Projet n°. **015403**

FONIO

Upgrading quality and competitiveness of fonio for improved livelihoods in West Africa

Specific targeted research project (STREP)
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WORK PACKAGE 3

The demand for new products and its effects on income generation and distribution

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Do market prices reveal consumers' preferences ?

Evidences from the retail market of fonio in Mali (West Africa)

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Abstract

Using data from market survey in Africa, we show that, according to the degree of processing of the cereal, market prices reveal (i) consumer preferences concerning quality attributes of the cereal, (ii) the characteristics of the suppliers (place of sales) and (iii) the abilities of the consumers to assess the quality attributes. We used a PLS (Partial least Square) procedure to estimate the role of each modality of the chosen attributes in the determination of the price.

Résumé

A travers l'analyse des prix de détail d'une céréale sur plusieurs lieux de vente dans la capitale du Mali, nous montrons que, selon le niveau de transformation des produits, le prix est expliqué soit par les attributs (caractéristiques) du produit lui-même, soit par les caractéristiques des offreurs (les lieux de vente) soit pas les caractéristiques des acheteurs (compétence, expérience, capacité à évaluer la qualité). La méthode des Moindres Carrés Partiels (PLS) a été utilisée pour l'estimation des prix hédoniques des différentes modalités des attributs. Cette méthode est intéressante car elle résout les problèmes de colinéarité et elle permet d'estimer « la valeur » de chacune des modalités prise séparément.

1 - Introduction

Markets were traditionally assumed to reflect perfectly consumers' preferences. Differences in prices must be explained by differences in quality. This idea is a critical assumption in the hedonic prices method whose aim is to estimate the shadow price of each quality attribute (Rosen, 1974). However, this assumption is based on the hypothesis that markets are perfectly competitive. If the markets are oligopolistic, the law of one price is not fulfilled. Different traders sell the same quality of the same good at different prices (Laffont, Tirole…). Moreover, even if markets are perfectly competitive, they can fail in reflecting consumers' preferences. Indeed, economic agent may have difficulties to measure quality (Akerlof, 1970). As a consequence, the bad quality will be paid at the same price as the good one, what will lead to the fall down of the average quality level on the market. Because the bad quality drops the good one out of the market, this phenomenon has been called "adverse selection". The same idea has been developed later on in different ways. A typology of quality attribute (based on their grade of visibility) has been elaborated: *search attributes* are measurable before the purchase, *experience attributes* after the purchase and *confidence attributes* are not measurable (Nelson 1970 ; Darby et Karni 1973). Later on, Barzel (1982) emphasized the costs of quality assessment (called « measure costs »). He showed that the grade of visibility of the quality attributes depends on the capacities of the buyers (their ability, experience and so on). So, if Akerlof and Barzel are right, the price may depend on the attributes of the buyer. Rosen's assumption may be tested by what we will call "an extended approach' of hedonic prices analysis. The idea is to explain the differences in prices not only by attributes of the product (like in Rosen's approach) but also by attributes of the seller and of the buyer. If price differences are exclusively explained by product attributes, Rosen's assumption will be confirmed. If attributes of the buyer matter, it will confirm the hypothesis of market imperfection. If the influence of buyers attributes is significant, it will confirm the role of attributes visibility stressed by Akerlof and Barzel.

We performed such an analysis with data from fonio retail market in Bamako (Mali, West Africa). We also chose to cross the data of the "extended hedonic prices analysis" with declarative data of consumers about the attribute important for them and taken into account at the moment of the purchase.

Different methods are used in marketing studies or economics, based on consumers' willingness to pay for new attributes or products. Even if these methods are quite sophisticated (e.g. conjoint analyses or market experiments), they use declarations or an artificial context of purchase. In our work, we designed a protocol that reflected real purchases of various existing products in retail markets. We compared what people said they liked, with the product they actually bought and the price they paid for existing characteristics, using the classical hedonic approach (Rosen, 1974).

The study focused on fonio (*Digitaria exilis),* a cereal grown in West Africa, mainly in Guinea, Mali and Burkina Faso. This cereal is a "minor" product in terms of production (in Mali, for instance, it represents less than 1% of all cereals consumed, and total production in Africa is about 250,000 metric tons), but it is well appreciated by most consumers who know about it, and is consumed occasionally for family or religious events (Konkobo-Yameogo *et al.*, 2004).

The fonio tiny grain (less than 1 mm) makes dehusking and milling, traditionally done by women using a pestle and mortar, highly laborious. After threshing, the paddy fonio grain is still surrounded by husks. Like rice, processing paddy fonio into milled fonio requires two steps. Firstly husks are removed (dehusking), from paddy grains to get whole grains. Secondly bran (pericarp and germ) is removed (milling) from whole grains. Dehusking and milling fonio grains

require four to five successive poundings alternated with as many winnowings. Productivity is very low: it takes nearly one hour to mill just one or two kilograms of paddy fonio. Moreover, before cooking or precooking milled fonio, all bran, dust and sand must be eliminated by several times washing, which increases processing time and effort. Thus, mechanizing all processing steps seems to be essential both to reduce the laboriousness of women's work and to improve the quality and availability of marketed fonio products (Cruz, 2004). Once the fonio is milled and cleaned, the cooking process is also a long technical task. It requires three successive steam cooking. Since the mid 1990s, several small scale enterprises have developed a new product: the *precooked* fonio. After milling and cleaning, they do the first cooking, dry the product, then seal it into plastic bags containing one kilogram. Konkobo-Yameogo *et al.* (2004) showed the increasing interest of urban consumers for fonio and the rapid emergence of small scale enterprises proposing precooked fonio.

In Bamako, consumers do not buy paddy for food consumption, but they can choose from different traditional products and several brands of precooked new products. In Bamako, traditional (processed by hand only) products are divided into three main categories by buyers and sellers:

✓ *decorticated* or *premilled* [1] fonio, which is actually a mixture of paddy, dehusked and milled grains in various proportions, more or less mixed with sand, dust and bran. A few stakeholders of the market chain, such as cooks in restaurants or traders, are able to subdivide the category into subgroups according to the region or country of origin, or to the milling quality (they give quality grades to different lots). However, traders and final buyers do not always agree on these subdivisions, and/or not able to recognise them by lack of knowledge or habit.

✓ *milled and not washed* [2], which contains milled grains with dust, bran, and sand,

✓ *milled and washed* [3], which means milled clean grain.

The new products called *precooked*[4] consist in milled, washed, cooked, dried and sealed in plastic bag fonio.

Traditional and new products differ mainly according to their place in a technological process (from less to more processed), but they are also sold in different places and to different people: traditional products are sold in markets, while precooked products are sold in small supermarkets or in small scale enterprises.

2. Methodology for the "Extended hedonic price analysis"

The field part of the study was organized into two main activities. Using individual interviews and focus group techniques the first one aimed at determining the different attributes according to several different consumers. The second one aimed at collecting market data on fonio purchases.

2.1. Identification of product attributes

Six focus groups were organized to check the list of quality traits collected through individual interviews and to synthesize general data on local population behaviour. In order to avoid the emergence of leaders during the discussion, each focus group was composed of six persons recruited during individual interviews from a same group of stakeholders. Thus, there was successively a focus group of "big" processors, "small" processors, restaurants (cheap and

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[1] *"Décortiqué"*

[2] *"Blanchi non lavé"*

[3] *"Blanchi lavé"*

[4] *" Précuit "*

expensive) cooks, traditional fonio consumers, and precooked fonio consumers. In each group, a general discussion took place on "*What is for you a good fonio? When you buy it? When you process it and when you consume it*". Finally by aggregation of the work of the groups, a list of attributes was elaborated and used for the market survey.

2.2.Market survey

Twelve different places of Bamako were selected for their representativeness of the city selling places. This market survey was implemented during September and October 2006. All 174 purchases of traditional products and 65 purchases of new products (precooked) were surveyed respectively in five open markets, five supermarkets and two other places. The data collected concerned the price actually paid and the characteristics of (i) the supplier (type of market, supermarket), (ii) the product attributes (type, size, colour…) estimated by the buyer (on the basis of the list elaborated by the focus groups), (iii) the buyer (age, education level, sex…), and (iv) the final use of the bought product (given, eaten at home, processed, prepared in a meal…).

2.3. Estimation of a Hedonic prices' model with the Partial Least Square method

Based on Rosen (1974) and Lancaster (1966), a product (a good) can be considered as a *"package of characteristics"* or a *"bundle of attributes"*. According to Rosen, in a competitive market, market prices reveal the preferences of the consumers for a specific combination of the characteristics. In addition to the quality characteristics of the product, we supposed that prices also depended on the partners of the transaction, since information might be distributed in a heterogeneous way. This was the reason why we included characteristics of the seller and the buyer in the hedonic model. The model can be written as follows:

$$p(z) = p(z_1, z_2, \ldots, z_n)$$

where p is the unit price of the good and z_i is the quantity of characteristics i incorporated in good z.

Regressing a quantitative variable over a large number of qualitative variables generates problems of colinearity because qualitative exogenous variables are less discriminatory (modalities of each characteristic are in small numbers: for instance there were only four different colours) and the exogenous variables are often closely related (cleanliness with colour for instance). The Ordinary Least Square [OLS] estimate drops the variables which are the most collinear in the dataset. Complete estimation cannot be achieved. The Partial Least Square [PLS] method, due to Wold *and al.* (1984), allows to exceed the colinearity problem at the time of estimating the coefficients of variables. It combines several techniques:

1. Projection of the variables on an axis (component). This axis is a linear combination of the exogenous variables (principal component analysis principle). One repeats the process on the residuals of the regression.

2. Linear estimate between the first two principal components which are orthogonal.

Because the estimate was realized between orthogonal components, we could not obtain the t-Student coefficient to control the level of significance of the variables: we used the Jackknife criteria and the Variable Importance in the Projection [VIP] table (Tenenhaus, 1998).

3. Results

3.1. List of attributes and modalities

Results of interviews: declared preferences by consumers when buying, processing or eating fonio.

When all the eaters (including all different stakeholders of the fonio market chain) were asked "*what's for you a good fonio when eating it*", gustative but also visual and olfactive criteria stood out, with a particular emphasis on gustative criteria. The question concerned the most common recipe (foyo), whereby fonio is steamed. Interviewed persons preferred fonio when it was well cooked, with a soft consistency (30 people out of 30), swollen, not sticky and with no sand (30/30); grains must be individual (27/30), smooth (28/30), not rough (25/30); colour must be light (20/30), with a minimum of paddy, herbs and other impurities (26/30). A sugary (23/30) and wild (10/30) smell were well appreciated, while dusty and old smell must be avoid (9/30).

The unanimously quoted quality attributes for home processing were the levels of milling and of cleanliness. These attributes were determined by the duration of the processing,and were quoted both by professionals (street restaurant keepers, processors) and ordinary consumers. Professionals were able to talk longer about the characteristics of the grain itself: they said that some grains were breakable while others did not break when milled. When soaked in water for cleaning, some grains became smooth and lost starch, while others remained whole. They said the good grains were mature, which was an image since all grains were mature when harvested. However, it reflected a real difference in the grain technological properties.

When buying fonio, all buyers said they preferred white, well decorticated and clean fonio. They usually thought that fonio imported from Guinea was cleaner, better decorticated, whiter, and more mature than fonio coming from Mali (its dryer regions especially).

For everybody and at each stage (purchasing, processing, eating), cleanliness and milling degree were essential quality requirements. A light colour was also quoted by everybody. These were vertical quality attributes and differences in prices ought to have been found for the different levels of these attributes. On the opposite, results were not clear for the other attributes. Texture of the grain (called *maturity*) was mainly quoted by professionals. Regarding the size, big grains were considered by some as a sign of good quality while others preferred small grains and others yet were indifferent to it. The origin was an indicator of cleanliness and good milling, but was not always associated with good taste. We did not have any quantitative data on another common recipe in Bamako, *djouka*, a brown-coloured salted meal, based on fonio and roasted groundnut. It was very often said by interviewees that brownish or immature grains were used to make *djouka*.

Table 1 gives the list of the attributes and the modalities used during the survey. All the characteristics of the product were quoted several times during the focus groups as important at one stage of the purchase, or of the process of the cereal, and as such potentially impacting the price of the product. Two attributes concerned the quality of the transformation process (milling degree and cleanliness), three attributes concerned the grain itself (size and colour) and its origin (country of production). It appeared during the interviews that the country of origin was considered by many of the buyers as a proxy of the quality of the grain. Even if the exact definition of this quality varied from one person to another, there was a kind of consensus (with a few exceptions) that fonio coming from Guinea was of better quality than those coming from Mali, mainly because of its cleanliness and good degree of milling. People used fonio in many

different occasions, for different purposes and cooked them in different ways. All these different uses were said to influence both the choice of the type of fonio and of its quality during the focus groups and interviews. Finally, these discussions underlined the differences between people: men (with the exception of traders) were said to be very non competent regarding evaluation of cereal quality in the market. The ability of rich people to recognize the "good" fonio was discussed: some said rich people just do not care because the have many servants who can clean and prepare it, while other thought rich people are exactly like others: some care and some do not care, some knows and some do not. It was difficult to capture a good proxy of the wealth of the interviewees during the survey, and we used both the "level of education" and the "job[5]" as imperfect proxy of the purchasing power of the interviewees.

3.2. Analysis of price and the role of different attributes and modalities.

Prices were quite different from one type of fonio to the other as shown in Figure 1.
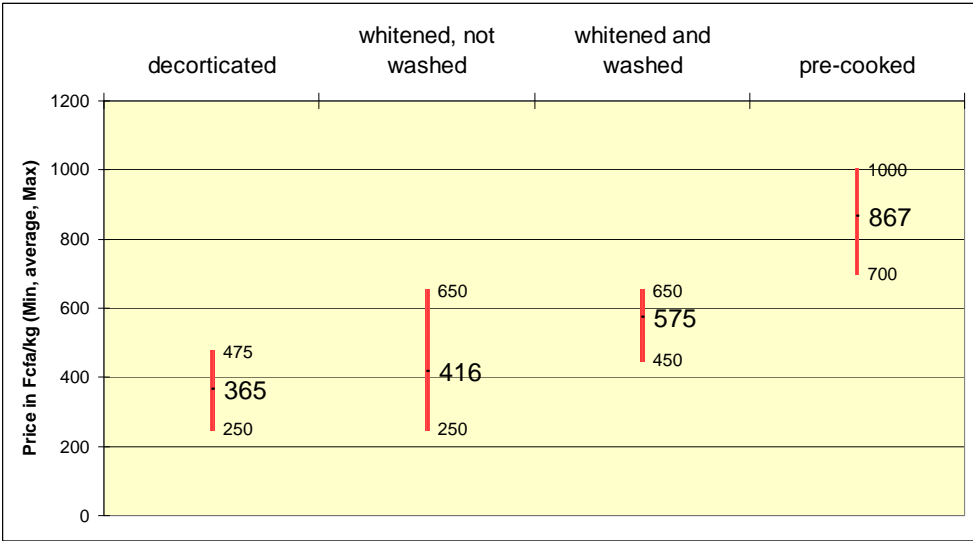
Figure 1: Retail prices of several types of fonio products in Bamako- Mali, October 2006

The global average price reached 538 CFAF/kg[6], but 92 % of the variations in retail prices were explained by the type of fonio. From the least to the most processed fonio, the price was multiplied by a factor of two to four (from 250 to 1000 CFAF/kg). The difference between average prices gave the average market value of milling (50 CFAF/kg), washing (160 CFAF/kg), and precooking plus packaging (290 CFAF/kg). At this stage, it was not possible to determine the part involved by processing costs, market segmentation or monopole, and consumers' preferences in price differences. For various reasons, one could suppose that traditional products were in competition (everyone knew the product, each seller had at least two or three different types of fonio), while very few suppliers had the precooked product, which was mostly sold in supermarkets, where no traditional products could be found. Thus, in the case of traditional fonios, we could suppose that prices really reflected both supply and demand, and therefore consumers' preferences, and willingness to pay for the different attributes. This was not as clear for the precooked product. When we analyzed each type separately, we showed what really counted apart from the level of processing. Descriptive statistics of average and standard deviation of price per different modality of each characteristic were presented in Table 3 (*decorticated*), 4 (*milled*) and 5 (*precooked*).

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[5] *Catégorie socio professionnelle* in french
[6] 656 CFA Franc= 1 Euro

3.2.1. Prices of decorticated fonio depended mainly on recipe, grain origin, milling degree, and grain colour.

During the period of the survey, the prices of decorticated fonio ranged from 250 to 475 CFAF/kg. We supposed that variations in prices were linked to (i) the different characteristics of the products themselves (in the so-called *decorticated* group) including the purchase location, and (ii) the consumers' expertise or ability to recognize the different characteristics. The R2 of the PLS regression was 0.4, which was good for such a regression and indicated a relatively good fit of the model. The model parameters are presented in Table 2. When the VIP value is above 0.8, the parameter of the variable is considered as being statistically different from zero.

The result of the regression can be written as follows:

P_{fonio} = 360,696

+ 2,463(*Medina market*) – 2,059(*Lafiabougou market*) – 1,572(*Magnambougou market*)	*place of purchase*
-5,021(*badly milled*) + 5,021(*well or very well milled*)	*milled degree*
-0,285(*very dirty*) – 0,736(*dirty*) + 0,898(*clean*)	*cleanliness*
+ 4,505(*white*) + 12,462(*cream white*) – 1,157(*grey*) – 4,812(*red, brown, not white*)	*colour*
+ 1,679(*big*) + 1,002(*small*) – 5,077(*do not know*)	grain *size*
+ 4,572(*Guinea*) – 5,685(*Mali*) + 0,996(*do not know*)	*origin*
- 5,858(*Djouka*) + 4,889(*other salted meal*) + 7,262(*do not know*)	*recipe*
- 2,691(*for sale or gift*) – 0,558(*week-end meal*) + 3,038(*special event meal*)	
+ 0.996(*regular meal*) + 7,135(*illness*)	*occasion*
+ 0,102(*household consumption*) – 2,576(*processing for sale in a small restaurant*)	
+ 4,377(*processing for a gift*) – 0,183(*gift: no home process*)	
+ 7,135(*processing for sale in a precooked type*)	*destination*
+ 2,675(*mother or other woman in the family*) – 3,254(*employee*)	
+ 2,1(*father or other man in the family*) – 2,732(*child, young of the family*)	st*atus of the buyer*
- 3,054(*under 20 years old*) + 3,751(*between 21 and 35*) – 3,316(*between 36 and 50*)	ag*e of the buyer*
- 0,183(*man*) + 0,945(*woman*)	se*x of the buyer*
+ 0,928(*employee*) – 2,391(*independent worker*) – 2,446(*others*) + 4,71(*housewife*)	*activity of the buyer*
+ 0,866(*region of production of fonio*) – 1,146(*region with no production of fonio*) buyer	*region of origin of the*
- 1,042(*primary school*) – 1,513(*secondary school*) + 2,264(*highschool and beyond*)	
+ 0,872(*other*)	*education level of the buyer*

Note that each exogenous variable is binary, and takes the value 0 or 1.
P_{fonio}, the endogenous variable is quantitative; it is the unit price of fonio in CFAF/kg.

The most significant (first rank of VIP) characteristic of the model was the fonio recipe; all modalities were different from zero and the parameters took the expected sign: to make *djouka* consumers bought cheaper fonio than they would for *foyo*. Grain origin, grain colour and milling degree were also very significant with the following expected parameters: positive for Guinea and negative for Mali, positive for white colour and negative for brown colour, and positive for well milled and negative for poorly milled. A comparison of means, with ANOVA using the Fisher test for each characteristic, confirmed these results. The four characteristics that had a significant effect on the average price were the recipe, grain origin, colour and milling degree.

Other significant modalities were more difficult to analyze. Destination such as "processing for sale in a small restaurant" was significant and negative while "processing for a gift" was positive. These results could be explained by the fact that women who cooked for street restaurants were used to buy fonio in large quantities at very low cost. On the opposite, someone who bought fonio in order to cook it and give it away did so not in such large quantities and possibly at irregular intervals. Characteristics of the buyer were less significant but more difficult to analyze at this stage.

It was surprising that the cleanliness level was not significant. During interviews it was always quoted as important, but the model showed that the level of cleanliness, as perceived by the buyer, had no impact on the price of *decorticated* fonio. It could be argued it was a bias of the

survey based on interviewees' perceptions, and not on physical measures. People might not have understood the question or might have been over-optimistic regarding the product they just bought. On the other hand, other technological characteristics, collected with the same methodology, appeared to be significant, and coherent with empirical knowledge. At this stage, it seemed that while buyers were able to assess milling degree, grain colour, size and origin by themselves or with indications from sellers, they were not able to assess the level of cleanliness during the purchase, which they would discover at home when processing the product. Each specific type was usually associated with a certain idea of level of cleanliness for most buyers. Cleanliness was actually not a real issue in the *decorticated* fonio "group" for the majority of individual buyers, who bought fonio very rarely (from once a week to once a month), in very small quantities (80% of the purchases of decorticated or milled fonio weighed less than four kilograms). Caution was necessary to differentiate between retail and wholesale markets as some were very close to each other: in wholesale markets professionals, such as restaurant keepers and small scale entrepreneurs bought their decorticated fonio and had greater expectations concerning quality. They bought larger quantities (from around 300 to 500 kg per month), on a regular basis, and paid different prices for different levels of cleanliness of decorticated fonio (our interviews). The same regression done at the wholesale market about larger quantities would certainly have shown different results concerning the cleanliness level.

3.2.2. Prices of milled fonio depended more on environment characteristics linked to supply and buyers than on grain characteristics (except for colour)

The analysis of variance was conducted for each characteristic and showed that the average price varied depending on the purchase location, colour, size, destination, status of the buyer, sex of the buyer, and activities of the buyer (at 1% significance level), occasion, education level (at 5% level). The PLS regression and VIP criteria gave more detailed results (Table 4).

Compared to *decorticated* fonio, the milling degree had no effect any longer on the price since the type was more homogeneous. The recipe had the correct sign (minus for *djouka* and plus for other salted meal) but was not significant any longer since very few people bought this kind of fonio to process it and sell it in large quantities to street restaurants. The origin was not significant any longer. The level of cleanliness gave incoherent results. The colour remained the only common significant characteristic.

Characteristics of buyers were here more significant: men, civil servants, higher educated persons paid a higher price compared to women, housewives, or less educated persons. In addition, the location was significant: prices in Magnambougou market and at the Niger riversides were higher than in Medina Koura and Korofina markets. This seemed logical and linked to the customers since Magnambougou was located in a wealthier area, and Niger riversides' purchasers were usually richer than people going to other markets.

3.2.3. Prices of precooked fonio depended mainly on supply characteristics (brand and purchase location).

For precooked fonio, only purchase location and brand had a significant effect on the unit price average (ANOVA test). All other variables (quality, buyer characteristics, etc.) had a minor effect on price (see Table 5). The product was standardized and variations in technological quality were low. Supply systems and brands were not competing yet with one another. Each purchase location and each processor had its own price policy. The product being new the consumers were not accustomed to it yet and had no means to make price comparisons. In the case of precooked fonios, prices resulted from a supply policy and not from the meeting between suppliers and purchasers.

4 - Discussion and conclusion

We showed that the fonio price was mainly determined by the grain milling degree. The four existing types of fonio, known by individual buyers at the retail markets, explained almost 95% of price variation. The market was thus well segmented for that product. In addition, the hedonic price estimation with the PLS method showed that for each type of fonio different attributes and modalities of attribute had a significant value.

For the decorticated fonio, the main determinants of price variation around the average were the final recipe, grain colour, grain origin, and grain milling degree. Specific characteristics of buyers (related to their idiosyncratic competence or sociocultural specificities) and supply (market places) played a minor role. The geographic origin of the grain guaranteed somewhat the level of cleanliness. Although buyers would rather purchase clean fonio (no dust, no sand), there were not many ways to check this at time of purchase, and they used the origin as a means to estimate *ex ante* the level of cleanliness. Decorticated fonio is heterogeneous in terms of technological characteristics compared to milled fonio, and price variations are mainly linked with technological characteristics.

The main determinants of the price variation of milled fonio were the purchase location as an attribute. Some modalities of the grain colour, size of the grain, occasion, destination, and the sex, type of employment and level of education of the buyer were also influencing the price. Final recipe, milling degree and grain origin had no influence on the price.

The main determinants of the price variation of the precooked product were the place of purchase and brands. Intrinsic characteristics of the product had little influence on price variation. Results of the hedonic models on the market prices were consistent with results from interviews and revealed consumers' preferences. It highlighted the fact that the fonio market was efficient for traditional products (decorticated and milled).

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Table 1: Quality attributes and their modalities

Who/What is concerned	Attributes or Characteristics	Modalities
SELLER	Purchase location	Open traditional Markets (Magnambougou, Médina, Lafiabougou)
		Supermarkets (Five different ones)
		At the processing unit
		"speciality store"
PRODUCT	Milling degree	Poorly milled
		well milled
		Very well milled
	Cleanliness degree	very dirty
		Dirty
		Clean
	Grain colour	White
		Cream white
		Grey
		red, brown, not white
	Grain size	Big
		Small
		do not know
	Grain origin	Guinea
		Mali
		do not know
USE	Recipe	Djouka
		Other salted main meal
		do not know
	Occasion	For sale or gift
		Week-end meal
		Familial or religious event
		Regular meal
		Other
	Destination	Familial consumption
		Processing for sale in her small restaurant
		Processing for a gift
		Gift (no home process)
		Processing for sale as precooked type
BUYER	Buyer status in the family	Mother or other woman
		Employee
		Father or other man
		Child, youngster
	Buyer age	Less than 20 years
		Between 21 and 35 years
		Between 36 and 50 years
	Buyer sex	Man
		Woman
	Buyer job	Employee
		self-employed worker
		Other
		Housewife
	Buyer origin	Region of fonio production
		Region with no fonio production
	Buyer education level	Primary or religious school
		Secondary school
		High school and beyond
		Other

Table 2: Parameters of the PLS regression for *decorticated* fonio.

		parameters	VIP*>0.8	VIP rank
	Constant	360,696		
Purchase location	Medina market	2,463	1	16
	Lafiabougou market	-2,059		
	Magnambougou market	-1,572		
Milling degree	**Poorly milled**	**-5,021**	**1,9**	**4**
	Well or very well milled	**5,021**	**1,9**	**3**
Cleanliness degree	Very dirty	-0,285		
	Dirty	-0,736		
	Clean	0,898		
Grain colour	**White**	**4,505**	**1,6**	**9**
	Cream white	**12,462**	**1,8**	**7**
	Grey	-1,157		
	Red, brown, not white	**-4,812**	**1,9**	**6**
Grain size	Big	1,679		
	Small	1,002		
	Do not know	-5,077	1,3	12
Grain origin	**Guinea**	**4,572**	**1.7**	**8**
	Mali	**-5,685**	**2,1**	**2**
	Do not know	0,996		
Recipe	**Djouka**	**-5,858**	**2,3**	**1**
	Other salted main meal	**4,889**	**1,9**	**5**
	Do not know	7,262	1	14
Occasion	For sale or gift	-2,691	1,1	13
	Week-end meal	-0,558		
	Special event (familial/religious) meal	3,038	0,8	22
	Regular meal	0,996		
	Illness	7,135		
Destination	Household consumption	0,102		
	Processing for sale in her small restaurant	-2,576	0,9	21
	Processing for a gift	4,377	1	17
	Gift (no home process)	-0,183		
	Processing for sale as precooked type	7,135		
Buyer status in the family	Mother or other woman	2,675	1	15
	Employee	-3,254		
	Father or other man	2,100		
	Child, youngster	-2,732	0,9	18
Buyer age	Less than 20 years	-3,054	0,9	20
	Between 21 and 35 years	3,751	1,3	11
	Between 36 and 50 years	-3,316		
Buyer sex	Man	-0,183		
	Woman	0,945		
Buyer job	Employee	0,928		
	Self-employed worker	-2,391	0,9	19
	Other	-2,446		
	Housewife	**4,710**	**1,5**	**10**
Buyer origin	Region of fonio production	0,866		
	Region with no fonio production	-1,146		
Buyer education level	Primary school	-1,042		
	Secondary school	-1,513		
	High school	2,264		
	Other	0,872		

Table 3: Descriptive statistics of prices for *decorticated* fonio

Characteristics	Modalities of each characteristic	Frequency		Unit Price CFAF/kg	
		N	N% column	Average	Standard Deviation
Purchase location	Medina market	28	48,3%	371	38
	Lafiabougou market	8	13,8%	356	18
	Magnambougou market	22	37,9%	360	31
Milling degree	Poorly milled	23	39,7%	350	26
	well milled	33	56,9%	373	35
	Very well milled	2	3,4%	400	0
Cleanliness degree	very dirty	9	15,5%	364	28
	Dirty	25	43,1%	363	33
	Clean	24	41,4%	368	36
Grain colour	White	18	31,0%	381	29
	Cream white	2	3,4%	425	71
	Grey	14	24,1%	361	27
	red, brown, not white	24	41,4%	351	28
Grain size	Big	14	24,1%	371	27
	Small	37	63,8%	367	32
	do not know	7	12,1%	343	45
Grain origin	Guinea	20	34,5%	380	38
	Mali	19	32,8%	346	13
	do not know	19	32,8%	368	35
Recipe	Djouka	28	48,3%	350	26
	Other salted main meal	28	48,3%	378	34
	do not know	2	3,4%	400	0
Occasion	For sale or gift	26	44,8%	358	22
	Week-end meal	4	6,9%	363	32
	Familial or religious event	8	13,8%	378	31
	Regular meal	19	32,8%	368	46
	Other	1	1,7%	400	.
Destination	Familial consumption	31	53,4%	365	32
	Processing for sale in her small restaurant	14	24,1%	355	20
	Processing for a gift	5	8,6%	385	34
	Gift (no home process)	7	12,1%	364	56
	Processing for sale as precooked type	1	1,7%	400	.
Buyer status in the family	Mother or other woman	36	62,1%	370	39
	Employee	4	6,9%	350	0
	Father or other man	3	5,2%	375	25
	Child, youngster	15	25,9%	355	19
Buyer age	Less than 20 years	10	17,5%	353	18
	Between 21 and 35 years	42	73,7%	370	32
	Between 36 and 50 years	5	8,8%	350	61
Buyer sex	Man	7	12,5%	364	24
	Woman	49	87,5%	366	35
Buyer job	Employee	12	21,1%	369	28
	self-employed worker	28	49,1%	359	31
	Other	6	10,5%	354	25
	Housewife	11	19,3%	384	44
Buyer origin	Region of fonio production	29	51,8%	367	41
	Region with no fonio production	27	48,2%	362	23
Buyer education level	Primary or religious school	23	40,4%	362	34
	Secondary school	6	10,5%	358	34
	High school and beyond	7	12,3%	375	32
	Other	21	36,8%	368	35
Total		58	100,0%	365	33

Table 4: *Milled* fonio: descriptive statistics and parameters of the model

Characteristics	Modalities = variables of the model	Descriptive statistics (price in CFAF/kg)			Results of the model	
		N	Average	SD	Parameter	VIP rank
Total		**99**	**416,21**	**52,98**	**constant = 431,61**	
Purchase location	Medina Koura market	18	392	35	-7,08	15
	Korofina market	44	394	16	-9,30	6
	Lafiabougou market	11	400	0	-4,31	
	Magnambougou market	21	450	32	10,19	8
	Niger Riversides	**5**	**590**	**55**	**43,21**	**1**
Milling degree	Poorly milled	2	400	0	-3,91	
	Well milled	22	417	28	0,11	
	Very well milled	75	417	59	0,31	
Grain colour	**White**	**79**	**403**	**30**	**-15,54**	**3**
	Cream white	**11**	**505**	**77**	**23,46**	**2**
	Grey	5	445	97	7,16	
	Red/brown/not white	4	400	0	-3,99	
Grain size	Big	23	425	37	2,77	
	Small	38	431	76	5,64	14
	Do not know	38	396	14	-7,72	9
Grain origin	Guinea	67	422	54	4,02	
	Mali	4	419	38	0,62	
	Do not know	28	403	51	-4,45	
Recipe	Djouka	30	403	24	-4,47	
	Other salted meal	69	422	61	4,47	
Occasion	For sale or gift	21	401	24	-4,64	
	Week-end meal	18	414	32	-0,67	
	Familial or religious event	13	390	50	-7,02	18
	Ordinary meal	45	433	66	7,07	11
	Other	2	400	0	-3,91	
Destination	**Familial consumption**	**40**	**443**	**69**	**10,56**	**5**
	Processing for sale in small restaurants	26	404	15	-3,77	
	Processing as gift	11	389	54	-7,32	
	Gift (no home process)	22	395	15	-6,30	17
Buyer status in the family	Mother or other woman	74	413	49	-3,09	
	Employee	7	411	28	-1,40	
	Father	**3**	**550**	**132**	**32,57**	**4**
	Other household member	15	408	22	-2,19	
Age	Less than 20 years	16	405	19	-3,24	
	Between 21 and 35 years	73	418	57	1,19	
	Between 36 and 50 years	8	431	70	3,86	
Buyer sex	Man	8	466	103	12,69	12
	Woman	88	412	45	-9,58	13
Buyer job	Employee	10	408	24	-2,29	
	Self-employed worker	24	424	46	2,48	
	Student	10	400	0	-4,26	
	Civil servant	**9**	**478**	**93**	**15,99**	**7**
	Unemployed	3	400	0	-3,95	
	Retired	4	450	100	8,31	
	Housewife	37	401	44	-5,60	16
Buyer origin	Region of fonio production	57	414	46	-1,46	
	Region with no fonio production	40	421	63	1,80	
Buyer education level	Primary or religious school	43	411	30	-2,35	
	Secondary school	10	463	94	12,15	10
	High school and beyond	12	423	60	1,80	
	Other	32	408	55	-2,93	

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Table 5: *Precooked* fonio: descriptive statistics and parameters of the model

Characteristics	modalities = variables of the model	descriptive statistics (price in CFAF/kg)			Results of the model	
		N	Average	SD	Parameter	VIP rank
Total		**65**	**867**	**88**	constant = 874,483	
Purchase location	At the processing unit	12	858	76	4,553	
	Speciality store	**26**	**792**	**27**	**-55,107**	**1**
	Supermarket 1	**2**	**1 000**	**0**	**85,484**	**6**
	supermarket 2 (Badalabougou)	11	879	29	1,784	
	Supermarket 3 (Hippodrome)	**11**	**995**	**15**	**51,369**	**2**
	Supermarket 4 (Hippodrome)	**2**	**1 000**	**0**	**92,527**	**7**
	Supermarket 5 (Hippodrome)	1	830	.	-15,932	
Brand	Brand-1	6	800	0	-34,238	9
	Brand-2	1	1 000	.	83,788	18
	Brand-3	2	900	71	-8,960	
	Brand-4	1	850	.	7,923	
	Brand-5	16	850	89	-4,370	
	Brand-6	**15**	**790**	**39**	**-40,739**	**4**
	Brand-7	1	825	.	-24,197	
	Brand-8	**18**	**953**	**54**	**43,287**	**3**
	Brand-9	2	830	0	-19,947	
	Brand-10	3	933	58	47,318	
Grain colour	Blanc	18	865	87	1,145	
	Cream white	27	875	91	3,189	
	Brown, red, grey, not white	20	858	87	-4,711	
Grain size	**Big**	**7**	**936**	**94**	**15,704**	**5**
	Small	24	856	86	-8,291	
	Do not know	30	858	84	2,614	
	several different sizes	4	874	95	-3,943	
Grain origin	Guinea	2	975	35	8,972	13
	Mali	1	850	.	-8,294	
	Do not know	62	864	88	-3,224	
Recipe	Djouka	7	914	107	12,117	19
	Other salted meal	53	866	87	-5,881	
	Other	5	810	22	-3,930	20
Occasion	For sale or gift	8	838	69	3,052	
	Week end	25	876	72	6,013	
	Familial or religious meal	9	827	83	-22,951	
	Ordinary meal	23	883	107	4,309	
Destination	Household consumption	55	875	88	8,208	12
	Processing for sale	1	800	.	-10,608	
	Gift (no home process)	8	819	84	-9,524	14
	Other	1	850	.	7,923	
Status of the buyer	Mother	39	849	80	-12,885	11
	Employee	4	911	86	-0,452	
	Father	13	875	91	7,074	
	Other member of the family	9	911	105	16,653	15
Buyer age	less than 20 years	2	900	141	10,385	
	Between 21 and 35	15	889	100	-1,504	
	Between 36 and 50	31	862	81	-1,770	
	More than 51	17	853	87	2,065	
Buyer sex	Man	19	862	88	1,309	
	Woman	46	869	89	-1,309	
Buyer job	Employee	13	858	74	-2,057	
	Self employedworker	6	892	102	-3,335	
	Student	4	950	100	11,938	10
	Civil servant	31	862	87	7,145	
	Retired	5	859	89	-0,324	
	Housewife	6	838	101	-21,964	
Buyer origin	Region of production of fonio	29	879	90	4,725	
	Region with no production	35	861	83	1,147	
Buyer education level	Primary school	13	902	91	8,652	16
	Secondary school	23	843	78	-6,917	17
	High school and Beyond	29	870	91	0,798	

[1] Note that VIP= Variable Importance in the Projection = 3.11 for rank = 1 ; VIP = 0.86 for rank = 20