebenstein, J. B. (1994). Resolving differences in willingness to pay and willingness to accept. *American Economic Review*, 84, 255-270.
- Tollens, E., & Demont, M. (2011). Forty years of rice R&D: Achievements and lessons learned. In M. C. S. Wopereis, D. Johnson, T. Horie, E. Tollens, & A. Jalloh (Eds.), *Realizing Africa's rice promise*. Wallingford, UK: CABI Publishing.
- Tomlins, K. I., Manful, J. T., Larwer, P., & Hammond, L. (2005). Urban consumer preferences and sensory evaluation of locally produced and imported rice in West Africa. *Food Quality and Preference*, 16, 79-89.
- USAID, 2009. Global food security response: West Africa rice value chain analysis, MicroReport, No. 161, United States Agency for International Development (USAID), Washington, D.C., USA.
- Van Mele, P. (2006). Zooming-in, zooming-out: A novel method to scale up local innovations and sustainable technologies. *International Journal of Agricultural Sustainability*, 4, 131-142.
- Van Mele, P., Wanvoeke, J., & Zossou, E. (2010). Enhancing rural learning, linkages and institutions: The rice videos in Africa. *Development in Practice*, 20, 414-421.
- Van Mele, P., Zakaria, A. K. M., Hosne-Ara-Begum, Harun-Ar-Rashid, & Magor, N. P. (2007). Videos that strengthen rural women's capability to innovate. *Communication for Development and Social Change*, 1, 79-99.
- Vandeplass, A., Minten, B., & Swinnen, J. F. M. (2009). On food quality in domestic markets of developing economies. In *Proceedings of the International Association of Agricultural Economists (IAAE) Conference, Beijing, China, August 16-22*.
- Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, 16, 8-37.
- Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009). The power of video to trigger innovation: Rice processing in central Benin. *International Journal of Agricultural Sustainability*, 7, 119-129.