Experimental Auctions with Exogenous and Endogenous Information Treatment: Willingness to Pay for Improved Parboiled Rice in Benin

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Abstract

The impact of information as an extrinsic quality cue on consumers' valuation of intrinsic food quality attributes can be captured by incorporating 'information treatments' in experimental auctions. We combine 'exogenous' information treatments such as a video broadcast and a radio transcript on the benefits of an improved rice processing technology with an 'endogenous' information treatment which elicits word-of-mouth exchange among consumers to assess the combined effect of exogenous and endogenous information on consumers' valuation of improved parboiled rice in two urban markets in Benin. We find that exogenous information increases market share of the locally improved product by 14% to the expense of imported rice, an effect which is further amplified by 10–11% through endogenous information. Endogenous information has a dampening effect on value though; while video and radio transferred 6–12% of value from imported to local rice, word-of-mouth redistributed 2% of the value back to the competing product.

Keywords: Experimental Auction, Willingness to Pay, Collective Induction, Word-of-Mouth, Benin

JEL codes: O33; Q130; Q160

1. Introduction

Experimental auctions are commonly used to assess consumers' valuation of intrinsic and extrinsic quality attributes of food products (Lusk and Shogren, 2007). 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.

In order to capture the impact of information as an extrinsic quality cue on consumers' valuation of intrinsic food quality attributes, 'information treatments' are typically incorporated into the experiments and participants are divided among treatment and control groups (e.g. Roosen *et al.*, 1998). Previous experiments have focused on treatments based on exogenous information sources (advertizing, video broadcasts, radio transcripts, brochures, etc.). It has been shown, however, that consumers are also highly influenced by endogenous information, such as word-of-mouth (WOM) communication (Demont *et al.*, 2013). Demont *et al.* (2013) introduce a 'collective induction treatment' which elicits WOM exchange among participants and acts as an aggregator of preferences and endogenous information. This study is the first to combine 'exogenous' information treatments such as a video broadcast and a radio transcript on the benefits of an improved rice processing technology with an 'endogenous' information treatment to assess the combined effect of exogenous and endogenous information on consumers' valuation of improved parboiled rice in two urban markets in Benin.

In many West African countries like Benin, agricultural extension services face many challenges and are under constant pressure to help farmers accessing the appropriate agricultural knowledge and information. 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 behavioral and institutional changes (Van Mele *et al.*, 2007; Zossou *et al.*, 2009b).

As most of sub-Saharan African 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's access to agricultural information.

However, once processing equipment is upgraded, markets need to be informed about the benefits of the locally improved product. The same exogenous information sources can be tailored to inform consumers on the value of the end-products. Knowing how consumers react to different qualities of locally processed crops in the absence and presence of such exogenous information will help to gain insights in how to promote innovations that improve product availability and quality (Demont & Neven, 2012; USAID, 2009). Moreover, once consumers have been exposed to exogenous information, the latter is further processed through individual and social cognition (Demont *et al.*, 2013).

This study conducts experimental auctions in two markets in Benin, i.e. the Dantokpa market in Cotonou in the south of Benin and the Malanville market in the north of Benin. In particular, we assess the combined effect of exogenous and endogenous information on urban Beninese consumers' valuation of extrinsic and intrinsic quality attributes, and hence quality-based competitiveness of locally improved parboiled rice, relative to imported rice. We find that both exogenous and endogenous information sources have the potential to increase the market share of the locally improved product relative to imported rice, but that endogenous information can have a slightly dampening effect on value. We conclude that information campaigns on the benefits of improved processing 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.

2. Methodology

2.1. Preparation

Short three-minute excerpts of video and radio broadcasts on improved parboiling were prepared using the 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 a 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 used the endow-and-upgrade method and endowed women with (i) traditionally parboiled rice (benchmark) and elicited 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.

2.2. 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) and we expect WTP for quality upgrading to be 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 two 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 two 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; 2013).

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 (€3) '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 or €0.61/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 (CIT):** 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 (Demont *et al*., 2013). 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-CIT 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.

2.3. Methodology for analyzing the determinants of WTP

Haines *et al.* (1988) argue that food consumption decisions should be modeled as a two-stage process. Participants first decide whether they are willing to upgrade their endowed kilogram of rice or not and if yes, they decide next how much they are willing to add for the new product. The double hurdle model introduced by Cragg (1971) correctly represents this two-stage decision process.

Let WTU_{ijpr} be the variable representing the willingness to upgrade an endowed kilogram of rice as a dichotomous 'adoption' variable (willing to upgrade or not) and let WTP_{ijpr} be the amount spent on the upgrade by the ith consumer ($i = 1, \ldots, 15$) in the jth session ($j = 1, \ldots, 18$) for the pth rice type (p = locally improved parboiled rice, imported rice) in the rth bidding round (r = pre-CIT, post-CIT):

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

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

where $\mathbf{x}_{ijpr}$ is a vector of independent variables including a dummy variable for imported rice (locally improved parboiled rice is set as the reference), a dummy variable for the post-CIT bidding round (the pre-CIT round is set as the reference), a dummy variable for the time of the day, a dummy variable for the city, two dummy variables for the exogenous information

treatment (video and radio; the control group is set as the reference), and a vector of socio-demographic variables $\mathbf{x}_v$ ($v = 1, \ldots, s = 16$), $\boldsymbol{\alpha}$ is a conformable vector of coefficients, u_{ij} is an individual specific disturbance for participant i in session j, and v_{ijpr} is the overall error term.

Following Cragg (1971), WTP_{ijpr} is the consumers' bid to upgrade the mediocre-quality benchmark rice to any of the three alternatives. The first hurdle (WTU) is the consumer's decision of whether or not to upgrade. The probability of the respondent choosing not to bid a positive amount in order to upgrade ($WTP_{ijpr} = 0$) is expressed by:

(3) $\qquad Prob\big(WTP_{ijpr} = 0\big) = \Phi\big(-\boldsymbol{\alpha}'_1 \mathbf{x}_{ijpr}\big)$

where Φ is the standard normal density function. The second hurdle determines the effect of independent variables on WTP_{ijpr}, given $WTU_{ijpr} = 1$ and $WTP_{ijpr} > 0$. The distribution of WTP_{ijpr} conditional on being positive is truncated at zero and assumed normal with mean $\boldsymbol{\alpha}'_2 \mathbf{x}_{ijpr}$ and variance σ^2. The second hurdle is formulated as:

(4) $\qquad f\big(WTP_{ijpr} | WTP_{ijpr} > 0\big) = \dfrac{(1/\sigma)\Phi[(WTP_{ijpr} - \boldsymbol{\alpha}'_2 \mathbf{x}_{ijpr})/\sigma]}{\Phi(\boldsymbol{\alpha}'_2 \mathbf{x}_{ijpr}/\sigma)}$

where Φ is the standard normal density function and $\boldsymbol{\alpha}_2$ is a vector of coefficients.

3. Results and discussion

3.1. Socio-demographic characteristic of the sample

In Table 1, we provide some descriptive statistics of the socio-demographic variables collected through our survey questionnaires. Statistical significance of the differences between both consumer samples are indicated with an asterisk. 60% of the participants on the Dantokpa market belonged to the ethnic group *Fon*, while this share was only 15% in Malanville where northern ethnic groups dominate. The average age recorded was 34 years which is very similar to previous experimental auctions using a similar sampling strategy (Demont *et al.*, 2012; 2013). 17–25% of the women had achieved secondary or tertiary education and two thirds (61–68%) were active as traders. Northern women were more actively involved in formal associations and more female-headed households were observed in the South. Average monthly household income was about 48,000 FCFA in the South and 36,000 in the North, feeding smaller families in the South than in the North. 29–40% of the households owned a house, 6% owned land and 8–16% had a cooking housemaid. In the South, households spent more time on preparing dinner, purchased and consumed rice more frequently (62–67% consumed rice on a daily basis) and were more involved in rice purchase decision-making of the household (92% versus 72% in the North). This confirms our assumption that women are the main decision-makers in rice purchase and justifies the focus

on women in our sampling strategy. The annual per capita consumption of rice in urban Benin was about 74–85 kg.

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). This justifies the value of inserting a collective induction treatment (CIT) between individual auction rounds. The lower awareness of local parboiled rice (26%) on the Dantokpa market may perhaps be explained by the fact that parboiled rice is associated with Nigerians as they are the usual customers who demand parboiled rice. Hence, many urban consumers may not be even aware that parboiled rice is also produced in Benin. Awareness of the improved parboiling technology was low (16–21%) and probably overestimated. Some of the participants may have confused the improved parboiling technology with the intermediate technology that were local innovations made by women rice processors (Zossou *et al.*, 2009b).

The consensus sessions were successful; 72–90% of the participants perceived to have had influence during collective induction and 98–99% agreed with group consensus. The latter is fairly consistent with previous experience (Demont *et al*., 2012; Demont *et al*., 2013). Nevertheless, the most trusted source of information used to judge the utility of a new rice type was TV (47%), followed by radio (33%) and WOM (33%). Preference for parboiled rice was higher in the North (85%) than in the South (38%) and almost all (89–90%) of those who preferred non-parboiled rice were willing to try parboiled rice, particularly after having been exposed to the visual characteristics and health benefits of parboiling through the video and radio broadcasts. Finally, 38–50% of the women admitted to be hungry during the experiment and more so in the North than in the South. The variable aims at explaining why bids tend to be lower during the afternoon and reported in previous experiments (Demont *et al*., 2012; Demont *et al*., 2013).

3.2. Willingness to upgrade (WTU) and willingness to pay (WTP)

Descriptive statistics of consumers' WTU and WTP to upgrade traditionally parboiled rice to improved parboiled rice and imported rice are reported in Table 2. WTU levels were in the range of 83–99% for the locally improved product and lower (61–86%) for imported rice. WTU to improved parboiled rice tended to be higher after exposure to radio or video, while the opposite was observed for imported rice. WTU to improved parboiled rice tended to increase after exposure to endogenous information, while for imported rice this was only the case for participants who had not been exposed to any of the information treatments.

Price premiums for improved parboiled rice were in the range of 37–89 FCFA/kg (€0.06–0.14/kg), i.e. 9–22% of the retail price of traditionally parboiled rice and slightly higher for imported rice, i.e. 86–94 FCFA/kg (€0.13–0.14/kg) or 22–24% of the retail price of traditionally parboiled rice. The premiums increased after exposure to auditory information transmitted through the radio transcript and further increased after exposure to visual information conveyed through the video broadcast.

3.3. Determinants of willingness to upgrade (WTU) and willingness to pay (WTP)

The coefficients and marginal effects of the determinants of willingness to upgrade (WTU) and willingness to pay (WTP) obtained through the double hurdle model are presented in Table 3. On the Dantokpa market in the south, consumers are 26% less likely to upgrade to imported rice than to locally improved parboiled rice, while in Malanville in the north the opposite is found, i.e. a 37% higher likelihood to upgrade to imported rice and a 21 FCFA/kg (€0.03/kg) or 5% higher value for the competing product. However consumers in both cities are equally likely to upgrade to the improved parboiled rice.

Exogenous information treatments such as the radio transcript are found to strengthen the market share of the locally improved product by 14% to the expense of imported rice which loses 16–29% of market share. This substitution effect is further amplified by a 10–11% gain in market share induced by exchange of endogenous information (WOM). Due to high initial WTU levels for improved parboiled rice (83–90%, Table 2) even without exposure to exogenous information, the additional effect of the video broadcast on WTU is insignificant. Visual information adds more than double as much value (49–50 FCFA/kg or €0.07–0.08/kg) to the 'advertized' product than auditory information (22–23 FCFA/kg or €0.03–0.04/kg). These findings are consistent with previous studies (Behrens *et al.*, 2007; Heinemann *et al.*, 2006; Tomlins *et al.*, 2005, 2007) that 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. Endogenous information, on the other hand, has a dampening effect on value; while video and radio transfers 6–12% of value from imported to local rice, WOM redistributes 2% of the value back to the competing product.

Finally, less educated women, members of a formal group, those who spend more time on cooking and those who are unaware of local parboiled rice tend to have higher preferences 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). This shows the importance of endogenous information on individual cognition. Participants who were aware of the local parboiled rice were 11% less likely to upgrade to imported rice. Imported rice is valued higher by *Fon* people in the South—who discount local improved parboiled rice and which is consistent with findings by Demont *et al.* (2012)—and by those who are involved in rice purchase decision-making in the household. WTP is generally higher in the morning, a result which is consistent with previous findings (Demont *et al*., 2012; 2013). This suggests that information campaigns, whether through radio or television, should be broadcasted in the morning before women are going to the market.

4. Conclusion

In this study, we assessed the combined effect of exogenous and endogenous information on urban Beninese consumers' valuation of intrinsic quality attributes, and hence quality-based competitiveness of locally improved parboiled rice, relative to imported rice. The innovative contribution of 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. Consumer acceptability was further amplified through word-of-mouth, although the latter had a slightly dampening effect on value. Perhaps consumers' initial enthusiastic WTP response to the radio transcript and video broadcast was calibrated after receiving more endogenous information from other participants. Further research will have to be conducted in order to reproduce our experiment in other contexts in order to improve our understanding on the interaction between exogenous and endogenous information. We conclude that information campaigns on the benefits of improved processing 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.

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Table 1: Descriptive statistics of socio-economic variables

Variable	Definition	Mean (std. dev.)	
		Malanville	Dantokpa
Fon	1 = belongs to ethnic group *Fon*; 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[a]	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)*
Try local	1 = household prefers imported. but is willing to try local rice; 0 = otherwise	0.87 (0.34)	0.97 (0.17)*
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	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 of consumers' willingness to upgrade (WTU) and willingness to pay (WTP, FCFA/kg) to upgrade traditionally parboiled rice to improved parboiled rice and imported rice

Treatment	Improved parboiled rice				Imported rice			
	Pre-CIT		Post-CIT		Pre-CIT		Post-CIT	
	WTU (%)	WTP (stdev)	WTU (%)	WTP (stdev)	WTU (%)	WTP (stdev)	WTU (%)	WTP (stdev)
Control	83%	42 (30)	90%	37 (25)	81%	86 (43)	86%	87 (46)
Radio	93%	60 (32)	99%	51 (26)	64%	92 (45)	61%	94 (50)
Video	87%	89 (49)	93%	77 (35)	64%	88 (43)	62%	88 (39)

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

Table 3: Determinants of consumers' willingness to upgrade (WTU) and willingness to pay (WTP)

	First hurdle: Willingness to upgrade (WTU)				Second hurdle: Willingness to pay (WTP)			
	Direct effects		Cross effects with 'imported'		Direct effects		Cross effects with 'imported'	
Independent variables	Coef. (SE)	Marginal effect	Coef. (SE)	Marginal effect	Coef. (SE)	Marginal effect	Coef. (SE)	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–CIT	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; fixed exchange rate: €1 = 655.957 FCFA; price of the benchmark rice = 350 FCFA/kg in Malanville and 400–450 FCFA in Dantokpa.