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Analysing potential demand for local rice in West Africa

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ABSTRACT

This paper analysed the potential demand for local rice in West Africa (WA) in order to generate key information which can support the self-sufficiency strategies on-going in the region. Data were collected using experimental approach based on second price of Vickrey and Endow-and-Upgrade methods in Benin, Côte-d'Ivoire, Niger and Nigeria from 693 consumers (with 68% female) representing their households. The analysis based on the framework of the new approach of consumer theory and used a Linear Expenditure System model. Results showed that WA consumers were willing to demand local rice. The probability to demand local rice was about 75%. Probability to demand local rice in the coastal countries was less than the one in landlocked country. The potential demand for local rice was about 44kg/capita/year in average over 57kg/capita/year for all types of rice including imported rice. The ranking of preference criteria showed that the most important rice preference criteria in the region were good taste, whiteness, absence of foreign matters, aroma and shape of grains. Moreover, the possibility to easily import rice affected negatively consumers' potential demand for local rice in WA. These results suggest that the policy enabling the production of good quality local rice meeting consumers' preferences and needs will strongly improve the self-sufficiency ratio and then reduce rice imports into the region.

Keywords: Local rice Self-sufficiency, Consumers preferences, Experimental approach

1. INTRODUCTION

Rice has become a highly strategic commodity in West Africa and is the largest source of food calories in the region (Seck et al., 2013). Rice consumption is increasing rapidly in West Africa because of population growth, urbanization and changes in eating habits. Although local production increased rapidly after the 2007-2008 food crisis, it has never caught up with demand. The self-sufficiency ratio has remained at around 50%. Such heavy dependence on imports can severely affect food security and political stability as demonstrated during the 2007–2008 rice price crises.

The food crisis of 2007-2008 highlighted that there is an urgent need to increase quality rice production and its marketing in West Africa. According to Laroche Dupaze and Postelle (2013), long-term food security cannot depend on imports. It must be built on the development of domestic production, with enough barrier protection against world price fluctuation and unfair trading. Conscious about those truths, several researches are being conducted in order to increase the production of good quality rice in the region. As explained by Stryker (2013), the production cost and post-harvest including processing activities are the most important constraints to African local rice competitiveness. To address these constraints, African policy makers should allocate more resources to locally produced rice in order to add value to it and to make it competitive vis-à-vis imported rice (Demont, 2013).

To convince the policy makers to provide the required support to rice sector, key information will be needed on the main drivers of the demand of locally produced rice in West Africa. One way to identify the drivers of the demand of this product is to analyse its potential demand in the region because in our current knowledge, there is no evidences on key indicators explaining the demand for local rice in West Africa. According to Westoff (1988), the potential demand is an unmet need. It is the amount of commodities that people would buy in case of large availability. The potential demand of a good depends on its attributes and consumers' characteristics (Lancaster 1966; Dagsvik et al., 2002; Potoglou and Kanaoglou, 2007). Based on these definitions, the response for the following questions will be needed to have a real insight on key indicators that could be the main drivers of large demand of locally produced in selected West African cities: (1) *Ceteris paribus*, what amount of local rice each West African consumer would like to buy to satisfy his need in case of availability?; (2) what rice attributes are required to satisfy the consumers preferences? and (3), what are their own characteristics which influence their potential demand for locally the product? This study

aims to answer these questions in order to guide in the rational decision making towards local rice competitiveness improvement.

To contribute to the response of above mentioned questions, the study identifies first the rice preference criteria of WA consumers. Secondly it analyses the potential demand for locally produced rice.

2. THEORITICAL MODEL

The main objective of individual consumer demand analysis is to explain the level of demand for commodities an individual consumes given the structure of relative prices, real income and a set of individual characteristics (Sadoulet and de Janvry, 1995). Basically, consumer theory aims to explain how the rational consumer chooses amount and type of commodities to consume in order to maximise his utility when confronted to various prices and limited budget (Sadoulet and de Janvry, 1995). However, the new approach to consumer theory (Lancaster, 1966) argued that commodities attributes are the basis of the utility providing. There are several methods to analyse individual demand following the consumer theory (Sadoulet and de Janvry, 1995).

For the analysis of the amount of consumed commodity or the expenditure on commodity consumption, there are several methods. To estimate a complete demand system, there are three most used functions (Sadoulet and de Janvry, 1995). Stone (1954) developed the Linear Expenditure System (LES). Deaton and Muellbauer (1980) proposed the Almost Ideal Demand System (AIDS). Bollino (1990) combines these two models in the Generalised Almost Ideal Demand System (GAIDS). However, AIDS and GAIDS estimations have three econometric problems: probit analysis of decision to consume, seemingly unrelated regressions and imposition of inequality restrictions (Sadoulet and de Janvry, 1995).

In fact, during the survey period, some of the targeted goods may not be consumed by some consumers implying zero values as observations of the endogenous variable. This situation calls the problem of probit analysis of decision to consume. Despite development of methods to escape this problem, it complicates the estimations combining a standard Ordinary Least Square (OLS) with a probit analysis (Sadoulet and de Janvry, 1995). In addition, demand equations in the AIDS and GAIDS appear to be unrelated (seemingly unrelated regressions), since neither endogenous quantities, nor budget shares appear in the right side of the equations. This is not the case in reality (Sadoulet and de Janvry, 1995). Furthermore,

imposition of inequality restrictions complicates the estimations of AIDS and GAIDS. Accordingly, among these three models (LES, AIDS and GAIDS) the LES is the most frequently used in empirical demand analysis, (Sadoulet and de Janvry, 1995). It derives from the following utility function:

$$u = \sum_{i=1}^n b_i \ln(q_i - c_i) \text{ with } \begin{cases} 0 < b_i < 1 \\ \sum_i b_i = 1 \\ q_i - c_i > 0 \end{cases} \quad (1)$$

c is the minimum amount of the commodity for subsistence and q is the total amount of the commodity.

Maximising and deriving this utility function, we obtain the following demand functions:

$$p_i q_i = c_i p_i + b_i \left(y - \sum_j c_j p_j \right), i = 1, \dots, n \quad (2)$$

b_i are the marginal budget shares and $\sum_j c_j p_j$ is the total subsistence expenditure;

$(y - \sum_j c_j p_j)$ is the income spent in b_i proportion between commodities;

y is the total income.

b_i are assumed to be superior to 0. Then, the LES is not suitable for the analysis of the inferior goods.

After simplification of the equation (2) dividing it by p_i , we obtain:

$$q_i = c_i + \frac{b_i}{p_i} \left(y - \sum_j c_j p_j \right), i = 1, \dots, n \quad (3)$$

3. DATA

3.1. Data set

Experimental methods were used to collect the data in five West African cities: Porto-Novo and Cotonou in Benin, Gagnoa in Côte d'Ivoire, Tilabery in Niger and Nassarawas in Nigeria (figure 1).

Experiments were carried out in Porto-Novo in 2014 and in the remaining cities in 2015. In each city, 10 experiments' sessions were organised during 5 days. There were 2 sessions per day with one in the morning and another one in the afternoon. In total there were 50 experiments' sessions during 25 experiments' days for all the cities. According to Demont *et al.* (2013b) and Demont *et al.* (2012), women are principal decision makers for rice purchase in West Africa. Nevertheless, there are some men who participate also in these decision makings according to the country. Furthermore, when a woman buys rice and her husband does not like its quality, she will probably stop buying that quality of rice and, refers to the choice of her husband. This is why men were also involved in this experiment in order to take into account their point of view in rice demand analysis. In addition, when someone (whatever the gender) comes at market to buy commodities, it is probably because he knows (or is informed on) what satisfies his household. Based on these facts, targeted consumers are women and men of 19 to 65 years old who were going to or coming from the markets.

For each session, at least 10 and at most 15 consumers were randomly selected. The recruiting agents positioned themselves on a gate of the market. They approached every third passer-by in order to include a random factor in the sampling (Demont *et al.*, 2013a). They explained to participants, the objectives of the research using flyers of preview auctions. They informed them also that the experiment will last about 3 hours. If someone agreed to participate, recruiting agent explained him that he will receive about 6\$ as taxi fee to go back home (Demont *et al.*, 2013a; Lusk and Shogren, 2007). This taxi fee can vary according to specific country life cost. The sample contained in total 693 consumers with 65% of women.

For each market, there were at least 4 types of rice put in competition: (i) a benchmark rice known as low quality rice (high level of broken, high level of foreign matters and heterogeneous grains) and known as cheap rice; (ii) at least 2 varieties of local alternative rice known as good quality and (iii) a popular imported rice sold on the market of the city where the experimentation took place. In the market, all alternative types of rice were more expensive than the benchmark. These types of rice were purposely selected based on the literature and results of a market survey.

During each session, 4 consecutive auctions were organized: individual auction on the uncooked rice (pre-tasting); individual auction on cooked rice (post-tasting); collective auction and individual auction after the collective one. The collective auction aimed to evaluate the effect of group on individual behaviors (Demont *et al.*, 2013b). For each auction,

data were collected using “endow-and-upgrade” method (Demont *et al.*, 2013a; Demont *et al.*, 2013b; Lusk and Shogren, 2007). In fact, the benchmark rice was offered to consumers free of charge. They were informed about its price. Afterwards, this benchmark rice was put in competition with each of the other rice (alternatives). Consumer was asked to choose between the benchmark and the alternative rice. If he chose the alternative, he would be asked to tell how much he was willing to add (Willingness-to-Pay: WTP) to the price of the benchmark to exchange it against the alternative rice. But if someone chose the benchmark, he would be asked to choose again supposing that the alternative rice cost also the price of the benchmark rice. At this stage, if he still chose the benchmark rice, his WTP would be considered as negative but if he chose the alternative rice, his WTP will be considered as zero value. This method allowed knowing the price that each selected consumer was willing to pay for each type of rice in auction. At the beginning of each session of auctions, after explaining the principle to consumers, an exercise was done using 3 well known cookies: one as benchmark and two as alternatives. This exercise allowed to be sure that they understood and to explain the principle again if necessary (Demont *et al.*, 2013a and Shogren *et al.*, 1994).

At the end of each section, one of the 4 auctions was randomly selected. Based on the price proposed by each consumer during this auction to pay each type of rice, he was asked to share out a budget of 20\$ to buy the types of rice he preferred for his household. The quantity of each type of rice was deduced from the proportion of budget affected to each type of rice. Afterwards, data on consumer’s household characteristics, monthly rice consumption expenditure, frequency of rice consumption in the household, quantity of consumed rice per frequency, household size etc. were collected.



Figure 1: Rice production zones and experimentation sites

3.2. Method of potential demand estimation for local rice

To estimate the potential demand for local rice, we first considered the quantity of each rice in auction that consumers were willing to buy when supposing to receive a budget of 20\$ for their household. Secondly, using these quantities, we estimated potential demand for both local and imported rice assuming that consumers had a budget of 20\$ for rice per year. From these quantities, we estimated probability to demand local rice ($Prob_{lr}$).

Using statistic-probability methods, the potential demand was estimated. Consumption frequency per year and the potentially consumed quantity per frequency were used. Let's remember that qlr_i was the potential demand per capita for local rice and let's assume that F_r was the rice consumption frequency per year in the household; D_r was the demanded rice quantity per frequency; N was the household size (number of members); Qr_i was the demand per capita for rice in West African household; qir_i was the remaining demand per capita for imported rice. The formulas are:

$$\begin{cases} Qr_i = \frac{F_r * D_r}{N} \\ qlr_i = Prob_{lr} * Qr_i \\ qir_i = (1 - Prob_{lr}) * Qr_i \end{cases} \quad (7)$$

3.3. Descriptive statistics of the sample

The representativeness of Benin in the sample is almost the double of the one of each of the other country (figure 2) just because experimentations were done twice in Benin. There were more than 65% of female in the sample (figure 3). It showed that in West Africa (WA), women are the most important contributor in activities related to food consumption. This fact was confirmed by the figure 4, showing that the majority of surveyed consumers was the wife of the household head. So they were the most important women of households.

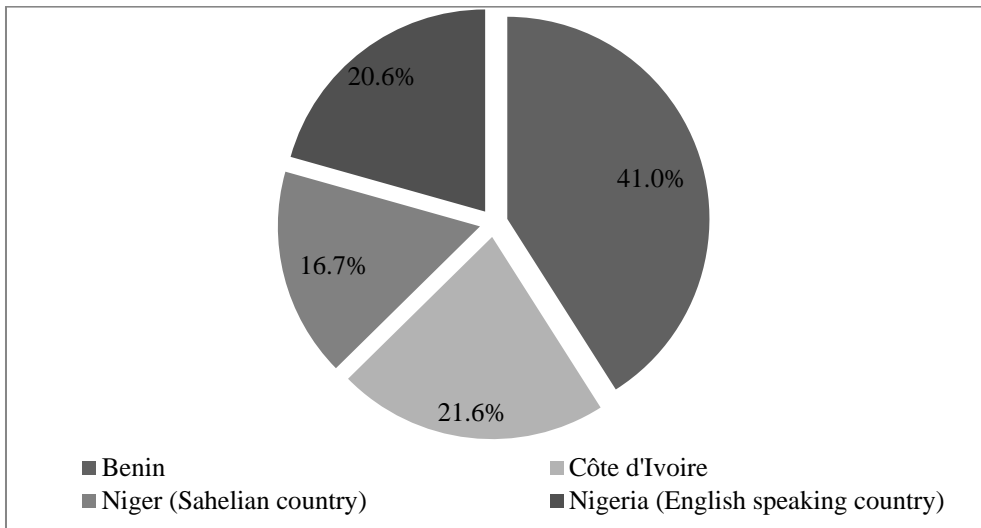


Figure 2: Repartition of the sample by country

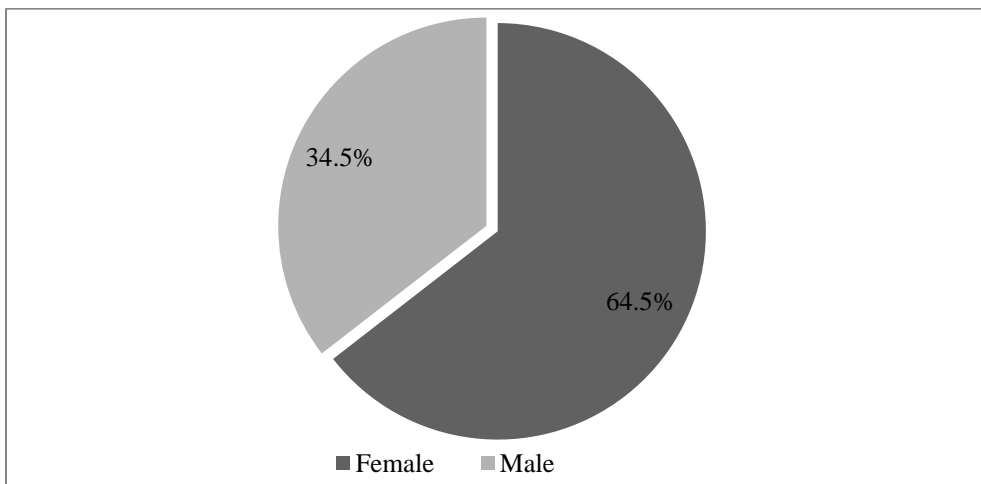


Figure 3: Repartition of the sample by gender

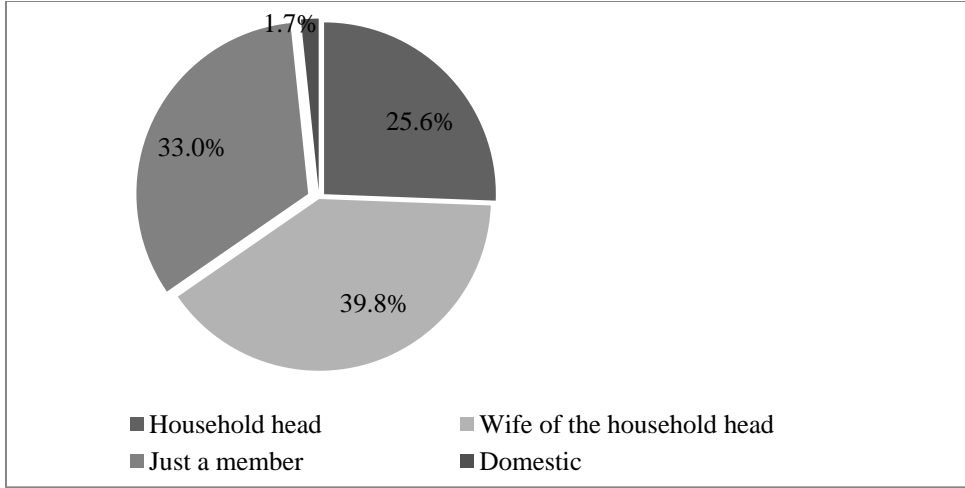


Figure 4: Repartition of the sample by position in household

4. EMPIRICAL MODEL

Let's assume that qlr_i is the potential demand of the West African individual i for local rice, clr_i is the minimum local rice for subsistence of the individual i , blr_i is the budget share of local rice expenditure for the individual i and plr is the local rice price in WA. Applied to the local rice case in WA, the equation (3) becomes:

$$qlr_i = clr_i + \frac{blr_i}{plr} \left(y - \sum_j c_j p_j \right), j = 1, \dots, m \quad (4)$$

Let's assume that $\beta lr_i = \frac{blr_i}{plr}$ and $ylr = y - \sum_j c_j p_j$

The equation (4) becomes:

$$qlr_i = clr_i + \beta lr_i ylr \quad (5)$$

Following the new approach to consumer theory (Lancaster, 1966), we could not analyse the local rice demand without taking in to account its attributes and the consumer characteristics. Then, let us assume that $ATlr_i$ are the WA local rice attributes wished by consumer i and $CARACT_i$ are the characteristics of consumer i . Adding these factors to the equation (5), it becomes:

$$qlr_i = clr_i + \beta lr_i ylr + \gamma lr_i ATlr_i + \delta_i CARACT_i \quad (6)$$

with $\gamma lr_i =$ estimated coefficients of local rice attributes and $\delta_i =$ estimated coefficients of consumer characteristics.

According to Fiamohe *et al.* (2014) and Naseem *et al.* (2013), rice attributes which can affect its demand in WA are price, cleanness, whiteness, breakage rate, size of grains, ease of cooking, taste, aroma, swelling capacity and duration of conservation after cooking. After a ranking of these attributes in the context of experimental approach, the five most important were retained for the model as $ATlr_i$. Nevertheless, in addition to those attributes, we projected to include the type of varieties in the model to be able to capture their effect on the level of the potential demand by consumers. Unfortunately, types of varieties differed from a WA country to another. There is no common variety to several countries. This fact created the collinearity problem between types of varieties and other variables. Consequently, type of variable was finally dropped from the model.

Theoretically, the demand of a product is influenced by its price, the prices of competing products and consumers' characteristics such as income level, age, sex, education etc. (Sadoulet and de Janvry, 1995). We used in this paper these consumers' characteristics as $CARACT_i$. The consumers' willingness to pay (WTP) for local rice (LRWTP) was used as price of local rice and their WTP for imported rice (IRWTP) was used as price of imported rice because they represented the price consumers agreed to pay for these types of rice. The imported rice price was included in the model because imported rice represented the most important competing product of local rice in Africa. Instead of ylr_i , we used the income per capita (INCAP) because it is a theoretical variable of demand. Hence, the equation (6), becomes:

$$qlr_i = clr_i + \beta lr_i INCAP_i + \alpha_{lr} LRWTP_i + \alpha_{ir} IRWTP_i + \gamma lr_i ATlr_i + \delta_i CARACT_i \quad (7)$$

with α_{lr} = estimated coefficients of WTP for local rice; α_{ir} = estimated coefficients of WTP for imported rice; $INCAP_i$ = the income of the consumer i; $LRWTP_i$ = the WTP of consumer i for local rice and $IRWTP_i$ = the WTP of consumer i for imported rice.

Due to the utilization of several dummy variables and the robustness problems of linear models, the log-log form was used (Greene, 2005, Sadoulet and de Janvry, 1995). Moreover, three types of estimated methods were used: Ordinary Least Square (OLS) which do not help correcting heteroskedasticity problems, a robust estimation method with assumption of homoskedasticity and a robust method with assumption of heteroskedasticity. Estimations were done using STATA 11 software.

One of the primary objectives of this paper was to estimate one model for each WA studied country. Unfortunately, there was no country model which was robust with an acceptable variation coefficient (explanatory power). So the only one solution was to estimate a single model for the whole West-Africa. Accordingly, as $CARACT_i$, variables such as type of country (TYPCOUN: costal or sahelian) and official language (LANG: French or english) were included in the model in order to carry out their effect. These variables are also indicators of geographical location which may influence demand (Sadoulet and de Janvry, 1995, Naseem *et al.*(2013)

5. RESULTS AND DISCUSSIONS

Here, we present and discuss obtained results.

5.1. West African consumers' willingness to buy rice according to its origin and rice preference criteria.

The Chi square independence test between the variable country and the variable origin of rice people were willing to buy and the one between the variable type of country (coastal or sahelian) and the variable origin of rice people were willing to buy presented Chi square values significant at the threshold of 1% (table 1). These results showed that consumers' willingness to buy rice according to its origin varied significantly with the country and the type of country. The large part of consumers from coastal countries (Benin, Côte d'Ivoire and Nigeria) were willing to buy both imported and local rice while the majority of consumers from sahelian country were willing to buy only local rice (figure 5).

The Chi square independence test between the variable country's official language and the variable origin of rice people were willing to buy presented a non-significant Chi square value (table 1). So the origin of the rice people were willing to buy did not significantly vary with the official language of their country. On the other hand, English people's willingness to buy rice according to its origin was not significantly different from the one of French people (figure 5).

The good taste, the low rate of foreign matters, the whiteness, the aroma and the shape of grains were respectively the most important rice preference criteria for surveyed consumers (figure 6). On the other hand, these criteria were those which affect the most consumers' preference for rice in West Africa. Accordingly, they were included in the model as $ATlr_i$

Table 1: Results of independence tests

Tests	Indicators	Values and significance
Independence test between country and origin of rice people were willing to buy	Pearson Chi-Square (6)	237.06***
Independence test between country's official language and origin of rice people were willing to buy	Pearson Chi-Square (2)	2.48 ^{NS}
Independence test between type of country and origin of rice people were willing to buy	Pearson Chi-Square (2)	200.29***

*** =significant at threshold of 1%, **= significant at threshold of 5%, * =significant at threshold of 10%, NS= no significant

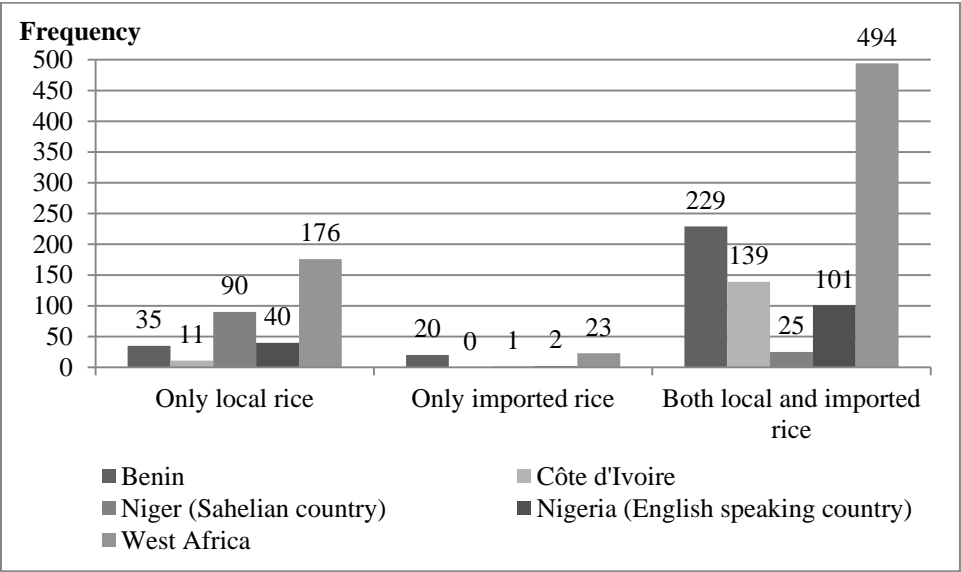


Figure 5: Repartition of West African consumers according to their willingness to buy local rice

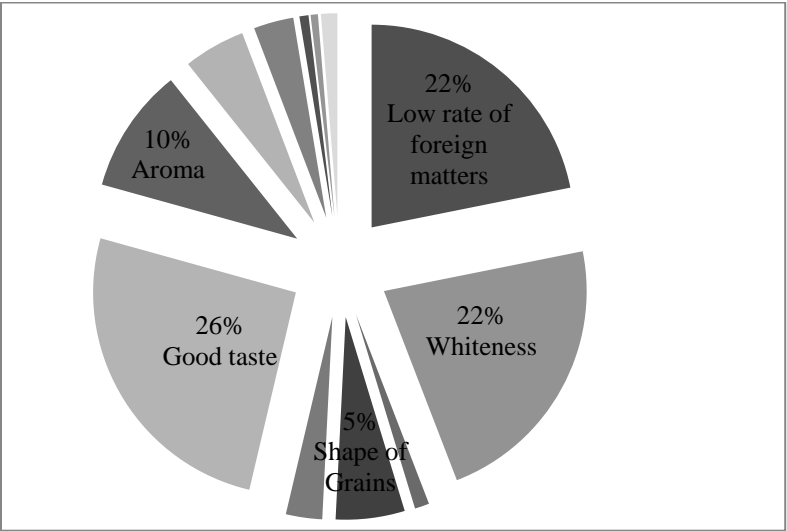


Figure 6: Repartition of West African consumers according the most important preference criterion

5.2. Probability to demand local rice in West Africa

The mean comparison test results showed that probability to demand local rice depended on the country and its type but not on the country’s official language (table 2). The probability for West African consumers to demand local rice would be about 0.75 (figure 7) if its quality took into account their preference criteria. Niger (sahelian country) presented the highest probability while Benin (costal country) presented the lowest one (figure 7).

Table 2: Results of means’ comparison tests

Tests	Indicators	Values and significance
Means' comparison test (ANOVA) for probability to consume local rice according to country	F of Fisher (3, 685)	46.02***
Means' comparison test (t of Student) for probability to consume local rice according to official language	t of Student	-1.17 ^{NS}
Means' comparison test (t of Student) for probability to consume local rice according to type of country	t of Student	12.87***

*** =significant at threshold of 1%, **= significant at threshold of 5%, * =significant at threshold of 10%, NS= no significant

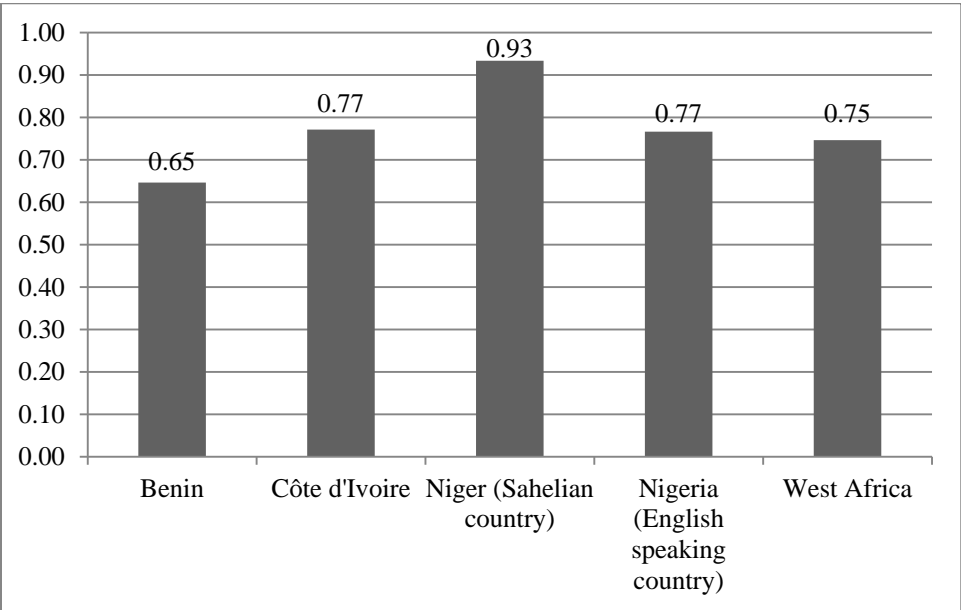


Figure 7: Probability for West African consumers to demand local rice

5.3. Demand for rice and potential demand for local rice in West Africa

The mean comparison tests (ANOVA) presented Fisher values F significant at the threshold of 1% (table 3). Therefore, the demand for rice and the potential demand for local rice in West Africa (WA) varied significantly with the country.

WA people demanded about 57 kg of rice per capita per year (table 3) to ensure their consumption. Côte d'Ivoire is the country wherein rice demand was the highest while Nigeria is the country wherein it was the lowest (table 3).

Concerning the potential demand for local rice, it was estimated to about 44 kg/capita/year in the whole WA. This result showed that if local rice were available with attributes which were in accordance with consumers' preferences, each West African would demand about more than 40 kg per year. This potential demand could be an important development factor in the sub-region. In fact, if this demand was really satisfied by domestic production, rice importation would be reduced (*Ceteris paribus*). The WA countries' trade balance could be improved.

Potential demand for local rice respected the same order of comparison of countries as the whole rice demand (table 3). But in terms of proportion, as showed in table 2, Niger (Sahelian country) was the first in West Africa (table 3). Côte d'Ivoire people consume a lot of rice and would like to consume a lot of local rice (table 3). It appeared that there were local rice varieties which currently satisfy preference criteria of Niger and Côte d'Ivoire people. These varieties should be tested in other WA countries.

Table 3: Demand for rice and potential demand for local rice in West Africa

Country/sub-region	Demand for rice per capita per year in kg		Potential demand for local rice per capita per year in Kg	
	Mean	Standard Deviation	Mean	Standard Deviation
Benin	42.58	30.67	28.00	24.93
Côte d'Ivoire	106.79	47.43	80.97	40.46
Niger (Sahelian country)	65.80	30.81	61.78	31.74
Nigeria (English speaking country)	29.90	30.18	22.91	26.68
West Africa	57.83	44.76	44.25	38.35
Means' comparison test	F (3, 686)= 148.44***		F (3, 682)= 135.05***	

ANOVA		
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*** =significant at threshold of 1%, **= significant at threshold of 5%, * =significant at threshold of 10%, NS= no significant

5.4. Factors determining potential demand of local rice in West Africa

All three models were globally significant at the threshold of 1% (table 4). They presented R square values of 0.31 and adjusted R square value of 0.30 (table 4). Therefore, about 30% of the variations of potential demand for local rice in West Africa (WA) were explained by the explanatory variables. In terms of coefficients and significance threshold of them, all three models presented almost the same results (table 4). They little differ from each other in terms of standard errors. We can conclude that there was no significant heteroskedasticity. Variables which significantly affected the potential demand for local rice were (table 4): Willingness to pay (WTP) for local rice (LNLRWTP), WTP for imported rice (LNIRWTP), household size (LNHOUSIZ), age of the respondent (LNAG), type of country (TYPCOUN), official language (LANG) and the fact that aroma is one of the five most important rice preference criteria of consumer (AROMA) (table 4). So these variables are the actual factors determining the potential demand for local rice in WA.

The constants were positive and significant at the threshold of 1% (table 4). So there was an incompressible quantity of local rice which was important in the feeding of WA people.

LNLRWTP presented a positive coefficient significant at the threshold of 1% (table 4). It showed that when WA people's WTP for local rice increases for 1%, their potential demand for that rice increases in average for about 1.71%. In contrast, LNIRWTP presented a negative coefficient significant at the threshold of 1% (table 4). So if their WTP for imported rice increase for 1%, their potential demand for local rice decreases for about 1.79%. These results showed the importance to improve the quality of local rice in WA, taking into account, the consumers' preference criteria. In fact, consumers WTP increase with their level of preference. Therefore, if consumers propose a high WTP for local rice, it will be due to their high preference for that rice. Accordingly, they will increase their demand for that rice. However, if they propose a high WTP for imported rice, they will increase their demand for that rice and decrease their demand for local rice.

When household size increases (LNHOUS), local rice potential demand per capita decreases. This fact highlighted the hypothesis that households with a lot of members in WA are more

facing food insecurity problem. Nevertheless, it could also be because in the great size household, people prefer imported rice or others commodities.

Potential demand for local rice, increase with the age of respondent (LNAG). It so appear that aged respondents appreciated local rice.

Type of country (TYPCOUN) affected negatively the potential demand for local rice (table 4). Therefore, WA people in coastal country tended to demand little local rice. It could be because of the influence of imported rice. In fact, due to the presence of port in coastal countries, they face a great influence of several qualities of imported rice. Moreover, people of these countries currently prefer imported rice which is even sometimes cheaper than the local rice. Therefore, great efforts are needed to reverse that tendency.

Official language (LANG) affected negatively the potential demand for local rice (table 4). It therefore appears that WA people in English country tended to demand little local rice (table 4). This fact is not really referred to local rice. As showing in the table 2, the probability to demand local rice did not vary with the country's official language. But a t test of Student showed that the whole rice demand varied with the official language. English people demand little rice for their consumption (table 3). Therefore, their little demand for local rice is due to their weak preference for rice.

Aroma (AROMA) was the only one rice attribute which really affected WA people's demand for local rice (table 4). The fact that aroma is one of the five most important preference criteria of consumers affected positively their potential demand for local rice. This result could be explained by the fact that the local rice submitted to the consumers was generally naturally aromatised. It showed that WA people appreciated more the natural aroma of local rice than the aroma of imported rice. This strength point must be used to promote WA local rice. Although, the good taste (GOODTAST) did not present a significant coefficient, its coefficient is positive. Therefore, the fact that good taste is one of the five most important preference criteria of consumers affected positively their potential demand for local rice. Then, WA consumers had appreciated the taste of local rice. Although whiteness (WHITENESS), the absence of foreign matters (FORMAT) and the shape of grains (SHAPGR) did not have significant coefficients, they all presented all negative coefficients. It showed that currently, WA consumers do not appreciate the level of these attributes in the local rice. It is desirable that WA agricultural researchers try to do their best to improve these attributes in local rice.

Table 4: Factors determining the potential demand for local rice in West Africa

Variables	Description	Statistics ¹	Models		
			OLS estimation	Robust estimation with assumption of homoskedasticity	Robust estimation with assumption of heteroskedasticity
CONSTANT	-	-	3.46 (0.58)***	3.46 (0.55)***	3.46 (0.56)***
LNINCAP	Naperian logarithm (ln) of the income per capita (US\$)	5.63 (1.18)	0.02 (0.03)	0.02 (0.03)	0.02 (0.03)
LNLRWTP	ln of consumers' willingness to pay (WTP) for local rice (US\$)	-0.38 (1.25)	1.71 (0.30)***	1.71 (0.31)***	1.71 (0.32)***
LNIRWTP	ln of consumers' WTP for imported rice (US\$)	-0.27 (0.24)	-1.79 (0.19)***	-1.79 (0.21)***	-1.79 (0.21)***
LNHOUSIZ	ln of the household size (individual)	1.80 (0.33)	-0.37 (0.06)***	-0.37 (0.06)***	-0.37 (0.06)***
LNAGE	ln of respondent's age	3.42 (0.74)	0.27 (0.13)**	0.27 (0.13)**	0.27 (0.13)**
TYPCOUN	Type of country (0= sahelian ; 1= coastal)	83.26%	-0.47 (0.13)***	-0.47 (0.11)***	-0.47 (0.11)***
LANG	Official language (0=French ; 1= English)	20.63%	-0.80 (0.18)***	-0.80 (0.21)***	-0.80 (0.21)***
SEX	Sex of the consumer (0= female ; 1= male)	35.50%	0.12 (0.09)	0.12 (0.09)	0.12 (0.09)
EDUC	Has the respondent received any formal education? (0= non, 1= yes)	74.03%	0.13 (0.10)	0.13 (0.10)	0.13 (0.10)
GOODTAST	Is good taste one of the five most important preference criteria of the consumer? (0= non, 1= yes)	71.86%	0.04 (0.09)	0.04 (0.09)	0.04 (0.09)
WHITENESS	Is grains' whiteness one of the five most important preference criteria of the consumer? (0= non, 1= yes)	67.10%	-0.02 (0.08)	-0.02 (0.09)	-0.02 (0.09)
FORMAT	Is absence of foreign matters one of the five most	40.26%	-0.05 (0.08)	-0.05 (0.08)	-0.05 (0.08)

¹ Mean (standard deviation) for quantitative variables and percentage of Yes or modality 1 for dummy variables

Variables	Description	Statistics ¹	Models		
			OLS estimation	Robust estimation with assumption of homoskedasticity	Robust estimation with assumption of heteroskedasticity
	important preference criteria of the consumer? (0= non, 1= yes)				
AROMA	Is aroma one of the five most important preference criteria of the consumer? (0= non, 1= yes)	49.49%	0.15 (0.08)*	0.15 (0.09)*	0.15 (0.09)*
SHAPGR	Is grains' shape one of the five most important preference criteria of the consumer? (0= non, 1= yes)	36.94%	-0.06 (0.08)	-0.06 (0.09)	-0.06 (0.09)
Number of observation			685	685	685
F(14, 670)			21.57***	25.06***	24.39***
R ²			0.31	0.31	0.31
Adjusted R ²			0.30	-	-

*** =significant at threshold of 1%, **= significant at threshold of 5%, * =significant at threshold of 10%, NS= no significant

For the models, values in bracket are the standard errors

6. CONCLUSION

This paper presents the estimation of the potential demand for local rice in WA and to analyze its determinants. It therefore contributes to the improvement of the scientific knowledge on WA rice consumers and the potential demand for local rice because in the literature, although West African (WA) consumers are known as people who prefer imported rice, there is no scientific information on the potential demand of local rice and its determinants in that sub-region. Analysis results show that the most important rice preference criteria in WA are good taste, whiteness, the absence of foreign matters, the aroma and the shape of grains. Probability to demand local rice in WA varies from 0.65 to 0.93 with 0.75 as average in the whole WA. Coastal countries presented a probability to demand local rice less than the one of Sahelian country. In average, each WA consumer demands about 57 kg of rice per year. Their potential demand for local rice is about 44kg per year. But to profit from that great potential demand for local rice, WA producers must produce a lot of local rice, respecting consumers' preference criteria. The results of econometric models show that aroma is the only one rice attribute which significantly positively affects consumers' demand for local rice. Then, those involving in decision making must work for conservation of natural aroma of local rice. Signs of the attribute related to the taste show that WA consumers appreciate the current level of local rice taste but it does not significantly affect their potential demand for local rice. Researchers have so to do to continue improving WA rice taste.

The possibility to easily import rice negatively affects consumers' potential demand for local rice in WA. It suggests that to promote local rice, policy makers have to work reducing the influence of imported rice on competitiveness of local rice. For example taxation can be used to more protect local rice producer. The Common Foreign Taxes (CFT) in Economic Community of West African Countries (ECOWAS) should take into account these kinds of needs.

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