

# Do urban African dwellers pay a premium for food quality and, if so, how much? An investigation of the Malian fonio grain market

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*Summary* – Very little data is available concerning the valuation of quality on existing food markets in Sub-Saharan Africa. Using data collected from a survey of fonio (a cereal) retail markets conducted in Bamako, Mali, Africa and a hedonic price Partial Least Square regression method, this study shows that most quality attributes declared as important by consumers have a specific hedonic price that is different from zero. This is interpreted as a result of the efficient performance of so-called traditional informal markets. Among the valued attributes, some are physical (colour, degree of milling) and thus relatively easy to assess, while the assessment of others (category or country of origin) are more complicated for both parties to the transaction. These attributes, however, also have specific hedonic prices. Informal norms and a certain amount of trust are thus present in these markets and should not be underestimated. The inclusion of buyer characteristics in the model is justified by the differences in bargaining power, which are essentially linked with different levels of experience buying or using the product. We showed that women were getting better prices for the same product quality. The premiums paid for quality varied from 1 to 14% of the price. These estimates have confirmed the other few estimates done in African food markets.

*Keywords:* fonio, cereal, quality, hedonic prices, PLS method, empirical investigation

## Les urbains africains paient-ils une prime pour la qualité des aliments et si oui, combien ? Une enquête sur le marché du grain de fonio au Mali

*Résumé* – Il existe très peu d'études concernant la valorisation de la qualité sur les marchés alimentaires en Afrique Sub-saharienne. La présente contribution montre, à partir de données sur le marché de détail du fonio (une céréale) à Bamako au Mali, et à partir d'une estimation des prix hédoniques par la méthode des moindres carrés partiels (PLS) que la plupart des attributs de qualité importants pour les consommateurs ont un prix hédonique différent de zéro. Ce résultat signifie que ce marché informel fonctionne suffisamment bien pour permettre une segmentation des produits selon différents niveaux de qualité. Parmi les attributs valorisés, certains sont physiques (couleur, niveau de décorticage) et relativement faciles à évaluer, tandis que d'autres sont plus difficiles à évaluer par les différents acheteurs et vendeurs (catégorie ou type de fonio, pays d'origine). Pourtant ces derniers attributs ont également un prix hédonique spécifique. Un certain niveau de confiance et des normes informelles sont ainsi nécessairement présents et ne doivent pas être sous-estimés. On a par ailleurs inclus dans le modèle certaines caractéristiques des acheteurs reflétant leur pouvoir de négociation, lié en partie à leur expérience. Cela a montré que les femmes obtiennent de meilleurs prix que les hommes pour la même qualité de produit. Les primes payées pour la qualité varient de 1 à 14 % et ces estimations confirment les autres rares estimations réalisées sur les marchés alimentaires africains.

*Mots-clés :* fonio, céréale, qualité, prix hédoniques, méthode PLS, recherche empirique

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## 1. Introduction

The quality of staple food in very poor countries – especially those in West Africa – is seldom questioned by agricultural and food economists. This is because it is overshadowed by other important questions such as availability (quantity available for consumption) or affordability (people's ability to access food), two pillars of the food security concept. However, questions concerning quality, quantity, and price are inter-related at all levels of the food production-trade-processing-consumption chains (Egg *et al.*, 2006). It is indeed quite straightforward to assume that markets expand more easily (in this case, farmers farm more cereals for sale, traders trade more, and consumers buy more) if trading rules (the majority of which are not written in West Africa) exist and are respected. Among these rules, the common definitions of produce and their characteristics, the clear and shared knowledge/information about produce, as well as the stability of these definitions are keystones.

In spite of very little available empirical material, it is commonly said that "low quality food" prevails in Africa (Vanderplas, 2009) and that formal certification schemes should be promoted (Masters and Sanogo, 2002).

This study is an empirical contribution that seeks to answer the following: do urban African consumers pay for quality attributes of produce? For which attributes and for how much? The question is not: how much are they ready to pay? But rather, how much are they actually paying? We are not concerned with consumers' willingness or intent, but really the current paid premium on existing urban markets. This not only captures the ability of consumers to pay for different quality attributes and to express their preferences, but also that of the different market stakeholders, which results in differentiated quality attributes for the same product.

There are actually very few published studies and accurate data related to this question. Langyinto *et al.*, 2003, and 2004, published a vast study concerning the premium paid for different characteristics of cowpea (*Vigna unguiculata* (L.) Walp) in West and Central Africa. Based on real prices paid in 16 markets in Ghana, Cameroon, Nigeria, and Senegal, the authors estimated different premiums ranging from 0.67% to 18% of the average retail price paid for various quality attributes such as the grain size, the "eye" or grain colour, etc. Their study "indicates that quality characteristics are very important in West African food markets" and that "even low income consumers are willing to pay a premium for products that match their preferences, and they are vigilant in identifying products that do not meet their standards".

Basing their assertions on rice consumption surveys conducted in Ivory Coast and Nigeria in 2000, Lançon *et al.* (2004) insisted upon the fact that quality attributes – such as cleanliness, standardization, and ability to swell (the result of which one gets a higher cooked volume for the same dry weight) – are key factors in the consumers' preference for imported rice over local rice. In other words, they showed that urban consumers paid a premium for cleanliness and standardization. Using their data from Bouake, Ivory Coast (*op. cit.*, p. 112), we estimated that imported rice represented 68% of total consumption whereas local rice was only 32%. The prices weighed by quantity were respectively 279 FCFA/kg and 252 FCFA/kg. This means that more than two-thirds of the population paid a premium of about 10% to satisfy their preferences regarding the quality of rice. The other third, according to the authors, were either very poor (20% of the total sample) or came from a specific region and were used to eating a specific category of rice (10%).

Vandeplass *et al.* (2009) showed that the premium paid by consumers for better quality rice was higher in India (up to 45%) than in Madagascar (10% maximum), which is a poorer country. Similarly, they argued that tomatoes of “good quality” (not rotten) were relatively more expensive in India compared to Madagascar.

### 1.1. Fonio as a case study

Our study concerned fonio (*Digitaria exilis*) – a cereal grown in West Africa. 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 was about 365,000 metric tons in 2005, Cruz, 2009 quoting FAO), yet it is well known and appreciated by most consumers (Konkobo-Yameogo *et al.*, 2004) and the market is expanding both in West African and European cities (Cruz, 2009). The miniscule size of this market acts as an advantage since it is easier to observe and analyse it in comparison to larger grain markets, such as millet (*Pennisetum glaucum*, (L.) R. Br) or sorghum (*Sorghum bicolor* (L.) Moench). There is no evidence that consumers behave differently nor similarly when buying fonio compared to millet or sorghum, which are the real staple foods of the inhabitants of the Sahelian region in West Africa. Despite this lack of “real” proof, one could arguably liken fonio to these cereals on the basis that it too is a cereal that is grown in the same regions and sold by the same type of sellers within the same kind of city markets to the final consumers (Bessler and Kergna, 2003, our observations). We hypothesise that the behaviours addressed in this study can at the very least be extrapolated for the study of other cereals. More generally, and according to several previous empirical studies (Dury *et al.*, 2002; Cheyns, 1998 and 2006; Bricas and Cheyns, 2003; Lançon *et al.*, 2004; Alpha *et al.*, 2009; Langyintuo *et al.*, 2003-2004), we suppose that this example illustrates at least one part of the West African urban consumers' attitudes toward food quality: *i.e.* most people, even the very poor, have strong quality requirements. They may not be able to afford to fulfil all of them, but they deal with them on a daily basis and use different means to “optimize” a complex system of preferences during the purchase, home processing, or cooking of food.

## 2. Methodology

Our methodology was based on the classical (1966) perspective of Lancaster's quality of produce, which is considered as a sum of quality attributes or characteristics, and on Rosen's (1974) hedonic estimation method, which provided a theoretical background to empirical estimations of the implicit or hedonic price of each of these characteristics. We collected the data directly through the observation of specific retail transactions in different markets of the city. After analysing the data using descriptive statistics (tables 1, 2) and a Partial Least Square (PLS) regression (table 3), we then ran different simulations (table 4).

### 2.1. Data collection

Our fieldwork was organized into two main activities. Using several open-ended individual interviews and 6 focus groups, the first aimed to determine the various attributes according to several different consumers. This also gave us most of the interpretation cues regarding what matters and why for fonio buyers and consumers. The second part aimed to collect market data on real fonio purchases using structured closed questionnaires. Five different marketplaces in Bamako were selected for their representativeness of fonio and, more generally, of grain markets (Bessler and Kergna, 2003). Although some of these markets have both wholesale and retail activities, we limited our scope to the retail purchases, as it was important for our research to track the variation of prices and quality at the very end of the food marketing chain.

The collection of data was implemented during September and October 2006. All 174 purchases of traditional products were surveyed in five traditional open markets. The data collected concerned the price actually paid and the characteristics of (i) the supplier (market type), (ii) the product attributes (type, size, colour, etc.), (iii) the buyer (age, education level, sex, etc.).

Most characteristics were declared by the buyer and were not assessed by an external expert or system of measure. While perhaps dissatisfying for those who prefer to objectivise the aspects of quality, this method does provide valuable information. For instance (table 2), 28% of the buyers declared that they did not know the origin nor the size of the grain, and 44% of them stated that they had no idea about the hardness of the grain. This can be interpreted into two ways: (i) these buyers did not really care about these aspects or (ii) they were not able to distinguish between the different modalities because they lacked information (problem of signal). The regression results gave more insight. In any case, it is clear that "white" is a perception declared by a specific person – the buyer – and has not been measured.

Bargaining is omnipresent in African food markets, and prices, even if not always discussed, are always up for negotiation. For most staple foods, including cereal and fonio, the produce is sold in bulk, and there are neither price tags nor any other tags or written labels. Hence the buyer is not helped by any formal institutions to determine what kind of product he/she is looking at. Instead the buyer relies on his/her personal abilities to assess the quality of the produce (using his/her knowledge) and very rarely relies an external formal institution.

As we observed in many different food retail markets in Cameroon and Mali – and as reported by other authors like Clark, 1994, in Ghana or Chaléard, 1996, in Ivory Coast – it is often the case that the price itself is not discussed, but rather the quantity of product for a given amount of money. The client asks the seller for a “gift” (which is the addition of extra product), which is either accepted or not. In the end, it is the price per kilogram (kg) that is decreasing, but not the “cost” itself. In our survey, we carefully reported all the details of the transaction concerning the amount of money paid, the purchased quantity, and the real paid price per kg (which is actually a calculated variable: amount of money paid divided by quantity in kg).

## 2.2. Addition of some seller characteristics to the standard hedonic model

In addition to the intrinsic characteristics of the product (as proposed by Rosen, 1974), we supposed that observed price variations also depended on the partners of the transaction. Buyers have different bargaining powers (see for instance Harding *et al.*, 2003) according to their individual characteristics.

As Harding *et al.* (2003) showed for homes in the United States, bargaining power depends on personal characteristics of the buyers or sellers, such as gender or the presence of school-age children in the family. Harding *et al.* (2003), Colwell and Munneke (2006), and Kumbhakar and Parmenter (2009) dealt with “big” durable goods, such as houses or offices, which were seldom ever bought in a lifetime. For those markets, considering both seller and buyer characteristics are necessary. In our case, we dealt with consumption goods, which are generally sold in very small quantities by a few sellers to many different buyers. Therefore, we made the assumption that sellers were more or less all the same in each marketplace and that most variations concerned the buyers.

As a consequence, the hedonic function was written as follows:

$$Y = \alpha + \beta X + \varepsilon \quad (1)$$

Where Y is the observed selling unit price of the good (in FCFA <sup>1</sup>/kg), X is a vector of the characteristics of the good itself and the transaction – including technical characteristics, quantity sold, and place of the transaction, as well as characteristics of the buyer that were supposed to influence his/her bargaining power.

$\alpha$  is the constant term,  $\beta$  the parameters related to the characteristic X, and  $\varepsilon$  the error.

## 2.3. Estimation of a Hedonic price model with the Partial Least Square Regression

Since most exogenous variables were discrete (qualitative), this model was first estimated using the Analysis of Covariance (ANCOVA) procedure. Several different ANCOVA were tested, including those with no specification, stepwise, or best R<sup>2</sup> procedures. The results were somehow difficult to analyse because they were quite

<sup>1</sup> Franc de la Communauté Financière Africaine. 656 FCFA = 1 euro (fixed parity).

sensitive to the chosen procedure and reference. This was mainly due to the collinearity between variables. This is a general statement of the fact that the regression of a quantitative variable over a large number of qualitative variables generates collinearity problems related to two different main causes. First, qualitative variables are less discriminatory than continuous ones: there are a few different modalities of each variable. Second, exogenous variables were very closely collinear (for example, cleanliness with colour).

To deal with these collinearity problems, we used the Partial Least Square (PLS) method proposed by Wold *et al.* (1984). As Stoica and Söderström (1998) mentioned: *“In ill-conditioned linear regression problems, in which regressors are nearly collinear, the use of Ordinary Least Squares (OLS) is generally to be avoided owing to its poor performance, such as large mean square errors (MSE). {...} Of the previously mentioned biased estimators, the PCA and PLS appear to be among the best.”* In a first stage, the method consists in computing an axis called “principal component”, which is a linear combination of the exogenous variables, or more precisely, of the different modalities of the exogenous variables ( $t_1$ ). This axis resumes the maximum variance of the model, as in a principal component analysis:

$$t_1 = w_{11}x_1 + \dots + w_{1p}x_p$$

$$\text{where } w_{1j} = \frac{\text{cov}(x_j, y)}{\sqrt{\sum_{j=1}^p \text{cov}^2(x_j, y)}} \quad (2)$$

$x_1 \dots x_p$  are all the modalities of all the characteristics  $X_i$ .

In a second stage, we regressed the price (endogenous variable) over this axis ( $t_1$ ):

$$Y = y_1 + c_1 t_1 + \epsilon' \quad (3)$$

Thus,

$$Y = y_1 + c_1 w_{11}x_1 + \dots + c_1 w_{1p}x_p + \epsilon' \quad (4)$$

Where  $y_1$  is the constant term,  $c_1$  the parameters related to the modalities  $x_i$ , and  $\epsilon'$  the error.

This method does not allow estimating t-Student coefficients to control the level of significance of the variables. Instead, the Variable Importance in the Projection (VIP) statistic was used as proposed by Tenenhaus (1998). As a rule of thumb, we chose the cut-off value at 0.8, as many practitioners usually do.

#### 2.4. Estimation of the model and simulations

Different sets of variables  $X_i$  were tested (see justification below) and each corresponding PLS regression is referred to here as a “model”. The results of three of them – “model 1” to “model 3” – are presented in table 3. Regressions were done using the XLSTAT software package. Once the “best” model had been chosen (model 2, table 3),

we ran simulations. Using the estimated parameters of model 2, we calculated the prices given by the model for different fonio purchases (knowing the market, type, milling degree, colour, origin of the product, profession, age, and education of the buyer, the model gave us the expected price). We chose a reference and then changed one characteristic after another to assess its specific effect on the final price (see table 4).

The estimation's results could be used for a simulation (table 4). For example, a non-professional, uneducated aged woman would buy brown, badly "decorticated" fonio from Mali at the Medina market (market-1) at the price of 351 FCFA/kg. We chose this specific transaction (a coupling of product and buyer characteristics) as a "reference" because: (i) it represents an average realistic combination of attributes that makes sense from an empirical point of view, and (ii) the estimate of the parameter is one of the estimate extremes. For example, the market-1 parameter equals  $-9.55$ , while the other extreme is the parameter of market-5, which equals  $+35.46$ .

Each simulation (sim1 to 9, table 4) consists in calculating the expected price for a slightly different coupling (product/person): sim1, where the market is different; sim2, where the type of fonio is different; etc., until sim9, where the time spent in school is different. When the characteristic had more than two modalities, the simulation was done using the other extreme, for instance, market-5.

In a sense, the difference calculated in the two last lines of table 4, in absolute and relative values, is an estimate of the maximum value of the hedonic price of each characteristic (market in sim1, type in sim2, etc.), while the value of parameters (in model 2, table 3) represents the hedonic price of each modality.

### 3. Results and discussion

#### 3.1. Results of the qualitative survey and description of chosen variables

Table 1 gives the summary statistics of the two quantitative variables of the model. On average, the unit price was 410 FCFA/kg, ranging from a minimum of 250 and a maximum of 650 with a coefficient of variation equal to 17.

The purchased amounts were quite small, as expected. They varied from 0.5 to 100 kg with a median of 2 and a mean of 5.5 kg.

Table 1. Descriptive statistics of quantitative variables

Variable name	Price	Quantity
Definition	Unit price	Purchased amount
Unit	FCFA/Kg	Kg
Number of observations	174	174
Minimum	250	0.5
Maximum	650	100.0
Median	400	2.0
Mean	410	5.5
Standard deviation	69.7	14.3
Variation coefficient (%)	17	262

Table 2 presents the list of the characteristics and their modalities used in the initial regression (model 1, table 3). During the focus groups, all the variables in table 2 were quoted several times as important at one stage or another of the purchase, the processing (including milling, cleaning, washing, and cooking), and the consumption of the cereal. As such, these variables potentially impacted the price of the product. This is the reason why we have kept all of them in a first stage of regression (model 1, table 3).

Among the different attributes, three concerned the quality of the transformation process (fonio "type", level of milling, and cleanliness), three concerned the physical aspect of the grain (size, hardness, and colour), and one its geographical origin (country of production).

During the course of our different interviews, it became clear that the country of origin – as avowed by the seller – was considered by many of the buyers as proxy of the fonio quality. 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 from Guinea was of better quality than that from Mali, mainly because of its cleanliness and good degree of milling. It was difficult to say which was coming first at the interview level since most buyers – except for professionals who usually dealt with larger quantities – displayed a certain amount of confusion about their ability to assess the "good quality" criteria.

The fonio types that appear here refer to how they were named by most stakeholders. It is related to the processed level. Grain in Bamako markets can be milled to various degrees: the operation of milling consists in removing the envelopes of the grain. A first type is the so-called "decorticated". It is a mixture of milled and non-milled grain. The second type is called "whitened" or "milled", during which the entire grain is dehusked. The third type is called "milled and washed": the pip, the bran, and all dust have been removed through a complex treatment with water. The definition of these categories and their boundaries were ambiguous at the end of the first phase of the survey, even if almost all consumers or other stakeholders were able to describe at least one category. This is why we finally included all of them in one single regression and did not split the model into different segments, as we had done in an earlier version (Dury *et al.*, 2007).

Finally, these discussions underlined the differences between people. There was general consensus on some issues, such as the effect of gender: men, except cereal traders, were said to be very incompetent regarding the evaluation of cereal quality in the market, while women were obviously more competent than men. Direct observation as well as interviews told us that the level of competence was quite different according to experience. In the models, we used three variables to capture the experience effect: age, professionalism, and region of birth. A "professional" refers to an individual buying fonio for processing (often cooking) and selling. This activity was usually done on a regular basis, thus these professionals were logically seen as better equipped to assess the fonio quality and negotiate the prices.

Many disputes concerned the role of wealth on the ability to recognize the "good" fonio. Some said rich people just did not care and did not spend time assessing the quality of their fonio purchases because they had servants to clean and prepare it. Others