WILLINGNESS TO PAY FOR PROCESSED GRAINS IN DAKAR SENEGAL: AN ANALYSIS USING DISCRETE CHOICE EXPERIMENTS

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ABSTRACT

WILLINGNESS TO PAY FOR PROCESSED GRAINS IN DAKAR SENEGAL: AN ANALYSIS USING DISCRETE CHOICE EXPERIMENTS

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This article studies consumer preference for processed traditional and non-traditional grains in Dakar, Senegal. While much attention has focused on substitution between traditional and nontraditional grains, less has shown how consumers make tradeoffs among processed products. Using an exit-interview method and two discrete choice experiments, I obtain marginal values of willingness to pay for processed grains. In this paper, I measure willingness to pay for domestically produced millet, maize, rice, and sorghum. I also measure willingness to pay for a second stage processed millet product. The results of this study show that consumers are willing to pay a premium for domestically produced processed grains, both traditional and non-traditional, save sorghum. Consumers are only willing to pay a positive premium for imported rice. The results also suggest that consumers are willing to pay a premium for fresh and bulk second stage processed millet

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Between 2010 and 2016, Senegal's per capita gross national income increased by 18%, one of the highest rates in the region (World Bank 2018). Most of this growth is happening in the capital of Dakar, which is growing at a rate of 4.4% (ibid). In rapidly growing Sub-Saharan African cities like Dakar, the increasing opportunity cost of time is changing the way households buy and prepare food. As incomes and the opportunity cost of time increase, demand for processed foods also increase (Reardon and Timmer 2012). Even poorer households are demanding more convenient forms of food as their time becomes more valuable.

There are three main waves of literature that have focused on the rise of processed foods in developing countries. The early debate developed the theory for household time allocation and studied households' substitution between processed non-traditional grains, mainly rice and wheat, and raw traditional grains, such as millet, processed at home. A need for further understanding of the debate prompted the second wave, which focused on substitution between processed non-traditional grains and first stage processed coarse grains. The recent debate, now focuses on substitution among (a) processed non-traditional grains, (b) first stage processed coarse grains, and (c) the second stage processed coarse grains.

These three main categories of processed grains, using millet as an example, are defined as follows. First, raw millet, refers to harvested, threshed, cleaned and sorted. Millet flour is first stage processed. It has been cleaned and milled. Second stage processed millet refers to the transformation of millet flour into different products. These forms of processed grains are critical to the analysis of the processed food literature. Additionally, inter-grain, refers to the study among various grain types. Intra-grain refers to the study within a specific grain type.

The first wave of the debate focused on substitution between processed non-traditional grains, mainly rice and wheat and coarse grains processed at home. The opportunity cost of time is key to understanding processed food consumption, first incorporated into the literature by Becker in "Theory of the Allocation of Time" (1965). The theory of opportunity cost of time was applied to the developing country context by Thompson and Schuh (1975). The connection between the opportunity cost of time and processed food was found by Senauer, Sahn, and Alderman when they studied rice and wheat consumption in Sri Lanka (1986). The debate was further extended when Kennedy and Reardon determined that poorer households sought more processed rice than wealthier households, in Burkina Faso (1993). These studies show the complexities between rising opportunity cost of time and the demand for processed food. The earlier debate noted that in Asia and Africa, the substitution was between coarse grains that traditionally had not been purchasable in a processed or packaged form and new, non-traditional grains. These coarse grains required more time at home to process and prepare, compared to the new, non-traditional products, mainly rice and wheat. In Burkina Faso, workers ate prepared rice at lunch from street vendors and purchased wheat for at-home consumption due to its shorter preparation time (Reardon, Thiomiano, & Delgado 1989). Consumers' growing demand for convenience inspired a second wave of literature.

The second wave of the literature developed as millet processors began selling processed and packaged millet. First, a three-way substitution debate emerged. Pitted against each other were: (1) processed non-traditional grains, rice and wheat; (2) first stage processed millet; (3) buying raw millet and processing at home. The third option was eventually eliminated in urban areas due to the rise of powered milling machines. In the late 1990's and early 2000's, the literature targeted the rise of imported rice and wheat, and governments pushed the consumption of local

grains and domestic rice production (Demont & Neven 2013). The first stage processed and packaged millet emerged to compete with processed rice and wheat products (Bricas 2008). The demand for processed traditional grains led to the rise of small-scale millet vendors who sold directly in food insecure neighborhoods where incomes were slowing increasing (Bricas 2008). Higher rates of employment and increasing incomes led to the third wave of the literature.

The third and current wave of the literature indicates that grain substitution now includes another element. Consumers substitute between: (1) processed non-traditional grains, such as rice and wheat; (2) first stage processed millet; and now; (3) second stage processed millet. Second stage processed millet refers to any product using transformed millet flour. The first and second stages remain the same but adding this third wave to the debate changes consumers' views of these products. For instance, in Ethiopia, teff, a traditional grain used to prepare second stage products (most commonly a bread called enjera), was found to be consumed by the relatively well-off households and its purchase increases with income (Alem & Söderbom 2018). Moreover, households headed by individuals with better labor market status consumed relatively more teff than those with poor labor market status (ibid).

Lastly, the literature has incorporated different research methods to understand how consumers substitute among food products. Through case studies of micro-enterprises and hypothetical discrete choice experiments, studies have assessed how consumers in developing countries substitute among various foods. Initially, cases studies provided a cost-effective way to understand food preference changes. For example, case studies of small-scale African food producers have shown that consumer demand for processed foods has increased food security and female employment (Bricas 2008). Secondly, discrete choice experiments (DCE) help researchers in developing countries affordably collect unique datasets to interpret these changes. For instance,

in India, urban consumers' preferences for food safety and quality revealed that wealthier, more educated consumers with children prefer safer and higher quality food (Roy et al. 2010). Additionally, DCEs revealed that rural Ugandan banana consumers were, on average, willing to accept GM varieties of bananas (Kikulwe, Birol, Wesseler, & Falk-Zepeda, 2008).

The literature thus far leaves three gaps. The first is the issue of substituting non-traditional grains and traditional processed grains. While studies have looked at the initial substitution issues among traditional and non-traditional grains, few have studied this when incorporating processed traditional grains. The second gap is understanding how consumers substitute among products of the same processed traditional grain. Again, there has been little work into the tradeoffs for processed traditional grains, such as millet. The third gap is a methodological gap of using DCE to determine consumers' willingness to pay for processed grains. DCE have rarely been used to determine the demand for processed food products in a developing country.

This paper contributes to these gaps in the literature in two main ways. First, it contributes findings about how consumers in an urban, developing country context make tradeoffs among processed millet, maize, rice, and sorghum. This is done using discrete choice experiment to find willingness to pay (WTP) values for processed grains. The second contribution is made through studying the new debate about traditional grains like millet. This is achieved using a discrete choice experiment to determine willingness to pay for attributes of a second stage processed millet product called thièré.

The rest of the article proceeds as follows. Section 2 presents the methods used to collect data and the experimental procedures. Section 3 reports the results of the two DCEs and the discussion. The article concludes with Section 4.

2. CONTEXT AND METHODS

As indicated earlier, there are few critical analyses of consumption of processed traditional and non-traditional grains in Africa. In this study, I used a mixed method approach to assess consumers' willingness to pay for processed grains. First, I conducted exit-interviews to gain demographic and purchasing habits. Then, through the use of DCE, I calculate consumers' willingness to pay for different grains. I also used DCE to determine consumers' willingness to pay for second-stage processed millet. The literature suggests that exit interviews have a greater external validity than studies in laboratories due to the priming of prior food purchases (Minten, Reardon & Sutradhar 2010).

This study sampled consumers in Dakar for two reasons. First, Dakar is the largest region in Senegal and the economic and political capital (ANSD, 2018). The food system in the city is changing rapidly as the city is growing at a rate of 4.4% per year (World Bank 2018). Second, with wide distribution of incomes, consumers in Dakar have more diverse consumption patterns than the rest of the population (van't Riet, den Harog, & van Staveren 2001). Dakar also has the various social classes necessary to capture variability among consumers. These reasons indicated that Dakar was the most efficient area to sample consumers.

Lastly, studying consumer preferences among millet varieties is critical for two main reasons. First, while various processed coarse grains are found in Dakar markets, including millet, maize, rice, and sorghum, millet is a widely consumed cereal. There are three main categories of processed millet. First, raw millet, which refers to harvested, threshed, cleaned and sorted. Millet flour is first stage processed. It has been cleaned and milled. Second stage processed millet refers to the transformation of millet flour into different products. The second reason for studying millet specifically is to understand demand for traditional grains with new processing techniques.

Learning how consumers purchase and make tradeoffs among millet-based products is necessary to understanding the larger changes in the food-system.

2.1 DATA

2.1.1 Sample

The sampling framework was set up as follows: First, communes were chosen for sampling areas. Second, retail types were chosen. Third, enumerators sampled respondents at the retail locations. The retail exit survey of 597 consumers was conducted in January and February of 2018.

The survey was collected in 12 communes in Dakar. Commune level population statistics were not available at the time of sampling, so geography experts were consulted to label a commune's density. Dakar's communes were first stratified by population density into four groups: dense, moderately dense, less dense, and not densely populated communes. Three communes were then randomly selected from within each density stratum.

Within each sampled commune, three retail types were sampled: supermarkets, boutiks, and street-vendors. Boutiks are small neighborhood shops, often located on a corner. Street-vendors are generally women who sell cereal products in their neighborhood. Sampling at these three retail locations was necessary in order to capture the variability among consumers. All supermarkets in the Dakar region were sampled due to their limited number. Boutiks and street vendors were sampled using a street-by-street approach to avoid sampling bias. Enumerators first found the most densely populated corner of the commune. They then walked down a street, stopped at a boutik, and sampled the first two customers who had finished shopping. Then, they continued down the street, sampling from every other boutik they encountered until they sampled the required amount of respondents. The same method was used for the street vendor sample. Within each

commune, enumerators started at the same starting point for both the boutik and street-vendor sample.

The questionnaire was structured as follows. First, respondents were asked about household demographics, consumption patterns, and mealtime habits. Second, respondents participated in two DCEs. The first experiment asked respondents to make hypothetical choices among millet, maize, rice, and sorghum as a function of different scenarios of price and production origin. The second experiment asked respondents to make hypothetical choices about a second stage processed millet product called thièré, with different processing techniques and packaging. Third, respondents answered questions regarding their purchase history and product preferences.

The interview and choice experiment were conducted as follows. First, one enumerator approached the first consumer he saw leaving the retail outlet. Then, the enumerator read the questionnaire aloud and filled in the responses on the tablet. Next, the enumerator explained the choice experiment procedure to the respondent and proceeded. The enumerator read the choice tasks aloud for all participants since it was understood that some respondents could not read French. Then, the enumerators concluded the interview with questions about purchase history, again reading the questions aloud and filling in the responses. Purchase history was defined by enumerators as physically making the purchase, not simply consuming. Lastly, the enumerator thanked the participant and either continued with another customer or left for another retail outlet. See Appendix for the questionnaire.

2.1.2 Sample Characteristic

The socio-demographic characteristics of the sample are reported in Table 1. Half of the sample (50%) were male. This is consistent with other consumption studies in the region (Bello & Awudu 2016). The sample is representative of households since the majority of the sample were heads of

their households (44%) or wives (31%). Additionally, two-thirds of respondents (67%) reported being responsible for their family's food purchases. Responsibility for a household's food purchases was defined as physically selecting food at a retail location, not simply financing the purchases. Of the remaining respondents, 20% were adult children of the household head, two percent were domestic workers, and three percent were other family members.

Urban households are generally smaller than rural households. The average household in Dakar has six members, while the national average is eight (ANSD 2014). The sample mean and median household sizes were six and five, respectively, very close to Dakar's average household size. In this study, household per capita weekly food expenditure is used as a proxy for household income. The mean household weekly food expenditure per capita was 12 USD, and the mean total weekly food expenditure was 56 USD per household.

Table 1: Socio-Demographic Characteristics of the Sample, sample size (N=596)

Socio-demographics characteristics	% of total
Male	50
Female	50
Household position relative to household head	
Head of household	44
Married to head of household	31
Adult child	20
Domestic worker	2
Other	3
Highest level of education for all household heads	
None	24
Primary	23
Secondary	26
University	27
Responsible for household food purchasing	67
Mean household size	6
Median household size	5

Table 1 (Cont'd)

Mean per capita household weekly food expenditure	11.27 USD

Note. 1 USD equals 517 FCFA in Jan 2018

Consumers in Dakar frequently purchase millet based products. Table 2 reports respondent-level millet purchasing habits. 45% (N=268) of respondents had personally purchased a millet-based product at the survey sampling location. For example, of those respondents that were sampled at the supermarket, 23% had just purchased a millet based product. Additionally, 100% of street vendor consumers reported purchasing a millet based product as the street vendors sampled only sold millet. To further understand the consumption history of the sample, I expanded the time recall period. Considering that 55% (N=328) of the sample had not purchased a millet based product on the day of the sample, I asked about those respondents for their millet purchase history over the past three months. Of the 55% (N=328) who did not purchase millet the day of, 87% (N=285) had purchased a millet-based product in the past three months. This shows that only 13% of the sample had not purchased millet products recently.

Table 2: Overall Millet Purchasing History (N=596)

Purchased millet-based product at the time of interview	45%
Supermarket	23%
Boutik	12%
Street vendor	100%
Purchased millet-based product in past three months (Excluding day-of customers)	87%

Now I move from the general millet purchasing history to specific data on purchasing history of the second-stage millet product, thièré. Table 3 reports respondents' most recent purchase of thièré. More than half of the sample had purchased thièré in the past week. This is significant finding that suggests that second stage millet is a frequently purchased dish. Despite

this finding and the fact that 87% had purchased a general millet based product in the past three months, as mentioned above, 21% of respondents reported that they had never personally purchased thièré. This can be explained by the fact that, for some, thièré is still prepared and consumed at home. This shows that a gap still exists between those who purchase and those who consume millet-based products.

Table 3 also reports where respondents made their most recent thièré purchase. These findings are consistent with my previous observations in the field. Most consumers purchase their second stage millet products, like thièré, at street vendors with some purchases taking place at supermarkets. Table 3 shows that most respondents purchased their thièré at a street vendor (85%) and some of the sample (13%) purchased their thièré at the supermarket. Very few purchased their thièré at a boutique (1%).

Table 3: Thièré Purchasing Habits (N=596)

Timing of consumer's most recent purchase of Thièré (percent of sample)	
Today	13%
Within Last week	53%
Two weeks ago	4%
Three weeks ago	3%
One month ago	2%
More than one month ago	4%
Never	21%
Location of consumer's most recent purchase of Thièré (percent of sample given past millet purchase)	
Supermarket	13%
Boutique	1%
Street vendor	85%

2.2 SURVEY DESIGN AND EXPERIMENTAL PROCEDURES

2.2.1 Inter and Intra Grain Choice Experiment Designs

I designed two DCEs as follows. In the first experiment, respondents were asked to make choices among four alternatives represented by second-stage processed grains commonly found in Dakar markets: millet, maize, rice, and sorghum. Table 4 outlines the attributes and attribute levels selected for this study. The products were hypothetically offered as 500 grams of grain at various price levels which represent real prices found in the market. The price levels were selected based on my market research at the three sampling locations.

The product origin was included because some grains, like rice, are produced domestically and imported. The literature suggests that imported rice from Asia is preferred to domestically produced rice (Demont 2013). An origin attribute determines consumer preference for imported grains.

Table 4: Coarse Grain Attributes and Levels

Attributes	Levels
Product	Millet, Maize, Rice, Sorghum
Price	Millet (200, 250, 300) Maize (250, 300, 350) Rice (300, 450, 500) Sorghum (300, 450, 500) (FCFA)
Origin	Domestic, Imported

The experimental design was critical to creating choices that elicited consumer preferences. Considering every first-stage processed grain at every combination of prices and product of origin levels, a full factorial labeled design would have resulted in 1,296 (3^4 2^4) choice questions. To reduce the number of questions and thus avoid respondent fatigue, we generated an orthogonal fractional factorial labeled design. In this design, which resulted in six choice questions, the prices

and country of origin levels of each first-stage processed grain are uncorrelated with the prices of each of the other three grains. A no-buy alternative was added to each choice question to mimic a more realistic shopping experience (Caputo et al. 2018). A sample choice experiment question is illustrated in Figure 1.

Figure 1: Sample Inter-Grain Choice Set

Which Product Would You Choose?	
Millet: Imported 400 FCFA	☐
Maize: Domestic 200 FCFA	☐
Rice: Imported 500 FCFA	☐
Sorghum: Domestic 300 FCFA	☐
No buy	☐

The second choice experiment targets preferences within a specific millet-based product, thièré. During the experiment consumers were asked to make choices between two alternative thièré products with differing attribute levels, as reported in Table 5.

Table 5: Second Stage Processed Millet Attributes and Levels

Attributes	Levels
Price	400, 500, 600 (FCFA)
Preparation	Dried, Fresh
Packaging	Bulk, Packaged

Two levels were selected for the preparation “Dried" or "Fresh" and packaging "Bulk" or "Packaged". The two types of preparation were selected to reflect actual product availability. Fresh refers to millet that has been steam cooked and is ready to eat. Dried millet is millet that has been steam cooked and then dried for preservation. Fresh and dried are the only two ways thièré is found in the market. Similarly, the two packaging levels were included after observing how different vendors sell thièré, regardless of the preparation. Bulk refers to millet that is purchased at any quantity. Packaged refers to millet that has been packaged prior to the purchase. It is important to note that all combinations of thièré preparation and packaging levels exist in Dakar. The price levels were determined by finding average prices of thièré, then creating a 100 FCFA minimum price and a 600 FCFA maximum price. The highest and lowest prices found were 750FCFA/500g and 300FCFA/500g, respectively. Most prices were around 450/500 FCFA. Using a difference of 100FCFA between prices reduced the likelihood of the experimental design producing choices that were either obviously appealing or unappealing. Additionally, keeping the prices within 200 FCFA required respondents to seriously consider the other two attributes.

Given these attributes, their levels, and the number of alternatives in each choice task, there were 144 possible total choice questions. To reduce the number of choice questions, I generated an orthogonal optimal in the difference fractional factorial design (Street and Burgess 2007; Van Loo et al. 2014). Overall, during the survey, respondents were faced with six choice questions, each represented by two alternatives for processed and packaged thièré and a no-purchase option, as displayed in Figure 2.

Figure 2: Sample Intra-Grain Choice Set

Which Product Would You Choose?	
Thièré 1: Dried Bulk (400 FCFA)	☐
Thièré 2: Fresh Packaged (600 FCFA)	☐
None of these products	☐

2.3 EMPIRICAL MODEL: THE RANDOM PARAMETER LOGIT

The data were analyzed using random parameter logit (RPL) (Train 2009). The RPL is state of the art in the applied discrete choice literature for many reasons. First, it allows for taste parameters to vary across the population and thus accounts for heterogeneity in consumer preferences (Train 2000). Second, it permits unobserved factors to be correlated over time; random-effects introduced by the panel-nature of the data. In this case, each individual answered six choice questions in both choice experiments. Third, it relaxes the independence of irrelevant alternatives (IIA) assumption (Revelt & Train 1998). Its advantages are also widely documented in the food choice experiment literature (Aprile 2012; Van Loo et al 2011; Ortega et al. 2011).

In the RPL model, the unconditional choice probability can be expressed as follows:

$$P_{ni} = \int L_{ni}(\beta)\ f(\beta) d\beta \quad (1)$$

where L_{ni} (β) is the logit probability evaluated at parameters β and $f(\beta)$ is the density function. Considering a sequence of observed choices by individual *n*, one for each choice task in the assigned sequence of T choice tasks, the logit probability in (1) takes the form:

$$L_{ni}(\beta) = \prod_{t=1}^{T} \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}} \quad (2)$$

where V_{ni} is the observed portion of the utility, which depends on the parameters β. As there is no closed form solution in (1), the probabilities are simulated using Halton draws. Halton draws give a more efficient distribution of draws for numerical integration compared to random draws (Bhat 2003; Train 2009).

The observed portion of the utility, V_{ni}, in (2) varies depending on the experiment. In the experiment among traditional and non-traditional grains, it is as follows:

$$V_{nit} = ASC_{nj} + \alpha PRICE_{njt} + \gamma_{nj} ORIGIN_{njt} \quad (3)$$

where ASC_{nj} are alternative specific constants indicating the different types of *j* grains (e.g., millet, maize, rice, and sorghum). *PRICE is* the *k*th grain's price in alternative *j*. *ORIGIN* is the *k*th grain's origin in alternative *j*, and γ_{nj} represents the effect of the *k*th grains' origin on the utility for the *j*th grains. The price enters in the model as a continuous variable, while the origin is effect coding (e.g. Bech and Gyrd-Hansen 2005 and Louviere et al. 2000). Hence, it is equal to 1 if domestic and -1 if imported. As a result, the estimated alternative specific constants represent the averaged utility attached to each grain as specified in the experiment, while the estimated coefficients for origin indicate deviations from the estimated alternative constants (Molin and Timmermans 2010). Finally, we assume that the coefficients of the origin and alternative-specific constants are independently normally distributed in the population, while the price coefficient is assumed to be fixed in the population.

As for the intra-grain experiment, the observed portion of utility in this choice experiment is:

$$V_{nit} = ASC + \alpha PRICE_{njt} + \beta_{n,pre} PREPARATION_{njt} + \beta_{n,pac} PACKAGING_{njt} \quad (4)$$

where ASC is the alternative specific constant representing the no-buy option. $Price_{njt}$ is the price for a package of 500 grams of second-stage processed millet, thièré*;* $Preparation_{njt}$ is a dummy variable equal to one if the product was prepared "dried" and zero if "fresh". $Packaging_{njt}$ is a dummy variable equal to one if the product was "unpackaged" and zero if "packaged." With the exception of the price coefficient, all coefficients are assumed normally distributed.

In both studies, the estimates derived from the RPL were used to calculate the WTPs. In the inter-grain experiment, we calculated the total amount that each respondent is willing to pay for a specific grain and its domestic/imported origin relative to the no-buy option. For the intra-grain experiment, we calculated the marginal WTP which represents the average premium respondents are willing to pay for fresh and bulk thièré.

3. RESULTS AND DISCUSSION

The data shows that consumers are willing to pay more for domestically produced cereals and grains. The results also show that customers are willing to pay a premium for unpackaged, bulk thièré. Lastly the results suggest that consumers are willing to pay a premium for fresh thièré.

3.1 INTER-GRAIN RESULTS

Table 6 displays the estimates from the RPL model of the inter-grain experiment.

Table 6: Results from Inter-Grain Random Parameters Logit

Variables		Millet	Maize	Rice	Sorghum
Alternative Specific Constants					
	Mean	1.64***	0.01	5.51***	-2.88***
		(5.03) †	(0.03)	(10.20)	(4.64)
	Sd.	3.66***	2.45***	5.46***	1.93***
		(11.91)	(10.30)	(14.51)	(3.48)
Origin					
Domestic (+1); imported (-1)					
	Mean	3.55***	2.48***	1.35***	1.42***
		(12.32)	(11.77)	(9.24)	(4.62)
	Sd.	2.73***	2.38***	1.86***	1.13**
		(12.33)	(9.36)	(10.70)	(2.49)
Price	Mean	-0.003***	-0.003***	-0.003***	-0.003***
		(3.58)	(3.58)	(3.58)	(3.58)
Model statistics					
Log likelihood			-2759.6704		
Number of Choices			3576		
Number of participants			596		
McFadden Pseudo R-squared			0.521		

Note: ***, **, * significance at 1, 5 and 10% level. †Numbers in parenthesis are standard errors

Results indicate that the price coefficient is negative and statistically significant at the 0.01 level. Hence, consistent with the economic theory, higher prices are associated with a lower likelihood

of purchase for both traditional and non-traditional grains. The mean coefficients for millet and rice are positive and statistically significant. On the other hand, the mean coefficient for maize is not statistically significant and the mean coefficient for sorghum is negative and statistically significant.

These results suggest that rice and millet at the most preferred grains, while maize and sorghum trail farther behind. This evidence is consistent with recent consumption trends that also suggest rice and millet are the most popular of the grains included in our studying. In 2017, annual millet consumption in Dakar was 15.3 kg per capita. Average annual rice consumption was 77.9 kg per capita. Annual, per capita maize consumption in Dakar was only 3 kg. Annual sorghum consumption was so low that in 2017 it was reported that only 0.1% of households in Dakar consumed any sorghum. Our results also indicate that the standard deviations of the grains are all statistically significant, suggesting that consumer preferences for different grain-types are heterogeneous.

As previously described, an estimated alternative-specific constant is the main utility derived from that alternative averaged across the levels of the origin variable. Hence, to provide more insights we focus the discussion and interpretation of the results on the relative impact of origin on the selection of the traditional and non-traditional grans.

The coefficients of the origin are all positive and statistically significant, indicating that consumers tend to prefer domestic grains. Other studies have shown that consumers prefer domestic over imported products (Shelicia Forbes-Brown et al. 2016; Chryssochoidis, Krystallis, & Perreas 2007). In addition to the existing literature, this study also shows that consumer preferences for imported versus domestic grains differ among grain type. To illustrate, the estimated coefficient for the effect of the origin attribute on millet is 3.55, while the estimated

coefficient on rice is 1.35. This indicates that the utility of purchasing millet and rice increases by 3.55 and 1.35 if domestic respectively, while it decreases by -3.55 and -1.35 if imported respectively.

These results are justified in two ways. First, millet sold in Dakar is almost certainly sourced by Senegalese producers, therefore consumers might not consider imported millet to be worth any additional amount of money. Moreover, many households in Dakar have a familial connection to agricultural households in the rest of the country. Thus, consumers might consider that purchasing local millet is supporting the country as well as family. Second, local rice consumption might follow similar logic. Our results suggest that consumers are willing to pay for domestic rice. This finding contributes to the literature that consumers prefer local rice (Demont, 2013). For the reasons mentioned above, as well as increased effort by the government to support domestic rice production, consumers might feel that by consuming local rice they are supporting the goal to reduce dependence on imported rice.

Table 7 reports the total mean WTP value for each of the first stage processed coarse grains, both domestic and imported.

Table 7: Total Willingness to Pay for the First Stage Processed Coarse Grains (500g)

Grains	Total WTP (in FCFA)	
	Domestic	**Imported**
Millet	1737*** (412) †	-642** (277)
Maize	827*** (166)	-834** (337)
Rice	2262*** (516)	1361*** (274)
Sorghum	-489* (266)	-1436*** (541)

Note: ***, **, * significance at 1, 5 and 10% level. †Numbers in parenthesis are standard errors

The results indicate that consumers are willing to pay the highest price for domestic rice (2262 FCFA). Interestingly, rice also represents the only imported grain for which consumers exhibited a positive willingness to pay (1361 FCA). This finding mirrors the current market where imported rice makes up a substantial proportion of purchased rice in Dakar. Domestically produced millet is the second most preferred grain, with a total WTP of 1737 (FCFA). Total WTP for imported millet, maize, and sorghum are negative which suggests that consumers would need to be compensated in order to consume these imported grains. Additionally, even domestic sorghum is not preferred by consumers with the only negative domestic total WTP.

Lastly, the total WTP values also indicate that the preferences are heterogeneous across grains. Domestic rice is nearly 20% more preferred than even domestic millet. However, due to the reasons mentioned above, millet still has a higher relative willingness to pay value than maize, Domestic maize, despite having a positive and statistically significant total WTP value, is still 50% less desirable than domestic millet. Consumers are willing to pay a statistically significant premium for domestically produced grains, even though the preferences vary across grain types.

These findings could have implications for Senegal's urban food demand and food policy. Due to high imports of rice, the government of Senegal is pushing for rice import substitution (Demont & Rizzoto 2012). Senegalese rice production is growing to meet the demand for local rice. However, due to marketing and scale issues, imported rice remains cheaper than local rice (ibid). My results suggest that consumers in Dakar are willing to pay a positive premium for local rice. Therefore, the government of Senegal could continue to support local rice production as well as the post farm-gate value chain. Moreover, consumers are willing to pay for local millet as well so investing in similar improvements to the millet value chain would also benefit millet consumers.

Tables 8 and 9 report mean total willingness to pay values for each grain produced domestically and imported among different consumer groups. Consumer groups are defined based on various sample characteristics including gender, level of food expenditure per capita, frequency of millet purchases, and where the respondent was sampled, among others. The statistical significance of differences in WTP across consumer groups are tested using t-tests assuming unequal group variances.

Table 8: Willingness to Pay for Grains Produced Domestically by Sample Demographics

Variable	Obs	Millet	Maize	Rice	Sorghum
Gender					
Male	278	2094	986	2483	-629
Female	316	2078	922	2614	-566
Low vs Mid and High Food Expenditure (Per Capita)					
Low	402	2136	911*	2638	-613
Mid and High	194	1982	1034	2389	-560
Low vs Mid Food Expenditure (Per Capita)					
Low	194	1982	1034	2389	-560
Mid	201	2155	869	2742	-603
Mid vs. High Food Expenditure (Per Capita)					
Mid	201	2155	869	2742	-603
High	200	2112	955	2532	-622
Low vs High Food Expenditure (Per Capita)					
Low	194	1982	1034	2389	-560
High	200	2112	955	2532	-622
Bought Millet Today (Per Capita)					
Yes	323	2087	960	2471	-560***
No	272	2081	942	2658	-638
Supermarket versus boutique sample location					
Supermarket	197	223**	883	2154***	-609**
Boutique	198	1971	1020	2688	-524
Supermarket versus street sample location					
Supermarket	197	2239	883	2154***	-609
Street	200	2043	951	2823	-653
Boutique versus street sample location					
Boutique	198	1971	1020	2688	-524***
Street	200	2043	951	2823	-653
Household head versus other					
Head	335	2065	917	2609	-570**
Other	260	2109	996	2489	-629

Table 8 (Cont'd)

Wife versus other					
Wife	188	2195	956	2682	-609
Other	407	2033	950	2499	-589
Household head versus wife					
Head	260	2109	996	2489	-629
Wife	188	2195	956	2682	-609
Household head has at least a primary school education versus lower than primary					
>= Primary	450	2147	914	2573	-600
< Primary	145	1888	1069	2505	-583
Household head has at least a secondary school education versus lower than secondary					
>=Secondary	314	2114	861***	2429*	-614
< Secondary	281	2050	1053	2700	-575
Household head has a university education					
University	160	1972	921	2179***	-636
< University	436	2127	962	2695	-581
Household has six or more members					
>= 6	284	2120	960	2389	-574
< 6	311	2052	944	2709	-616

Note: Means of a two-sample t-test with unequal variances. *=.10, **=.05, ***=.01

Table 9: Willingness to Pay for Imported Grains by Sample Demographics

Variable	Obs	Millet	Maize	Rice	Sorghum
Gender					
Male	278	-765	-1029	1250**	-1726**
Female	316	-698	-1006	1648	-1677
Low vs Mid and High Food Expenditure (Per Capita)					
Low	194	-854*	-1102***	1217**	-1689
Mid and High	402	-672	-976	1582	-1705
Low vs Mid Food Expenditure (Per Capita)					
Low	194	-854*	-1102*	1217***	-1689
Mid	201	-626	-1018	1764	-1709
Mid vs. High Food Expenditure (Per Capita)					
Mid	201	-626	-1018	1764*	-1709
High	200	-714	-933	1408	-1701
Low vs High Food Expenditure (Per Capita)					
Low	194	-854	-1102***	1217	-1689
High	200	-714	-933	1408	-1701
Buy Millet Today					
Yes	323	-688	-978*	1426	-1676**
No	272	-780	-1063	1513	-1728
Responsible for Food Purchase					
Yes	400	-731	-992	1521	-1709

Table 9 (Cont'd)

No	195	1892	1004	2305	-551
Share of household member who ate breakfast at home yesterday					
100%	232	-818	-1042	1158***	-1712
<100%	363	-674	-1000	1663	-1692
Share of household member who ate lunch at home yesterday					
100%	377	-696	-1017	1617**	-1698
<100%	218	-789	-1016	1205	-1703
Share of household member who ate dinner at home yesterday					
100%	536	-723	-1014	1575***	-1699
<100%	59	-795	-1039	478	-1704
Supermarket versus boutique sample location					
Supermarket	197	-596	-874***	1288	-1667
Boutique	198	-754	-1101	1517	-1687
Supermarket versus street sample location					
Supermarket	197	-596**	-874***	1288	-1667***
Street	200	-838	-1074	1591	-1745
Boutique versus street sample location					
Boutique	198	-754	-1101	1517	-1687***
Street	200	-838	-1074	1591	-1745
Household head versus other					
Head	335	-683	-998	1652***	-1677**
Other	260	-791	-1041	1226	-1729
Wife versus other					
Wife	188	-630	-926**	1749**	-1702
Other	407	-776	-1059	1335	-1699
Household head versus wife					
Head	260	-791	-1041*	1226***	-1729
Wife	188	-630	-926	1749	-1702
Household head has at least a primary school education versus lower than primary					
>= Primary	450*	-654**	-998	1529	-1698
< Primary	145	-966	-1074	1269	-1704
Household head has at least a secondary school education versus lower than secondary					
>=Secondary	314	-645*	-965**	1441	-1700
< Secondary	281	-825	-1075	1494	-1700
Household head has a university education					
University	160	-722	-869***	1376	-1692
< University	436	-735	-1072	1495	-1703
Household has six or more members					
>= 6	284	-815	-1075	1352	-1693
< 6	311	-653	-963	1570	-1706

Note: Means of a two-sample t-test with unequal variances. *=.10, **=.05, ***=.01

We first focus our discussion on differences in willingness to pay for grains produced domestically across groups, reported in Table 8. The key finding from Table 8 is that preferences for all domestically produced grains are not statistically significantly different across income groups. This indicates that preferences for domestic grains are relatively homogenous across incomes (per capita household weekly food expenditure is a proxy for income). Moreover, this suggests that for consumers in Dakar, domestic grains, both traditional and non-traditional, are normal goods. The only exception is domestically produced maize. The statistically significant result shows that lower income households are willing to pay less for domestic maize than mid or high income households, at the 10% level.

Next, Table 9 reports total WTP values for imported grains across groups. The same groups were used in Table 8 and Table 9. The key finding in Table 9 is that, relative to domestic grains, there are more statistically significant differences between income groups across imported grain types. For example, low income consumers are willing to pay less than mid and high income households for imported millet, maize, and rice. This is an important finding because it suggests that imported millet, maize, and rice are not inferior goods. The positive WTP values for imported rice allows me to suggest that imported rice is at least a normal good. This is consistent with much of the literature surrounding rice consumption (Demont 2013). I cannot suggest that millet and maize are normal goods because the total WTP values are still negative and statistically significant.

3.2 INTRA-GRAIN RESULTS

Estimates from the RPL are presented in Table 10.

Table 10: Results from Intra-Grain Random Parameters Logit

Variables	Coefficients	Estimates
Preparation (dried (+1); fresh (0)		
	Mean	-26.66***
		(4.67)
	Standard Deviation	38.17 ***
		(4.87)
Packaging (bulk (+1); packaged (0)		
	Mean	19.82***
		(4.47)
	Standard Deviation	34.99***
		(5.36)
Price	Mean	-0.002***
		(2.31)
NOBUY	Mean	-2.45
		(5.59)

Model Statistics	
Log likelihood	-1620.926
Number of Choices	3582
Number of participants	597
McFadden Pseudo R-squared	0.5880986

Note: ***, **, *significance at 1, 5 and 10% level. †Number in parenthesis are |t-stats|

The estimated means for all attributes are statistically significant, and the signs are as expected. For instance, the price coefficient is negative and statistically significant, indicating that as price increases, consumers demand less. The alternative specific constant indicates that the no buy option is also negative and statistically significant, suggesting that our sampled consumers preferred one of the product profiles as compared to the no-buy option. The coefficient for the bulk packaging attribute is positive and statistically significant, while the coefficient of preparation is negative and statistically significant. This indicates that consumers' utilities increase when thièré is fresh and unpackaged (bulk). The estimated standard deviations of the preparation and

packaging attributes are also statistically significant, indicating that consumer preferences for those attributes are heterogeneous. The estimated means and standard deviations of these coefficients provide information on the share of the population that places positive values on each of those attributes and the share that places negative values (Train 2009). In this case, for example, the distribution of the packaging coefficient obtained an estimated mean of 19.82 and estimated standard deviation of 34.99, such that 71% of the distribution is above zero and 29 % is below. In other words, about 71% of our sampled consumers prefer bulk thièré, and about 29 percent prefer unpackaged thièré. Similarly, the results indicate that 24% of the sampled population prefer dried, while the vast majority, 76% prefer fresh.

Table 11 presents marginal willingness to pay values for dried and bulk thièré.

Table 11: Willingness to Pay for Second Stage Processed Millet Thièré (500g)

Marginal WTPs	**Mean (in FCFA)**
Preparation (Dried)	-13273.8
Packaging (Bulk)	9866.04

As household sizes are quite large (average six members), meals are likely produced in large quantities. Thus, for ease of preparation, most food may be purchased fresh. The results also indicate that households prefer to purchase fresh thièré in bulk. By buying in bulk, consumers are in control of the quantity purchased, compared to a prepackaged product. Additionally, consumers are more accustomed to purchasing bulk. A fresh and bulk product provides convenience through easily prepared second-stage millet based product in quantities that households demand.

Table 12: Willingness to Pay for Thièré by Sample Demographics

Variable	Observations	Mean Willingness to Pay for **Dried** Preparation	Mean Willingness to Pay for **Bulk**
Gender			
Man	278	-5491	1685
Woman	316	-4578	2813
Low vs Mid Weekly Food Expenditure (Per Capita)			
Low	194	-4623	2062
Mid	201	-4236	3057
Mid vs High Weekly Food Expenditure (Per Capita)			
Mid	201	-4236**	3057
High	200	-6099	1621
High vs Low Weekly Food Expenditure (Per Capita)			
High	200	-6099	1621
Low	194	-4623	2062
Bought Millet Today			
No	323	-4793	1327
Yes	272	-5221	3346
Bought Millet Past Three Months			
No	40	-5441	2564
Yes	283	-4701	1876
Responsible for Food Purchase			
No	195	-5057	573
Yes	400	-4955	3067
Share of household member who ate breakfast at home yesterday			
100%	363	-4619	1753
<100%	232	-5567	3028
Share of household member who ate lunch at home yesterday			
100%	377	-4932	1815
<100%	218	-5087	3002
Share of household member who ate dinner at home yesterday			
100%	536	-4786	2180
<100%	59	-6828	2884
Supermarket versus boutique sample location			
Supermarket	197	-5219	1405
Boutique	198	-4400	1262

Table 12(Cont'd)

Supermarket versus street sample location			
Supermarket	197	-5219	1405
Street	200	-5344	4060
Boutique versus street sample location			
Boutique	198	-4400	1262
Street	200	-5344	4060
Household head versus other			
Head	260	-5387	1948
Other	335	-4679	2484
Wife versus other			
Wife	188	-4331	3755
Other	407	-5292	1555
Household head versus wife			
Head	260	-5387	1948
Wife	188	-4331	3755
Household head has at least a primary school education versus lower than primary			
>/= Primary	450	-5169	2285
< Primary	145	-4427	2141
Household head has at least a secondary school education versus lower than secondary			
>/=Secondary	314	-5307	1802
< Secondary	281	-4633	2750
Household head has a university education			
University	160	-5420	1186
< University	436	-4826	2686
Household has six or more members			
>/= 6	284	-4591	2378
< 6	311	-5351	2133

Table 12 compares the WTP values between demographic groups. Groups were determined by natural breaks in the data. For example, gender was separated by male and female while "share of household members who ate millet for breakfast" was separated by households where all members ate breakfast at home versus households where at least one member ate breakfast away from home. Comparing low and middle weekly per capita food expenditure households, shows

that there is not a statistically significant difference in mean WTP between the two for dried thièré or for buying thièré in bulk. Comparing mid and high incomes is there only grouping that shows a statistically significant different between preferences for fresh millet. Middle income household dislike dried thièré less than middle income households.

This is understandable because these households are more likely to be prefer buying first stage processed millet and prepare thièré at home instead of purchasing it from a processor. Also, respondents who purchased a millet-based product on the day of the interview are willing to pay a statistically significant premium for bulk thièré. This is most likely due to the fact that a majority of the people who purchased their millet product today were sampled at the street vendor location Street vendors often sell their products unpackaged meaning that these consumers are accustomed to purchasing their products in bulk. The marginal willingness to pay value is also positive and statistically significant for all respondents who had purchased a millet-based product within three months of the interview. These results suggest that consumers prefer fresh thièré and they prefer bulk thièré.

The implications of these findings are already observed in the market. Consumers overwhelmingly prefer unpackaged and fresh thièré. Supermarkets understand that consumers prefer to purchase only the quantity needed as indicated by the rise of bulk bins in supermarkets and selling fresh (frozen and packaged) thièré in Dakar.

4. CONCLUSION

In this study, I use two choice experiments to analyze consumer preferences for various grains and a second-stage processed millet product, thièré, in Dakar, Senegal. My results show three main points. First, consumers in Dakar are willing to pay a premium for domestically produced grain, in the order of; domestic rice, millet, maize, sorghum. Second, consumers are not willing to pay for imported millet, maize, or sorghum. They are however willing to pay for imported rice. Third, consumers are willing to pay a premium for fresh and unpackaged thièré.

First, customers are willing to pay a premium for domestically produced cereals. A positive coefficient for domestic products does support previous literature suggesting that consumers make tradeoffs among traditional and non-traditional grains (Kennedy & Reardon 1994). Additionally, poorer households have a positive and statistically significant preference for millet than other households.

Second, consumers are only willing to pay a statistically significant premium for imported rice compared to imported millet, maize, or sorghum. Moreover, consumers are heterogeneous in their willingness to pay for various grains depending on their income level. Poorer households are willing to pay statistically significantly less for imported rice than richer households. This adds to the existing literature on rice consumption by providing WTP values by income level.

Third, consumers are willing to pay a premium for fresh and bulk second-stage millet, thièré. Conventional wisdom suggests that consumers demand packaged food since western consumers associate packaged foods with convenience. However, I find that fresh and bulk attributes may represent another form of convenience for a household in Dakar. First, households find it convenient to buy in bulk because it allows them to purchase exactly the quantity they demand. Additionally, packaged millet products (for both fresh and dried) are a relatively recent

phenomenon. Therefore, the sample might be more accustomed to purchasing in bulk and thus report that they prefer it. Finally, households may prefer buying fresh because it frees up time cooking the second stage millet.

These findings culminate to suggest that consumption habits are complex. Consumers are willing to pay a statistically significant premium for domestically produced grains, even though the preferences vary across grain types. Demand for traditional grains is being over taken by non-traditional grains, like rice. Understanding the nuances and complexities of the food system is critical to supporting the future transformation of food systems in growing cities, like Dakar.

The future of work on food systems and the rise of processed foods in developing countries consider two main points, hypothetical bias and food system monitoring. First, the hypothetical bias surrounding discrete choice experiments in developing countries This paper shows that hypothetical bias in discrete choice modelling can report values that are simply too high. I found extremely high values of willingness to pay for processed products. Future work in the discrete choice modeling literature will need to address and control for these high value. I suggest finding geographically and culturally specific ways to avoid hypothetical biases. Second, continued reporting on trends in rapidly changing food systems, like Dakar, are critical to keeping a pulse on demand for processed foods.

As shock waves of rising incomes and access to technology continue, researchers should investigate behavior changes surrounding the food system and their outcomes. These behavior changes increasingly include packaged foods, food delivery systems, and online marketing of food products. Only future research will tell what outcomes are to be expected.

APPENDIX

Questionnaire: Consumption of Millet Based Product
January 30 2018

You are being asked to participate in a research study of urban millet consumption patterns. You will first be asked general questions regarding your household. The next section is a recall of your consumption patterns from the day before. You will then be asked to make hypothetical choices about food consumption options. You will not have to give your name or the name of family members. You will not have to divulge any personal financial information. You must be at least 18 years old to participate in this research.

Participation in this research questionnaire is completely voluntary. You have the right to say no, or withdraw at any time. You will not be compensated for this research project. This project will take approximately 20 minutes to complete.

If you have concerns or questions about this study, such as scientific issues, or to report an injury, please contact the researchers (Sarah Chase-Walsh +221 782938251 or Anta Ngom +221 772024672). If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at +1-517-355-2180, Fax +1-517-432-4503, or e-mail irb@msu.edu or mail to 4000 Collins Rd, Suite 136, Lansing, MI 48910.

You indicate your voluntary agreement to participate by completing and returning this survey by clicking on the button below, you indicate your voluntary agreement to participate in this online survey.

Instructions
The respondents will be informed that this survey is anonymous and no individual information will be taken. The survey is composed of four parts. Part A consists of general questions. Part B is a series of questions concerning the purchase of food and the current behavior of purchases of processed millet products. Part C consists of questions to evaluate the hypothetical choices of participants among millet-based products. Part D deals with recent purchases and preferences.

Part A

General Questions

1. Neighborhood _____ Town_____ Date_____

2. Type of vendor or enterprise?
1=Corner store, 2=Woman selling on corner, 3=Supermarket, 4=Fastfood shop 5=Wetmarket

3. Did you buy a millet based product today?
1=Yes 2= No

4 Have you purchased a millet based product in the past three months?
1=Yes 2=No

5. Are you responsible for food purchases in your household?
1=Yes 2=No

6. What is your position in the household?
1= Head of household 2.Spouse 3 Child 4 House-keeper

7. How many members are in the household Children Adults

8. What is the highest level of education received by the head of the household?

9. Respondent Gender
1=Male 2=Female

Part B

Breakfast

1. What did your household eat for breakfast yesterday?
CODES 1= Rice, 2=Bread, 3=Millet 4= Sorghum

2. Did your family eat together yesterday?
CODES 1= Yes 2= No

3. How many children ate breakfast with the adults ?

4. What breakfast prepared in the house or purchased outside of the home?
CODES 1= Prepared at home, 2= purchased outside of the home

5. If you purchased a millet based product was it… (continue to chart)

Made at home?	Purchased ready to eat										Purchased as an intermediate product									
	Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location 1=Corner store, 2=Street vendor, 3=Supermarket, 4=Fast food, 5=Market	Type of enterprise1=Small 2=Medium 3=Large	Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location 1=Corner store, 2=Street vendor, 3=Supermarket, 4=Fast food, 5=Market	Type of enterprise
	Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place		Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place	
Thiakry																				
Thiéré Ngalakh																				

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6.Did anyone in the household eat anything else for breakfast **inside** the home ?

Who	Which product? (1=Thiakry 2= Thièré 3=Ngalakh 4=Fonde 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor, 4=Purchased at supermarket 5= Market)
Husband		
Spouse		
Children		
Other		

7. Did anyone in the household eat anything else for breakfast **outside** the home

Who	Which product (1=Thiakry 2= Thiere 3=Ngalakh 4=Fondé 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor, 4=Purchased at supermarket 5= Market
Husband		
Spouse		
Children		
Other		

Lunch

1. What did your household eat for lunch yesterday?
CODES 1= Rice, 2=Bread, 3=Millet 4= Sorghum

2. Did your family eat together yesterday?
CODES 1= Yes 2= No

3. How many children ate lunch with the adults ?

4. What dinner prepared in the house or purchased outside of the home?
CODES 1= Prepared at home, 2= purchased outside of the home

5. If you purchased a millet based product was it… (continue to chart)

	Made at home?	Purchased ready to eat?										Purchased as an intermediate product									
		Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location1 =Corner store, 2=Street vendor, 3=Supermarket, 4=Fastfood 5=Market		Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location1 =Corner store, 2=Street vendor, 3=Supermarket, 4=Fastfood 5=Market	
		Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place	Type of enterprise	Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place	Type of enterprise
Thiakry																					
Thièré Ngalakh																					
Fondé Lakh																					

6.Did anyone in the household eat anything else for lunch **inside** the home ?

Who	Which product? (1=Thiakry 2= Thièré 3=Ngalakh 4=Fonde 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor, 4=Purchased at supermarket 5= Market)
Husband		
Spouse		
Children		
Other		

7. Did anyone in the household eat anything else for lunch **outside** the home

Who	Which product (1=Thiakry 2= Thiere 3=Ngalakh 4=Fondé 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor, 4=Purchased at supermarket 5= Market
Husband		
Spouse		
Children		
Other		

Dinner

1. What did your household eat for dinner yesterday?
CODES 1= Rice, 2=Bread, 3=Millet 4= Sorghum

2. Did your family eat together yesterday?
CODES 1= Yes 2= No

3. How many children ate dinner with the adults ?

4. What dinner prepared in the house or purchased outside of the home?
CODES 1= Prepared at home, 2= purchased outside of the home

5. If you purchased a millet based product was it… (continue to chart)

Made at home ?	Purchased ready to eat?										Purchased as an intermediate product									
	Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location 1=Corner store, 2=Street vendor, 3=Supermarket, 4=Fast food, 5=Market		Freshly packaged		Fresh and unpackaged		Packaged and dried		Unpackaged and dried		Purchase location 1=Corner store, 2=Street vendor, 3=Supermarket, 4=Fast food, 5=Market	
	Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place	Type of enterprise	Unit	Price	Unit	Price	Unit	Price	Unit	Price	Place	Type of enterprise
Thiakry																				
Thiéré																				
Ngalakh																				
Fondé																				
Lakh																				

6.Did anyone in the household eat anything else for lunch **inside** the home ?

Who	Which product? (1=Thiakry 2= Thiéré 3=Ngalakh 4=Fonde 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor,

		4=Purchased at supermarket 5= Market)
Husband		
Spouse		
Children		
Other		

7. Did anyone in the household eat anything else for lunch **outside** the home

Qui	Which product (1=Thiakry 2= Thiere 3=Ngalakh 4=Fondé 5=Lakh Sankel)	Where was it purchased (1=prepared in the house, 2= Purchased at corner store, 3=Purchase from street vendor, 4=Purchased at supermarket 5= Market
Husband		
Spouse		
Children		
Other		

Choice Experiment Section

Choice Experiment 1.
Imports vs. Domestic products

1. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Senegal: (400)	Imported: (300)	Imported (500)	Imported (400)	

2. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Imported: (500)	Imported: (250)	Imported (600)	Senegal (300)	

3. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Imported: (400)	Senegal: (500)	Imported (500)	Senegal (500)	

4. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Senegal: (400)	Senegal: (300)	Senegal (300)	Imported (300)	

5. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Senegal (400)	Imported: (500)	Imported (500)	Senegal (400)	

6. Which product would you buy?

Millet	Maize	Rice	Sorghum	No Buy
Senegal (300)	Imported: (309)	Senegal- (500)	Imported (500)	

Choice Experiment 2
Imports vs. Domestic products

1. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Fresh Packaged (500)	Dried unpackaged (300)	

2. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Fresh Packaged (350)	Fresh unpackaged (350)	

3. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Fresh unpackaged (500)	Dried packaged (300)	

4. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Dried Packaged (300)	Dried unpackaged (300)	

5. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Dried unpackaged (500)	Dried unpackaged (300)	

6. Which product would you buy?

Thièré 1	Thièré 2	No Buy
Fresh Packaged (400)	Dried unpackaged (300)	

Part D. Recent purchase history and shopping preferences

1.Roughly, what is your weekly budget for food purchases? (In FCFA) ?

	2. When was the last time you purchased… ?	3. Where did you buy it…? 1=Corner store, 2=Street vendor, 3=Supermarket, 4=Fast food 5=Market	4. Why did you choose this vendor? 1 = Best price 2 = Best quality 3 = Food safety 4 = For convenience
Thiakry			
Thièré			
Ngalakh			
Fondé			
Lakh			

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