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SEPTEMBER 23 - 26, 2019 // ABUJA, FEDERAL CAPITAL TERRITORY, NIGERIA

# 6<sup>th</sup> African Conference of Agricultural Economists

Rising to meet new challenges: Africa's agricultural development beyond 2020 Vision



*Invited paper presented at the 6th African  
Conference of Agricultural Economists,  
September 23-26, 2019, Abuja, Nigeria*

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## **Impacting consumer valuation of improved local parboiled rice in Benin through video and rural radio**

### **Abstract**

To elicit the effect of video and radio about improved parboiling on urban Beninese consumers' WTP for improved parboiled rice, we carry out experimental auctions in two markets in Benin: the Dantokpa market in the south and Malanville market in the north. We purposely selected three different rice types available in Benin: (i) traditionally parboiled rice, (ii) non-parboiled imported Thai long grain rice and (iii) improved parboiled rice. We conducted nine experimental sessions with the endow-and-upgrade method. We chose the Vickrey second-price auction and ran three auctions simultaneously. We incorporate a collective induction treatment followed by a second individual auction round. The double hurdle "Craggit" model in Stata is used to analyze the significance of the video and radio treatments. Consumers' WTP for parboiled rice with the improved method differ significantly from one group to another with higher bids for the group video followed by radio group. Information campaigns on the benefits of improved parboiling not only play a role in informing poor women processors about new technologies that may add value to produce and reduce poverty, but also in informing consumers on the value of the end-product. Video documentary and radio transcript and even the mere exhibition of parboiled rice tended to influence consumer preferences.

**Keywords:** Video, Rural Radio, Experimental Auction, Benin

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## **1- Introduction**

In many West African countries like Benin, agricultural extension services face many challenges and are under constant pressure to help farmers to have access to the appropriate agricultural knowledge and information. Also most staff within advisory services are men and rural development interventions are often male-biased (Lahai *et al.*, 2000; Squire, 2003; Katungi *et al.*, 2008). Indeed this challenge of gender bias in agricultural extension, there is a weak in rural institutions in West Africa, with the exception of the market trader with their sense for business and entrepreneurship (Röling *et al.*, 2004). So, particular attention needs to be paid to enhance learning opportunities for the marginalized poor, women and youth. To address these challenges, videos are increasingly used in agricultural extension and easily integrated with other rural learning approaches (Van Mele, 2008; Zossou *et al.*, 2009a; Zossou *et al.*, 2012). Earlier research showed that video has great potential to enhance sustainable agriculture by encouraging local innovations to take into account farmers' creativity and to trigger many behavioural and institutional changes among (Van Mele *et al.*, 2007; Zossou *et al.*, 2009b).

As most of sub-Saharan Africa countries have noted a growth of rural radio stations over the past few decades as part of a broader process of democratization, this is an opportunity for research-extension-farmer linkages. The videos developed for agricultural extension were used as a resource from which radio scripts were developed. Agricultural extension could benefit from both the reach and the relevance that local broadcasting can achieve by using participatory communication approaches (Chapman *et al.*, 2003). In a context of poverty, food insecurity, high rurality and low literacy rates, the use of video and rural radio (based on the basic principles of participatory approaches) is an opportunity to promote rural people access to agricultural information. But what will be the impact of farmers' videos and radio broadcasts on consumers' valuation of the end products? The value that consumers attribute to products in the market is the starting point for any research on value chain (Hobbs *et al.*, 2000). Knowing how consumers react to different qualities of locally processed crops will help to gain insights in how to promote innovations that improve product availability and quality (Demont & Neven, 2012; USAID, 2009). Experimental auctions are becoming increasingly popular as a tool to measure consumers' willingness to pay (WTP) for new food products or new quality attributes of existing food products. In an experimental auction, people bid to buy real products using real money in a setting employing rules that provide incentives for people to truthfully reveal their value for each product up for sale. The bidding environment can be constructed to provide market feedback to participants which re-enforces the truth-telling bidding strategy and

promotes individual reflection on their value for the goods. The bids obtained in the experimental auctions are interpreted as the maximum amount consumers are willing to pay for the new good; and as such, experimental auctions can be (and have) fruitfully combined with traditional sensory methods to yield measurements of the desirability of products using a money metric.

Earlier experimental auctions in Benin (Demont *et al.*, 2012) suggest that media campaigns should be aired prior to the women going out to the market. Instead of a tasting session, an “information treatment” could be introduced into the experiment (e.g. Roosen *et al.*, 1998), during which a video or a radio script on improved parboiling is broadcasted. This would enable measuring the impact of information and generic promotion on the WTP for quality rice processed through the improved parboiler.

This study deals to carry out experimental auctions in two markets in Benin: (i) Dantokpa market in Cotonou in the south of Benin and (ii) Malanville market in the north of Benin in order to elicit urban Beninese consumers’ WTP for intrinsic quality attributes of local parboiled rice and the effect of a video broadcast and radio transcript about improved parboiling on WTP for improved parboiled rice.

## **2- Methodology**

### ***Preparation***

Short three-minute excerpts of video and radio broadcasts on improved parboiling were prepared using AfricaRice video ‘Cashing in with parboiled rice’ (<http://www.accessagriculture.org/node/479/en>). The research question consisted in assessing whether these information sources would affect consumer preferences.

Analogously to previous research (Demont *et al.*, 2012), we decided to use traditionally parboiled rice as lower-quality benchmark and auction rice parboiled through the improved parboiler. We ordered both rice types from a women association in Glazoué and ensured that both rice types were processed from a single rice variety, i.e. IR841. We further decided to add the most commonly consumed non-parboiled imported rice for comparison. After visiting several wholesalers, we concluded on using Thai long grain rice. This configuration would allow us to assess the impact of video and radio on urban Beninese consumers’ preferences for parboiled versus non-parboiled rice and their price premiums for improved parboiling and post-harvest grain quality. We use the endow-and-upgrade method and endow women with (i) traditionally parboiled rice (benchmark) and elicit willingness to pay for two alternative upgrades: (ii) non-parboiled imported Thai long grain rice and (iii) improved parboiled rice.

In order to be as close as possible to the Dantokpa market, we hired a classroom of a college based on the market. In Malanville, we hired a storage room from a trader on the market. In each location, we hired one male enumerator for conducting the surveys and three female enumerators/recruiters for sampling and recruiting rice consumers on the market. The questionnaire was split in two parts, i.e. one that can be administered during the auctions and one that is administered after the auctions in order to avoid revealing too much about the rice types' identity and the objectives of the study. In the second part, specific questions on the rice types used in the experiment were included. All other sheets were adapted for the experiment and printed.

### ***Design***

Analogously to Roosen *et al.* (1998), we used a fixed benchmark; we chose the traditionally parboiled rice produced in Glazoué. Compared to the context in 2009 during our previous study (Demont *et al.*, 2012), we found it difficult to obtain traditionally parboiled rice with clearly inferior quality. This is already an interesting result in its own right and suggests that previous research and information campaigns (video) have had a real impact on processors. Traditional parboilers told us they learnt from the videos and devoted more attention to grain quality since they watched them. Hence, the benchmark we used in this study was superior to the benchmark in the 2009 study (Demont *et al.*, 2012), which implies that WTP for quality upgrading is lower. Nevertheless, In terms of quality and price, the benchmark rice type is equal or inferior to the two alternatives in the auctions. Hence, analyzing the difference between (i) and (ii) reveals consumers' WTP for imported rice, the difference between (ii) and (iii) reveals consumers' WTP for post-harvest grain quality and foreign (Thailand) origin and the difference between (iii) and (i) reveals the added value of improved rice parboiling.

We chose the Vickrey (1961) second-price auction because of its weakly dominant strategy for participants to bid their true value for the goods. We ran three auctions simultaneously following Melton *et al.* (1996) and Roosen *et al.* (1998) and used the endow-and-upgrade method, i.e. each participant was endowed with one kilogram of the benchmark rice and was asked three times to submit a bid for upgrading this kilogram to a kilogram of an alternative rice type. We explained to participants that one product and one bidding round would be binding. This decision was made to avoid the substitution effect that might arise if participants could win more than one product, which would in turn compromise bidding their true value for the products.

After purchases are made, consumers will often make comparisons between their expectations and the product performance they experience. If performance is below expectation, the customer might end up dissatisfied and might sense an imbalance in his/her cognitive system, a phenomenon called “cognitive dissonance” (Festinger, 1957). One available strategy for customers who experience discomfort from cognitive dissonance is to share their discomfort via word-of-mouth (WOM) and to seek information via WOM which can reduce the discomfort (Buttle, 1998). Likewise, positive WOM information may exist which may boost consumers’ value for rice products through social cognition. In order to capture this phenomenon, we incorporate a collective induction treatment followed by a second individual auction round, which is an innovation compared to previous literature (Demont *et al.*, 2012).

We conducted nine experimental sessions over the course of four days in the two laboratory settings described above, both located on the central market. To minimize costs, we conducted two sessions per day during the first three days (one in the morning and one in the afternoon) and three sessions the last day. This enabled us to reconfirm our earlier findings in rural Glazoué (Demont *et al.*, 2012) and check whether bids change during the day in the urban Beninese context. We focused on women as they are the major decision makers in rice purchasing in Benin as well as in other rice consuming African countries (see review by Demont *et al.*, 2012). Although mixed-gender and naturalistic studies are more likely to capture the processes of real, functioning groups, their use would sacrifice experimental control (e.g. over group membership, status structures) (Rao and Steckel, 1991) and would introduce complicating factors related to the property of income pooling (Munro, 2005). Therefore, in order to balance out extraneous status variables or other individual difference influences during collective induction (Kirchler and Davis, 1986), for each session, we recruited an *ad hoc* group of 15 women from the central market. In order to include a random factor during sampling, every third female passer-by with an estimated within the age of 18-65 was approached. Whenever we approached a group, we selected maximally one participant to ensure that the participants would not know each other.

Each experimental session involved nine steps:

- i. **Recruitment:** The enumerators-recruiters went to the central market and randomly approached women showing them a flyer with pictures of previous experimental auctions. They explained to participants they were going to participate in a 2.5-hour market test and receive a participation fee of 2,000 FCFA “for their taxi back home.” The latter pretext is commonly used in Africa to detach pecuniary endowments from their “gift” or “payment-for-service” context. It elegantly avoids the fee being seen as a *quid pro quo* for which participants should reciprocate

(Lusk and Shogren, 2007), and which may bias the bids (Loureiro, Umberger and Hine, 2003). During recruitment, the rest of the team prepared the room;

ii. **Information treatment:** Before starting our introduction, we projected a short video or broadcasted a short radio transcript of three minutes on improved parboiling to the participants. In order to cover all languages, *Fon*, *Dindi* and French versions of the video and radio broadcasts were used. One third of the women (treatment group) was treated with the video, another with the radio transcript and the control group was not treated;

iii. **Introduction:** We started the experimental session in the popular local language of *Fon*, with translations to *Dindi*, French and *Haoussa* where necessary. The three rice types were presented in filled 30 kg baskets on a table in front of the room, such as they are typically presented on the market. However, in order to avoid lining-up bias (Demont *et al.*, 2012), we avoided presenting the rice types according to an increasing quality gradient and placed the inferior benchmark in the middle and the two upgrades left and right from the benchmark. We asked the animators to collect WTP values in a random way, avoiding any perception of a linear relationship or ranking among the alternative rice types. We did not use any labels on the rice baskets presented on the table in front of the room; the only function of the presentation table was to associate the rice types on the individual tables to a real market context of alternative rice types presented in 30 kg baskets. We explained to participants that we endowed them with one kilogram of the benchmark rice. During the experiment, participants could examine the visual (purity and homogeneity) quality attributes of the uncooked rice types. We explained the auction procedures to the participants. First, we explained the endow-and-upgrade method. We learned from previous experience that price premiums elicited through the endow-and-upgrade method were more reliable after “calibration,” i.e. providing the absolute market price of the benchmark (400 FCFA/kg retail price). However, we did not reveal and asked the participants not to reveal any price information on the alternative rice types. Secondly, we explained the second-price auction mechanism;

iv. **Training session with biscuits:** Following Shogren *et al.* (1994), we used commonly known brands of biscuits to familiarize the participants with the auction procedure. Each participant received a “Coasters” biscuit (benchmark) and was then asked to bid on two alternative types of biscuits: Biscuit “Gin Gin” and “Football”. We conducted a single round in order to ensure that all participants fully comprehended the system;

v. **Individual auction 1:** We explained to participants that we would use a similar procedure for the three rice types, repeated over two individual and one collective auction trials and that we would randomly select one rice type and one bidding round as binding. We used a



two-stage approach to elicit WTP (Haines, Guilkey and Popkin, 1988). For each alternative rice type, we first asked which product the participant preferred between the benchmark and the upgrade. If she chose the benchmark, we asked whether she would still choose the benchmark if both products were priced equally. If she responded positively, we recorded a dash ( $WTP < 0$ ); if she responded negatively, we recorded a zero ( $WTP = 0$ ). If the alternative was chosen, we asked her WTP to upgrade to one kilogram of the alternative rice type. Responses were recorded privately for each participant. During the auction rounds, a first survey questionnaire was administered to the participants that had completed price elicitation. The survey aimed at obtaining socio-demographic data;

vi. **Collective induction treatment:** We asked the participants to split in three groups of five and gather around three separate tables and attempt to achieve a consensus on their collective WTP (CWTP) to upgrade the benchmark rice into each alternative rice type. The collective auctions were incentive compatible as they were also subject to the Vickrey second price mechanism. Following common practice in group research, no specific method of doing so was imposed or implied. Groups were left alone during the discussion that followed to avoid bias from the researchers. After consensus, the group reported the CWTP values;

vii. **Individual auction 2:** The same procedure was used as in step 4 in order to obtain post-collective induction WTP for the alternative rice types;

viii. **Survey:** We administered a second survey questionnaire to collect specific information on consumer preferences and awareness of the alternative rice types used in the experiment. We conducted the survey after the rice auctions to avoid revealing the study's objectives (Corrigan and Rousu, 2008). To test group success, the survey included a question on whether or not the participants agreed with the CWTP values reached through group consensus (Cartwright, 1971; Sniezek and Henry, 1989; Ito *et al.*, 2009);

ix. **Closing ceremony:** We randomly selected one rice type and one of three bidding rounds as binding, deducted the second price from the participation fees of the winning bidders and distributed the rice and the adjusted participation fees to the participants. We finally asked participants to line up in front of the room for a group picture.

The double hurdle "Craggit" model in Stata is used to analyze the significance of the video and radio treatments.

### **3- Results and discussions**

#### ***3.1 Socio-demographic characteristic of the sample***

The majority of participants in Dantokpa and Malanville markets were young (on average 34 years old) and illiterate (75-83%) (Table 1). Their main activity was the small trade (61-68%), consistent with Fafchamps *et al.* (2005). Parboiled rice was better known in the north (93%) compared to the south of Benin (26%). Nearly half of the participants who know parboiled rice (49%) reported having received information word-of-mouth. This is one of the reasons that justify the inclusion of collective treatment between individual bids.

The low level of knowledge (26%) of parboiled rice on Dantokpa market can be explained by the fact that parboiled rice is considered as 'a type of rice for Nigerians'. Effectively, this type of rice is often consumed by the immigrants from Nigerian who live in Cotonou. Consequently, many urban consumers are not even aware that the parboiled rice is also produced in Benin. About 16-21% of participants said they knew the improved rice parboiling technology. But this was probably overestimated because some participants may have confused the improved rice parboiling with intermediate technologies that were local innovations made by women rice processors (Zossou *et al.*, 2009b).

### ***3.2 Individual versus collective willingness-to-pay***

#### ***Imported rice***

There was no significant difference between the participants WTP from the three groups (control, radio and video) for the imported rice (Table 2). Video and radio do not seem to have a significant effect on participants WTP for imported rice. This can be explained by the fact that the information on the video and the radio is not about the imported rice. Video and radio inform participants about the benefits of parboiled rice in general and especially the benefits of parboiled rice with the improved method.

The pre-collective WTP compared to the post-collective WTP did not differ significantly in the video and radio groups. We conclude that the prices given individually by participating for imported rice are socially acceptable as group discussions do not seem to have a great influence on the participants in their assessment of the quality and the price of imported rice. These findings are consistent with our previous experimental auctions in Benin that showed that the individual WTP bids are within the range of socially acceptable prices defined through group consensus (Demont *et al.*, 2012).

#### ***Improved parboiled rice***

There was a significant difference between participants' WTP from the three groups (Table 3). Compared to the control group, participants who were exposed to video were willing to pay 23 - 47 FCFA more; and the participants who were exposed to radio were willing to pay 9 - 18 FCFA more. So the awareness through video and rural radio seems to have a positive impact on the value of local parboiled rice with the improved method. The positive impact of the video seems to be more important than the rural radio 'one. Exogenous information treatments on improved parboiling such as video and radio transcripts boost WTB of the end-product of such technologies to the expense of imported rice.

The pre-collective WTP compared to the post-collective WTP differ significantly in the control and radio groups. Group discussions seem to have an effect on the participants who bring down their offers respectively from 42 to 37 FCFA CFA and 60 to 51 FCFA for the radio and control groups. In the video group, although there has been a small discount (-12 FCFA) in the post-collective offers, the difference is not significant between the pre and post-collective WTP.

### **3.3 Determinants of WTP and WTB**

Participants prefer imported rice 26% less than improved parboiled rice (Table 4). Urban dwellers in Malanville are 37% more likely to upgrade to imported rice than people in the capital (Dantokpa market). However they are equally likely to upgrade to the improved parboiled rice in both cities.

The radio transcript attracts improved parboiled rice consumers as they are 14% more likely to upgrade to this product after having been exposed to the radio message. Visual information builds value as dwellers are willing to pay 39 FCFA/kg more for improved parboiled rice after having been exposed to the video broadcast. Imported rice loses 52 FCFA of its value after the video message. These findings are consistent with previous studies (Behrens et al., 2007; Heinemann et al., 2006; Tomlins et al., 2005, 2007) and showed that information campaigns on the benefits of improved parboiling not only play a role in informing poor women processors about new technologies that may add value to produce and reduce poverty, but also in informing consumers on the value of the end-product.

The collective induction increases the likelihood by 11%. The opposite happens for imported rice, which loses 29% of market share after the radio message and further 10% after collective induction.

More highly educated women are 16% less likely to upgrade to imported rice. Imported rice is valued higher (12 FCFA/kg more) by *Fon* people from the South Benin who discount local improved parboiled rice. Women who are involved into household purchase decision-making

tend to pay 20 FCFA/kg more for imported rice. Awareness of local parboiled rice was higher in the North (93% versus 26% in the South) and of those who were aware, half (49%) noted receiving the information through word-of-mouth (WOM). Participants who were aware of the local parboiled rice are 11% less likely to upgrade to imported rice.

#### **4- Conclusion**

The innovative element in this study is that we combined exogenous (video and radio) and endogenous (collective induction) information treatments in order to estimate the impact of information on consumer preferences. We found that intrinsic quality attributes play an important role in upgrading rice value chains and tailoring the latter to consumer preferences. However, without information consumers cannot make informed choices. The results of this study suggest that more extension needs to be done at consumer level. Indeed, we found that the video documentary, the radio transcript and even the mere exhibition of parboiled rice tended to influence consumer preferences. Our design is unique because it allows both estimating WTP for quality (improved parboiling versus traditional parboiling) and technology preferences (non-parboiled versus parboiled rice). The latter is measured more in a willingness-to-accept (WTA) sense because the decline in WTB is an indicator of willingness-to-keep or preference.

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**Table1:** Descriptive statistics of socio-economic variables.

| Variable                | Definition  | Mean (std. dev.) |              |
|-------------------------|---|------------------|--------------|
|                         |   | Malanville       | Dantokpa     |
| <i>Fon</i>              | 1 = belongs to ethnic group <i>Fon</i> ; 0 = otherwise  | 0.15 (0.36)      | 0.60 (0.49)* |
| Age                     | Age in years  | 34 (12)          | 34 (11)      |
| Higher education        | 1 = secondary and tertiary education; 0 = otherwise   | 0.17 (0.38)      | 0.25 (0.44)  |
| Trader                  | 1 = active in trading; 0 = otherwise  | 0.68 (0.47)      | 0.61 (0.49)  |
| Housewife               | 1 = housewife; 0 = otherwise  | 0.19 (0.40)      | 0.21 (0.41)  |
| Social network          | 1 = member of a social network; 0 = otherwise   | 0.53 (0.50)      | 0.38 (0.49)* |
| Household head          | 1 = presents herself as head of household; 0 = otherwise                                      | 0.13 (0.33)      | 0.26 (0.44)* |
| Household income        | Monthly household income in 1000 FCFA <sup>a</sup>  | 36 (19)          | 48 (33)*     |
| Household size          | Number of individuals in household  | 6.5 (3.4)        | 4.9 (1.8)*   |
| House                   | 1 = household owns a house; 0 = otherwise   | 0.40 (0.49)      | 0.29 (0.45)  |
| Car                     | 1 = household owns a car; 0 = otherwise   | 0.11 (0.32)      | 0.03 (0.17)* |
| Motorbike               | 1 = household owns a motorbike; 0 = otherwise   | 0.51 (0.50)      | 0.53 (0.50)  |
| Land                    | 1 = household owns land; 0 = otherwise  | 0.06 (0.24)      | 0.06 (0.24)  |
| Cooking housemaid       | 1 = household has a cooking housemaid; 0 = otherwise  | 0.08 (0.27)      | 0.16 (0.36)  |
| Dinner preparation time | Total time (minutes) spent on preparing dinner (going to the market, preparation and cooking) | 137 (58)         | 221 (97)*    |
| Purchase frequency      | Number of rice purchases per week   | 2.2 (2.9)        | 3.0 (2.4)*   |
| Purchase quantity       | Quantity of rice purchased per week (kg)  | 9.1 (4.8)        | 6.2 (5.6)*   |
| Daily purchase          | 1 = household purchases rice on a daily basis; 0 = otherwise                                  | 0.22 (0.42)      | 0.17 (0.38)  |
| Consumption frequency   | Number of rice meals per week   | 6.8 (3.5)        | 8.4 (5.3)*   |
| Daily consumption       | 1 = household consumes rice on a daily basis; 0 = otherwise                                   | 0.67 (0.47)      | 0.62 (0.49)  |
| Per capita consumption  | Annual quantity of rice consumed per capita (kg)  | 85 (48)          | 74 (68)      |
| Involvement             | 1 = is involved in rice purchase decision-making in household; 0 = otherwise                  | 0.72 (0.45)      | 0.92 (0.27)* |
| Purchased               | 1 = has purchased rice today; 0 = otherwise   | 0.16 (0.37)      | 0.19 (0.40)  |
| Plans purchase          | 1 = plans to purchase rice today; 0 = otherwise   | 0.33 (0.47)      | 0.53 (0.50)* |
| Hungry                  | 1 = is currently hungry; 0 = otherwise  | 0.50 (0.50)      | 0.38 (0.49)* |
| Product awareness       | 1 = is aware of local parboiled rice; 0 = otherwise   | 0.93 (0.25)      | 0.26 (0.44)* |
| Technology awareness    | 1 = is aware of improved parboiling; 0 = otherwise  | 0.21 (0.41)      | 0.16 (0.37)  |
| Preference local        | 1 = household prefers local rice; 0 = otherwise   | 0.67 (0.47)      | 0.25 (0.44)* |
| Variable                | Definition  | Mean (std. dev.) |              |
|                         |   | Malanville       | Dantokpa     |



|                        |  |             |              |
|------------------------|--|-------------|--------------|
| Try local              | 1 = household prefers imported. but is willing to try local rice; 0 = otherwise          |             |              |
| Preference parboiled   | 1 = household prefers parboiled rice; 0 = otherwise                                      | 0.85 (0.36) | 0.38 (0.49)* |
| Try parboiled          | 1 = household prefers non-parboiled. but is willing to try parboiled rice; 0 = otherwise | 0.90 (0.31) | 0.89 (0.31)  |
| Influence              | 1 = perceives to have had influence during group discussion; 0 = otherwise               | 0.90 (0.30) | 0.72 (0.45)* |
| Agreement              | 1 = agreed with group consensus; 0 = otherwise   | 0.99 (0.12) | 0.98 (0.15)  |
| Number of participants |  |             | 135          |

Note: The fixed exchange rate is 1000 FCFA = €1.52.

\* Denotes statistical significance of the difference at the 5% level based on a t-test.

**Table 2:** Descriptive statistics for consumers' WTP for the imported rice

| Treatment | Pre-collective WTP |             |         | Collective WTP     |             |         | Post-collective WTP |             |         |
|-----------|--------------------|-------------|---------|--------------------|-------------|---------|---------------------|-------------|---------|
|           | Mean               | (Std. dev.) | % WTP=0 | Mean               | (Std. dev.) | % WTP=0 | Mean                | (Std. dev.) | % WTP=0 |
| Control   | 86 <sup>b*</sup>   | (43)        | 4%      | 104 <sup>b**</sup> | (30)        | 0%      | 87 <sup>b*</sup>    | (46)        | 6%      |
| Radio     | 92 <sup>b*</sup>   | (45)        | 0%      | 105 <sup>b*</sup>  | (34)        | 0%      | 94 <sup>b*</sup>    | (50)        | 0%      |
| Video     | 88 <sup>b*</sup>   | (43)        | 2%      | 106 <sup>b*</sup>  | (37)        | 0%      | 88 <sup>b*</sup>    | (39)        | 1%      |

Notes : The fixed exchange rate is 1000 FCFA = €1.52.

Different superscripts in the same column denote populations which are significantly different based on an ANOVA F-test and with a significance level of 5%.

Different numbers of asterisks (\*) within the same line denote populations which are significantly different based on the student paired test referred to the pre-collective WTP.

**Tableau 3:** Descriptive statistics for consumers' WTP for the improved parboiled rice

| Treatment | Pre-collective WTP |             |         | Collective WTP    |             |         | Post-collective WTP |             |         |
|-----------|--------------------|-------------|---------|-------------------|-------------|---------|---------------------|-------------|---------|
|           | Mean               | (Std. dev.) | % WTP=0 | Mean              | (Std. dev.) | % WTP=0 | Mean                | (Std. dev.) | % WTP=0 |
| Control   | 42 <sup>c**</sup>  | (30)        | 12      | 40 <sup>c**</sup> | (22)        | 6       | 37 <sup>c*</sup>    | (25)        | 14      |
| Radio     | 60 <sup>b***</sup> | (32)        | 0       | 49 <sup>b*</sup>  | (16)        | 0       | 51 <sup>b**</sup>   | (26)        | 0       |
| Video     | 89 <sup>a**</sup>  | (49)        | 0       | 63 <sup>a*</sup>  | (30)        | 0       | 77 <sup>a**</sup>   | (35)        | 0       |

Notes: The fixed exchange rate is 1000 FCFA = €1.52.

Different superscripts in the same column denote populations which are significantly different based on an ANOVA F-test and with a significance level of 5%.

Different numbers of asterisks (\*) within the same line denote populations which are significantly different based on the student paired test referred to the pre-collective WTP.

**Tableau 4:** Determinants of consumers' individual and collective willingness-to-pay

| Independent variables         | First hurdle: Propensity of upgrading |                 |                               |                 | Second hurdle: Amount paid |                 |                               |                 |
|-------------------------------|---------------------------------------|-----------------|-------------------------------|-----------------|----------------------------|-----------------|-------------------------------|-----------------|
|                               | Direct effects                        |                 | Cross effects with 'imported' |                 | Direct effects             |                 | Cross effects with 'imported' |                 |
|                               | Coef. (Std er.)                       | Marginal effect | Coef. (Std er.)               | Marginal effect | Coef (Std er.)             | Marginal effect | Coef (Std er.)                | Marginal effect |
| Imported                      | -1.13 (0.58)*                         | -0.26*          |                               |                 | -3.13 (27.81)              | -2.21           |                               |                 |
| Malanville                    | -0.57 (0.44)                          | -0.13           | 1.63 (0.34)***                | 0.37***         | -0.29 (10.44)              | -0.21           | 30.25 (15.82)*                | 21.36*          |
| Morning                       | 0.09 (0.17)                           | 0.02            | 0.13 (0.17)                   | 0.03            | 13.34 (6.54)**             | 9.42**          | 5.21 (7.46)                   | 3.68            |
| Post-collective               | 0.48 (0.15)***                        | 0.11***         | -0.44 (0.14)***               | -0.10***        | -11.30 (5.15)**            | -7.98**         | 11.71 (6.48)*                 | 8.27*           |
| Video                         | 0.03 (0.22)                           | 0.01            | -0.70 (0.18)***               | -0.16***        | 69.44 (9.37)***            | 49.03***        | -70.35 (10.63)***             | -49.67***       |
| Radio                         | 0.63 (0.29)**                         | 0.14**          | -1.28 (0.25)***               | -0.29***        | 31.32 (9.03)***            | 22.12***        | -31.90 (10.71)***             | -22.52***       |
| Household incomes             | -0.00 (0.00)                          | -0.00           | 0.00 (0.00)                   | 0.00            | 0.00 (0.00)                | -0.00           | 0.00 (0.00)                   | 0.00            |
| Household size                | -0.00 (0.03)                          | -0.00           | -0.00 (0.02)                  | -0.00           | -1.57 (1.32)               | -1.11           | 0.78 (1.25)                   | 0.55            |
| Fon                           | 0.48 (0.34)                           | 0.11            | -0.16 (0.24)                  | -0.04           | -17.30 (8.61)**            | -12.22**        | 27.47 (11.07)**               | 19.39**         |
| Age                           | 0.01 (0.01)                           | 0.00            | 0.00 (0.01)                   | 0.00            | -0.56 (0.35)               | -0.39           | 0.36 (0.39)                   | 0.26            |
| Higher education              | 0.43 (0.34)                           | 0.09            | -0.69 (0.38)*                 | -0.16*          | 4.73 (9.45)                | 3.34            | 8.03 (12.07)                  | 5.67            |
| Trader                        | 0.53 (0.38)                           | 0.12            | -0.53 (0.37)                  | -0.12           | 3.65 (11.33)               | 2.58            | -2.68 (13.99)                 | -1.89           |
| housewife                     | -0.04 (0.39)                          | -0.01           | -0.20 (0.37)                  | -0.05           | -6.65 (11.40)              | -4.69           | 11.60 (14.02)                 | 8.19            |
| Social network                | -0.14 (0.19)                          | -0.03           | 0.34 (0.18)*                  | 0.08*           | -3.91 (6.94)               | -2.76           | 2.26 (8.58)                   | 1.60            |
| Cooking housemaid             | -0.28 (0.25)                          | -0.06           | 0.34 (0.27)                   | 0.08            | -7.46 (9.49)               | -5.27           | -4.01 (13.14)                 | -2.83           |
| Dinner preparation time       | -0.00 (0.00)                          | -0.00           | 0.00 (0.00)**                 | 0.00**          | 0.03 (0.03)                | 0.02            | -0.02 (0.04)                  | -0.02           |
| Household head                | -0.35 (0.23)                          | -0.08           | 0.28 (0.21)                   | 0.06            | -7.81 (8.44)               | -5.51           | 1.92 (9.68)                   | 1.36            |
| Involvement                   | -0.05 (0.24)                          | -0.01           | 0.23 (0.21)                   | 0.05            | -20.99 (13.81)             | -14.82          | 27.89 (12.21)**               | 19.69**         |
| Hungry                        | -0.04 (0.18)                          | -0.01           | 0.18 (0.17)                   | 0.04            | 1.21 (7.34)                | -0.85           | 4.30 (8.22)                   | 3.04            |
| Plans purchase                | 0.04 (0.16)                           | 0.01            | -0.27 (0.17)                  | -0.06           | -0.65 (7.08)               | -0.46           | -10.44 (7.75)                 | -7.37           |
| Product awareness             | 0.16 (0.27)                           | 0.04            | -0.48 (0.26)*                 | -0.11*          | -8.20 (8.36)               | -5.79           | 0.48 (12.50)                  | 0.34            |
| Technology awareness          | 0.16 (0.33)                           | 0.04            | -0.13 (0.28)                  | -0.03           | -4.29 (7.2)                | -3.03           | 11.17 (9.75)                  | 7.88            |
| Constant                      | 0.82 (0.60)                           |                 | 1.63 (0.34)***                |                 | 62.22 (25.61)**            |                 | 30.25 (15.82)*                |                 |
| Sigma = 47.50 (5.88)          |                                       |                 |                               |                 |                            |                 |                               |                 |
| Number of observations = 1056 |                                       |                 |                               |                 |                            |                 |                               |                 |

Notes: Marginal effects of changing the explanatory variables are evaluated at the mean of the explanatory variables. Values in parentheses are standard errors. Asterisk (\*) and double asterisk (\*\*) denote variables significant at 5 per cent and 1 per cent, respectively. WTP = willingness-to-pay; CWTP = collective willingness to-pay; fixed exchange rate: €1 = 655.957 FCFA; price of the benchmark rice = 350 FCFA/kg in Malanville and 400-450 FCFA in Dantokpa.