Parboiling as a diversification strategy to improve rice market value in Senegal

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Abstract:

This study used an experimental approach involving 144 rice shoppers in Dakar market to assess market value of parboiled rice compared to traditional white rice as consumed in Senegal. Four different rice types produced locally were used in the experiment: one standard rice, Sahel 108 white rice and three alternatives parboiled rice of Sahel 108, 134 and 177. The descriptive analysis shows that the market price of each alternative parboiled rice was over the double of one of the standard rice with a premium estimated at 71% for parboiled rice of Sahel 108 and134, and 129% of Sahel 177 over the standard rice. In addition to the strong preference for broken rice, taste (80%), whiteness (60%) and cleanliness (60%) were revealed as the most important rice criteria in Dakar market respectively. The robust regression analysis suggests that poor and non-educated people are an important market segment for Sahel 108 white rice in comparison to richer and educated consumers who value more the parboiled rice. Word of mouth communication appears to be a potentially marketing strategy to promote Sahel 108 non-parboiled rice in poor households while promoting Sahel parboiled rice among rich and educated households in Dakar in Senegal.

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Abstract

The preference for imported rice to locally produced rice in Senegal affects negatively the economy of small-scale farmers and processors in the rice business in Senegal. Consumers generally prefer imported broken rice to the local broken rice for its superior grain quality. To improve the quality and the market value of rice produced locally in Senegal, the diversification option can be a solution to improve its market value then, incomes, and food and nutrition security for the target actors. This study used an experimental auctions approach involving 144 rice shoppers in Tilene market in Dakar to assess market value of parboiled rice compared to traditional non-parboiled rice as consumed in Senegal. Four different rice types produced locally were used in the experiment: one standard rice, Sahel 108 non-parboiled rice and three alternative parboiled rice of Sahel 108, 134 and 177. Using descriptive analysis, the results show that the market price of each alternative parboiled rice was over the double of the price of the standard rice with a premium estimated at 71% for parboiled rice of Sahel 108 and134, and 129% of Sahel 177 over the standard rice. In addition to the strong preference for broken rice, taste (80%), whiteness (60%) and cleanliness (60%) were revealed as the most important rice criteria in Dakar market respectively. The results of the robust regression analysis suggest that poor and non-educated people are important market segment for Sahel 108 non-parboiled rice in comparison to rich and educated consumers who value more the parboiled rice. Worth of mouth communication appears to be potentially successful marketing strategy to promote Sahel 108 non-parboiled rice in poor households while promoting Sahel parboiled rice among richer households to improve incomes and food and nutrition security of the small-scale value chain actors in Senegal River Valley.

1. Introduction

In Senegal, consumers generally prefer the white milled broken rice and more importantly, imported broken rice for its superior grain quality compared to the broken rice locally produced (Demont and Rizzotto, 2012). Indeed, 99% of rice imported in 2014 in Senegal was broken rice (UN Comtrade, 2014). Their preference for imported rice to locally produced rice affects negatively the economy of small-scale farmers and processors who are majorly involved in the rice business in Senegal. To improve the quality and then the market value of rice produced locally in Senegal, the diversification of the product and then the segmentation of its market can be a solution to improve incomes and, food and nutrition security for the target actors. The diversification of local rice in Senegal can be done through parboiling system by transforming poor quality paddy from farmers' fields into high quality milled rice (Ndindeng *et al.* 2015; Etoa *et al.*, 2016). The segmentation of local market has direct link with product differentiation that creates new markets different from the existing markets of existing products. According to Fall (2012), the parboiled rice emerged in the Senegal River Valley (SRV) as new rice product a few years ago and this rice is produced only in the southern zone (Kolda and Casamance) for self-consumption or export to Guinea Bissau. The parboiling activities was introduced in SRV through women groups properly trained on the use of the parboiling technology to produced upgraded quality local rice in order to improve their income, food and nutrition security. According to Bhattacharya (1985), Manful *et al.* (2009) and Odenigbo *et al.* (2013), rice parboiling significantly improves the physical, cooking and nutritional quality of milled rice.

In the SRV, many varieties have been developed and grown by farmers. Among these varieties there are Sahel 108, Sahel 134 and Sahel 177. This study analyzed the marketability of those selected varieties to identify among them the most preferred by consumers and the segments of markets that could be developed in order to increase the supply of the new products and then improve incomes and food and nutrition security of small-scale actors in the rice value chain in Senegal. Specifically, this study assessed consumers' preference and elicited their willingness to pay for newly introduced types of rice products. These objectives are supported by the hypothesis that upgrading Sahel rice through parboiling system increases its market value compared to Sahel white milled broken rice produced in the condition of processing business as usual and as sold in Senegal food markets.

Furthermore, taking into consideration that Sahel varieties have characteristics that suite with climate changes environment (AfricaRice, 2017) and that the parboiled milled rice is sold at higher price compared to the white milled broken rice on the markets (AfricaRice market

survey, 2016 and Table 2), promoting this upgraded quality rice will considerably improve income, food and nutrition security in Senegal SRV.

2. Materials and methods

Market study were carried out in the main urban market of Tilene located in Medina quarter in Dakar (Senegal). Tilene market of Medina is one of the most popular consumption daily markets in Dakar. This market is highly frequented by urban consumers and is also near the mayor office where the auctions took place. Data were collected using experimental auctions conducted from 29 March to 2 April 2016. Vikrey's second price auction method was used in combination with endow-and-upgrade method (Lusk and Shogren 2007; Vickrey, 1961). Details of the auctions' procedures are given by Demont *et al.* (2017).

For the experiments' study, two categories of rice were used. The first category is a poor-quality Sahel 108 white milled broken rice produced in the condition of doing the processing business as usual and sold on the market at lower price of USD$0.60. This rice is named standard rice in the experiment. The second category of rice refers to three different types of rice upgraded through parboiling system. These types of rice include Sahel 108, Sahel 134 and Sahel 177 and named alternative rice in the experiment. In this group of rice, the quality of Sahel 108 variety was upgraded through parboiling system compared to Sahel 108 non-parboiled rice (white milled broken rice).

During the market experiment study, about 144 urban shoppers ("consumers") were randomly selected in Tilene market to assess their preference and elicit willingness to pay (WTP) for the alternative types of rice in comparison to the standard rice, and identify their decision criteria for purchasing. These consumers were those responsible for selecting the rice types for their own household consumption.

In this study, the WTP is defined as the absolute difference between the price that consumers indicated they were willing to pay for alternative rice and the standard rice price. In Dakar, 10 experimental auctions were performed, with an auction having 10 to 15 consumers. In each auction, four rounds were organized and consumers evaluated the different rice types, as follows:

- pre-tasting round, in which consumers were interviewed after visual assessment of the physical characteristics of uncooked rice types;
- post-tasting round, in which consumers were interviewed after the assessment of the sensory attributes (aroma, taste, texture, and other characteristics of the cooked rice);

- collective round, in which, after the assessment of both uncooked and cooked rice types, consumers were requested to gather in groups of four or five around a table and discussed to reach consensus on the collective WTP for each of the alternative rice types;
- post-collective round, in which individual consumers assessed the different rice types individually after the group discussion.

After the different rounds, consumers were hypothetically endowed with a fixed budget of US$ 20 and was asked to use it to buy the rice types in auctions according to their preference and based on the price their proposed during the post-collective round (Demont *et al.*, 2017). Then it was supposed that only these rice types were on the market. This last experiment allows computed the propensity of buying each rice type and its potential demand. That means that all the selected Sahel rice varieties were put in competition. The propensity of buying each rice type was computed as follow:

$$\frac{Quantity\ demanded\ for\ the\ rice\ type * 100}{Total\ demanded\ quatity\ for\ all\ auctionned\ rice\ types}$$

The potential demand per capita for each rice was computed by multiplying this propensity of buying by the yearly demand per capita of the household (Demont *et al.*, 2017).

Each auction ended with a short survey to collect sociodemographic and economic data from each consumer. Descriptive statistics were used to show consumers' sociodemographic and economic information and decision criteria for purchasing rice types.

Robust regression analysis was performed to identify the determinants of the revealed price premium for the upgraded Sahel 108 rice (parboiled rice) relative to Sahel 134 and 177 rice (parboiled rice). These revealed price premiums were computed as the difference between the WTP obtained in the post-collective round for this Sahel 108 and those for Sahel 134 and 177 respectively. Each difference was divided by the price of standard rice and expressed in percentage (Demont *et al.*, 2017). Variables included in the regression as explanatory variables were education, age, income per capita, and household size. In addition, tasting premium and word-of-mouth (WOM) communication premium were assessed and included in the regression analysis. The latest was included based on Demont and Rizzotto (2012), who pointed out that Senegalese consumers rely heavily on WOM communication to inform their preferences. Taste premium which is an indicator of the quality competitiveness is computed as:

$$\frac{[(WTP\ in\ post - tasting\ round) - (WTP\ in\ pre - tasting\ rond)] * 100}{Standard\ rice\ price}$$

Positive taste premium indicates that tasting can increase consumers' WTP. The WOM communication premium is computed as:

$$\frac{[(WTP\ in\ post - collective\ round) - (WTP\ in\ post - tasting\ round)] * 100}{Standard\ rice\ price}$$

Positive WOM communication premium indicates that communication among consumers can increase their WTP.

3. Results and discussion

In Tilene market in Dakar, all the surveyed sample were female shoppers (Table 1) indicating that the food shopping is almost exclusively female activity and this is consistent with Demont and Ndour (2015) and Demont et al. (2012) who stated that women are the major decision makers in households' rice purchases in West-African countries. About 43% of consumers received a formal education and were relatively young (40 years old). The average size of their household was about 12 persons with an average yearly income per capita estimated at US$ 400.

Table 1: Descriptive statistics of rice shoppers' socio–demographic characteristics and rice preference criteria on Dakar market in Senegal

Variable	Unit/description	Mean	SD	t test
Consumer characteristics				
Female	1 = yes; 0 = no	1.00	0.00	_
Formal education	1 = yes; 0 = no	0.43	0.50	10.30***
Age	Years	40.3	13.2	36.61***
Income per capita	US$	398	575	7.12***
Household size	Individuals	12.4	9.79	15.20***
Rice attributes in top–five of preference criteria				
Cleanliness[a]	1 = yes; 0 = no	0.57	0.50	13.75***
Whiteness	1 = yes; 0 = no	0.62	0.49	15.21***
Head rice recovery	1 = yes; 0 = no	0.15	0.35	4.94***
Slenderness	1 = yes; 0 = no	0.34	0.48	8.59***
Unstickiness	1 = yes; 0 = no	0.08	0.27	3.44***
Taste	1 = yes; 0 = no	0.83	0.38	26.09***
Aroma	1 = yes; 0 = no	0.17	0.37	5.35***
Softness	1 = yes; 0 = no	0.16	0.37	5.21***
Swelling capacity	1 = yes; 0 = no	0.38	0.49	9.40***
Other attributes	1 = yes; 0 = no	0.58	0.49	14.15***
Number of participants			144	

[a] Absence of foreign matter

*** significant at the threshold of 1%

The Table 2 shows the market price of some Sahel rice types, the added monetary value by parboiling on the Sahel rice varieties and price premium of these rice types on the standard rice in Tilene market in Dakar. The parboiled Sahel rice were more expensive than the white ones.

The added value by the parboiling on the Sahel 108 was about 71% of the white Sahel 108 price. Likewise, the price of the parboiled Sahel 134 was the double of the price of the white Sahel 134. The price of parboiled Sahel 177 was even more than the double of the price of the white rice of the same variety. Accordingly, one can assert that the parboiling added important value to Sahel rice varieties in Tilene market in Dakar. The net value added by parboiling could be estimated if the related costs including the product's transaction costs were known. Apart from the white Sahel 134, all the other types of rice of Sahel varieties were more expensive than the white Sahel 108 which is the standard rice. The market price of the parboiled Sahel 177 is over the double of the market price of this standard rice.

Table 2: Market price and parboiling added value of the Sahel rice varieties

	Market Price (US$/kg)	Market added value by parboiling (%)	Market price premium over the standard rice (%)
Sahel 108, NP (standard)	0.60	_	_
Sahel 108, P	1.03	71.43	71.43
Sahel 134, NP	0.52	_	-14.29
Sahel 134, P	1.03	100.00	71.43
Sahel 177, NP	0.62	_	2.86
Sahel 177, P	1.38	122.22	128.57

Globally the rice shoppers (about 60% in average) preferred all the alternative rice in the pre-tasting round compared to the standard rice (Sahel 108 white milled broken rice) (Table 3). The Sahel 177 parboiled rice was the most preferred by 75% of the consumers followed by Sahel 108 parboiled rice preferred by 56% of consumers. In the post-tasting round, consumers have considerably increased their preference for the standard rice leading it to the second position after Sahel 177. Likewise, they decreased their WTP for alternative rice after tasting each type of rice. However, after the group discussion, they decreased slightly their preference for the standard rice (about 40%) but without reaching their preference during the pre-tasting round (38%) (Table 3). It is then clear that the WOM communication and the taste of the white Sahel 108, allow increasing the consumer preference for this Sahel rice type and decreasing the consumer preference and WTP for the alternative rice types (Table 4). These results show that rice consumers in Dakar appreciate the taste of the Sahel 108 white milled broken rice because they usually consume this rice compared to the other alternatives rice. The relative high preference (Table 3) and WTP (Table 4) recorded by all the alternatives rice except the Sahel 134 can be explained by their high degree of cleanliness.

Table 3: Descriptive statistics of rice shoppers' preference for benchmark and alternative rice types on Dakar market in Senegal

Preference of consumer	Alternative rice								
	Pre–tasting (% of consumers)			Post–tasting (% of consumers)			Individual post–collective (% of consumer)		
	Sahel 108, P	Sahel 134, P	Sahel 177, P	Sahel 108, P	Sahel 134, P	Sahel 177, P	Sahel 108, P	Sahel 134, P	Sahel 177, P
Prefer the alternative rice to the standard rice	56.25	54.17	74.31	36.81	45.14	63.19	48.61	54.17	76.39
Prefer the standard rice (Sahel 108, NP) to alternative rice	36.81	42.36	23.61	59.72	52.78	36.11	39.58	36.11	20.14
Prefer the standard rice (Sahel 108, NP) but will prefer the alternative rice if their prices are the same	6.94	3.47	2.08	3.47	2.08	0.69	11.81	9.72	3.47
Number of participants	144								

Note. NP = non–parboiled/white milled rice; P= parboiled

Table 4: Descriptive statistics of rice shoppers' willingness to pay to upgrade standard to alternative rice types on Tilene market in Dakar, Senegal

Standard rice and price	Rice upgrade	Pre–tasting			Post–tasting			Post–collective		
		WTP (US$/kg)		t test	WTP (US$/kg)		t test	WTP (US$/kg)		t test
		Mean	SD		Mean	SD		Mean	SD	
Sahel 108, NP (US$ 0.60 /kg)	Sahel 108, P	0.15	0.22	8.38***	0.09	0.19	8.39***	0.10	0.17	10.83***
	Sahel 134, P	0.14	0.19	5.81***	0.10	0.15	7.75***	0.10	0.14	9.75***
	Sahel 177, P	0.21	0.24	7.19***	0.18	0.22	8.56***	0.20	0.23	10.29***
Number of participants		144								

Note. WTP = willingness to pay; NP = non–parboiled; P= parboiled

*** significant at the threshold of 1%

In addition to the strong preference for broken rice, taste (80%), whiteness (60%) and cleanliness (60%) were revealed also as the most important rice criteria in Dakar respectively (Table 1).

Furthermore, assuming that Tilene market in Dakar is supplied only by Sahel rice varieties, Sahel 108 white milled broken rice (standard rice) would be the most demanded by consumers because the propensity of buying this rice was about 43% compared to other alternatives Sahel rice (Table 5) with the Sahel 177 rice being the second most demanded rice. It is important to notice that either non-parboiled or parboiled, the Sahel 108 rice variety would have about 54% of the total rice demand in Dakar. Accordingly, the consumer potential yearly per capita demand for Sahel 108 rice would be more than 50 kg for a total rice demand of about 95kg/capita/year

(Table 5). This result is very similar to the statistics of USDA (2017) and FAOSTAT (2017) which show that in Senegal, the average yearly rice consumption was about 92 kg/capita/year for the last decade and about 95 kg/capita/year for the last three years. It is then clear that, in absence of imported rice on this market, the Sahel 108 rice variety would have an important share of the rice market in Dakar. Moreover, between non-parboiled and parboiled Sahel 108, the consumer would prefer the non-parboiled Sahel 108 rice. However, in terms of price premiums, this rice type recorded a negative price premium relative to Sahel 177 (Table 6) indicating that consumers, for their daily consumption, would prefer Sahel 108 but consider Sahel 177 rice as *luxury* rice because of the relatively high premium they affected to this rice type. The preference of consumer about Sahel 134 rice is very low (Table 6). Accordingly, they affected a positive price premium to Sahel 108 relatively to Sahel 134 (Table 6).

Table 5: Consumers' propensity to buy and potential demand for Sahel rice in Dakar market, Senegal

Variable	Propensity of buying (%)			Potential yearly demand per capita (kg)		
	Mean	SD	t test	Mean	SD	t test
Sahel 108, NP	43.05	35.35	14.36***	42.24	52.23	9.43***
Sahel 108, P	11.00	17.33	7.48***	9.67	22.93	4.92***
Sahel 134, P	12.19	17.45	8.24***	11.67	24.48	5.56***
Sahel 177, P	33.77	30.94	12.87***	31.53	46.47	7.94***
Number of observations		144			136	

*** significant at the threshold of 1%

Table 6: Average consumers' revealed price premiums for upgraded Sahel 108 relative to Sahel 134 and 177 on Tilene market in Dakar, Senegal

Variable	Revealed rice premium [b] for Sahel 108 (%)		
	Mean	SD	t test
Relative to Sahel 134	0.20	22.6	0.11
Relative to Sahel 177	-16.1	33.4	-5.80***
Number of participants		144	

[b] Revealed price premium for Sahel 108 relative to Sahel 134 or Sahel 177 obtained in the third (post–collective) bidding round = (WTP for Sahel 108– WTP for other Sahel upgrade)/price of benchmark rice.

*** significant at the threshold of 1%

The results of the regression model show that a change in consumers' WTP for both Sahel 108 and other Sahel rice after tasting and group discussion affected the revealed price premium of

Sahel 108 (Table 7). Consumers who increased WTP for Sahel 108 after tasting and group discussion tended to have greater WTP for it than for other types of Sahel rice. As shown by Table 3 and Table 4, Dakar consumers appreciated very well the taste of Sahel 108 rice in comparison to the other types of Sahel rice. In contrast, consumers who increased WTP for other types of Sahel rice (134 and 177) after tasting and group discussion tended to have lower WTP for Sahel 108 rice than for other types of Sahel rice. These results are consistent with Demont *et al.* (2017) and Demont *et al.* (2013b) and show that the Sahel 134 and 177 are major competitors of Sahel 108. Thus, in case of absence of imported rice on Dakar Markets, the Sahel rice varieties will compete with each other. However, the most demanded would be the Sahel 108 for its tasting quality and price (Table 5).

Furthermore, there was a negative relationship between the revealed price premium for Sahel 108 and income per capita and education indicating that poorer and uneducated consumers tended to prefer and pay more for Sahel 108 than Sahel 134 and Sahel 177 rice respectively. These results suggest that adoption of WOM communication among poor households and frequent organization of tasting events with them on Sahel 108 would improve its sales in the cities. However, its sales could be further increased by investing in physical quality upgrading to meet the specific market characteristics and traits of other Sahel rice preferred by rich and educated consumers (Demont *et al.*, 2013a).

Table 7: Factors determining consumers' revealed price premiums for upgraded Sahel 108 relative to other Sahel rice varieties on Dakar market in Senegal

Variables	Revealed price premium of Sahel 108 relative to Sahel 134	Revealed price premium of Sahel 108 relative to Sahel 177
Taste premium [C] Sahel 108 (%)	0.34 (0.05)***	0.60(0.17)***
Taste premium Sahel 134 (%)	–0.30 (0.06)***	NA
Taste premium Sahel 177 (%)	NA	–0.31 (0.12)***
WOM premium [d] Sahel 108 (%)	0.41 (0.07)***	0.82 (0.20)***
WOM premium Sahel 134 (%)	–0.39 (0.09)***	NA
WOM premium Sahel 177 (%)	NA	–0.77 (0.16)***
Formal education	–4.73 (4.22)	–6.62 (3.97)*
Age (year)	–0.02 (0.12)	0.06 (0.17)
Income per capita (US$ 100)	–0.48 (0.27)*	–0.03 (0.29)
Household size (individual)	–0.24 (0.17)	0.01 (0.29)
Constant	9.01 (8.77)	–9.88 (8.21)
Number of participants	144	144
Fisher value	7.64*** (dif1=8, dif2= 95)	4.21*** (dif1=8, dif2=95)
R^2	0.211	0.658

Note. Robust standard errors are represented between brackets.

NA Non-Applicable

[c] taste premium is the premium of the taste: (post-tasting WTP– pre-tasting WTP)*100/price of benchmark rice.

[d] WOM premium is the Word-Of-Mouth premium. It is influence of group discussion on individual WTP: (post-collective WTP– post-tasting WTP)*100/price of benchmark rice.

* Denotes statistical significance at the 10% level; *** Denotes statistical significance at the 1% level.

4. Conclusion

The Sahel 108 is marketable in Dakar. Consumers appreciate very well its taste and would prefer it for daily consumption. Poor and non-educated people are important market segment that accorded more value to this rice variety in comparison with rich and educated consumer. WOM communication is more credible than marketer initiated communications (Demont *et al.*, 2013b; Allsop *et al.*, 2007) and appears to be potentially successful marketing strategy for the promotion of the Sahel 108 rice consumption in Dakar This variety can then be promoted to improve food security level in poor households in Dakar. Traders in Dakar have little information on the marketable volumes of local rice, its quality and prices (Colen *et al.*, 2013). Hence Sahel 108 marketability could also be promoted by providing information on its quality and price to traders in rice marketing channels. Further research on traders' willingness to sell this rice is of interest.

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