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Assessing Rice Consumers' Preferences and Willingness to Pay in Haiti

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Assessing Rice Consumers' Preferences and Willingness to Pay in Haiti

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by

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ABSTRACT

In the last 30 years, rice has become the number one food staple in Haiti, and rice imports have outpaced domestic production to supply the country's increasing rice demand. Policy makers support the claim that increasing local rice supply will not only reduce the dependency on imported rice but also upheave the national economy. However, there is a lack of information on Haitian consumers' preferences for rice to aid the development of the local rice supply chain. This research aims to bridge that gap by assessing Haitian consumer preferences and willingness to pay for selected rice quality characteristics. The results from a hypothetical choice experiment conducted in Haiti suggest that Haitian consumers value domestic rice more than imported rice but are indifferent about presence of broken rice in the sample. The information treatment about parboiled rice has a positive impact on consumers' willingness to pay (WTP). As expected, WTP for parboiled rice is on average statistically greater among the respondents in the treatment group than for those in the control group. The results highlight the importance of developing marketing information about parboiled rice and the domestic origin of the rice sold in the market as a way to improve the competitiveness of domestic relative to imported rice. Although the results suggest that consumers are indifferent about the presence of broken rice in the sample, further quality assessments are needed to assess the role of certain rice quality attributes that can guide investment in more modern processing technologies.

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Chapter 1 - Introduction

Food insecurity is a long-standing problem in Haiti. In 2014, 70% of the Haitian population was food insecure, and without changes in policies, 60% will likely remain food insecure in 2024 (Rosen, Meade, Fuglie, & Rada, 2014). According to Food and Agriculture Organization of the United Nations (FAO, 1996), food insecurity has four dimensions, none of which relates to the origin of the food products (e.g., imported versus domestic). The definition emphasizes food availability from both local production and net trade combined; the economic capacity to have access to it; the capacity, skills, or knowledge to use it in a way that it supplies the required energy for a human being; and, the capacity to sustain all those traits over time.

Although the number of undernourished people in Haiti has decreased over the last 25 years (Figure 1), the prevalence of undernourishment remains high at 46.8% for the period 2014 – 2016 (FAO, 2018). In fact, many associate the problem of food insecurity in Haiti to its increasing import dependency. Furthermore, climate change seems to be another factor that has the potential to worsen the situation of food insecurity in Haiti. According to a joint report elaborated by the World Food Program (WFP) and CNSA[1] (2016), the food insecurity observed in Haiti during 2015 was attributed to a drought that undermined the local production. The report states 72% of the households they interviewed have lost more than 80% of their agricultural production for the fall season of 2015. Considering that 45% of them relied on agriculture to generate income, this situation has aggravated their food insecurity.

[1] CNSA: "Coordination Nationale de la Sécurité Alimentaire"

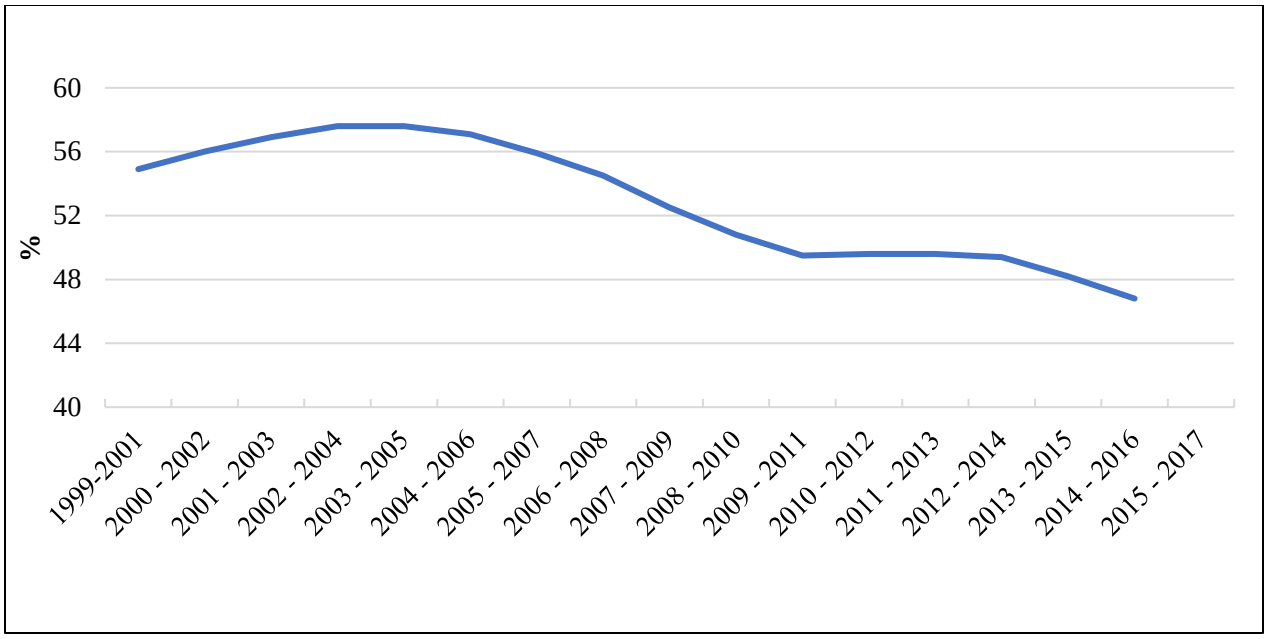


Figure 1. Haiti: Prevalence of undernourishment (%) - 3-year average (FAO, 2018)

Many defend the point that food sovereignty is essential to eradicate food insecurity in the country. While there are many definitions of what the term food sovereignty stands for, there is at least a common ground that those definitions refer to political right of every country to produce their own food (Patel, 2009).

As previously mentioned, the country has gradually relied more on agricultural imports (see figure 2). Although this tendency started in the 1970s, Figure 2 shows that it got worse during the 1980s when Haiti implemented trade liberalization promoted by the International Monetary Fund (IMF). The increase in agricultural imports coincided also with a low growth of the economy (Figure 3). The gross domestic product (GDP) plummeted in the early 1980s averaging a negative 0.9% of growth from 1980 to 1994. The average growth of Haiti between 1980 and 2017 was just 0.77% (calculation from data of IMF, 2018).

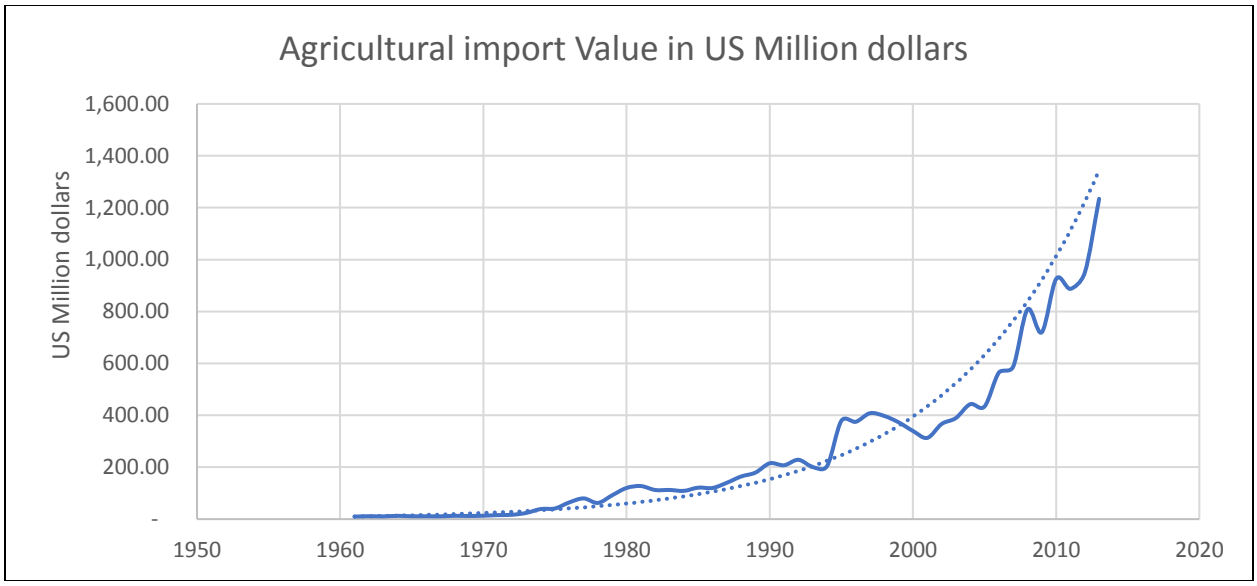


Figure 2. Agricultural Imports for Haiti in US $ million (Nominal US dollars) (FAO, 2018)

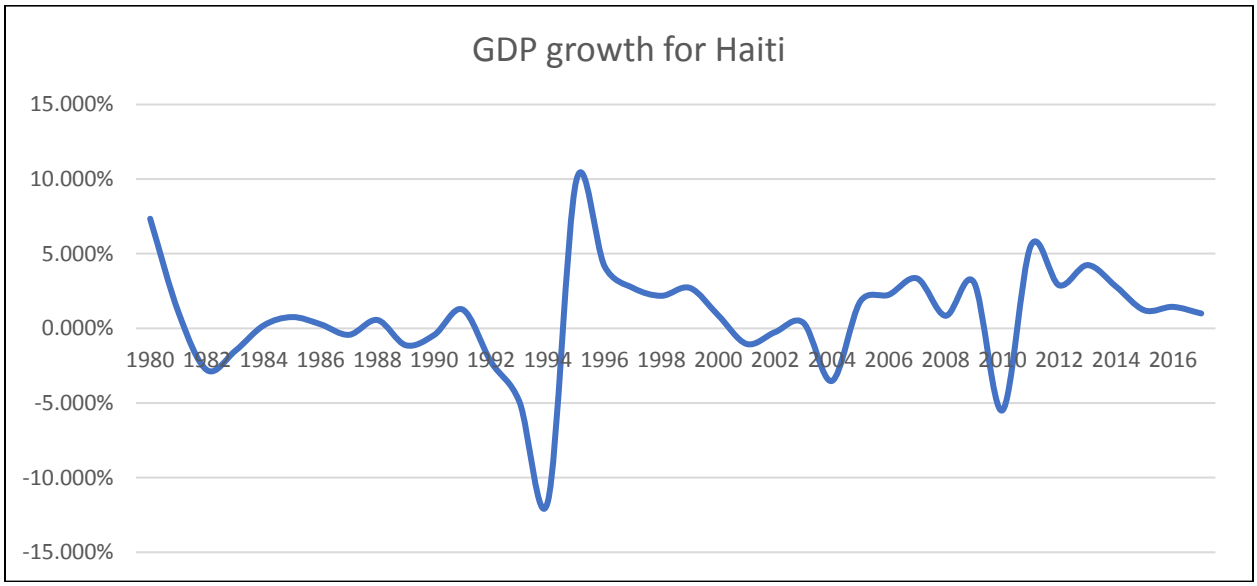


Figure 3. Evolution of the GDP of Haiti in percentage (IMF, 2018)

The slow economic growth and high population growth led to a decline in per-capita GDP and an increase in poverty. The average GDP per capita in Haiti between 1980 and 2017 was just USD $1837.67 (constant 2011 USD), relative to USD $11659.74 for Latin America. According to

IMF (2018), in 2010[2], the year that the 7.3-magnitude earthquake hit Port-au-Prince in January, the GDP per capita of Haiti was USD $1501.98, which is equivalent to $4.72 a day. Even considering the highest GDP per capita of Haiti (USD $2507.41) that was in 1980, corresponding to just USD $6.87 a day. Such economic conditions make it clear that the Haitian population have barely enough to have access to food on a daily basis.

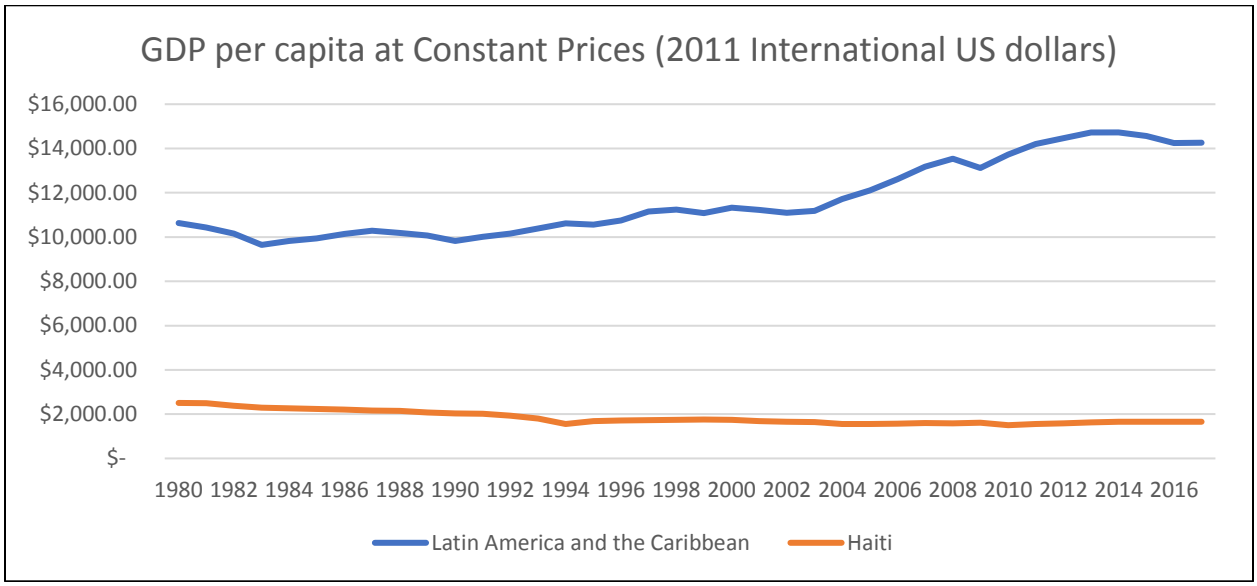


Figure 4. Comparison of GDP per Capita between the Latin America and the Caribbean and Haiti (IMF, 2018)

To eradicate food insecurity, the focus of the Haitian government and many international aid organizations has been on increasing the national production. The Haitian government, in collaboration with international organizations such as USAID, the Inter-American Development Bank (IDB), and WFP have developed agricultural policies aimed at increasing productivity, improving harvest techniques and post-harvest marketing process to ensure food availability, introducing new rice production techniques, developing value chains, and investing in irrigation

[2] The GDP per capita in the text refers to GDP per capita at Constant prices (2011 US dollar).

and flood control infrastructure. These interventions are expected to have substantial positive impacts on food security given that more than 48% of the population is rural.

The current state of the rice sector in Haiti

Rice production

According to the MARNDR (2016), domestic rice production accounts for around 17% of Haiti's total rice supply. Domestic rice production has remained stagnant during the 1980s and 1990s but has shown promising growth since the 2007 global rice crisis (Figure 5). The trend in the acreage has increased relatively more than the production. Indeed, the average rice harvested area went from just 37 thousand hectares (ha) between 1961 and 1974 to 49 thousand ha between 1974 and 1987. Between 2003 and 2016, the average rice harvested area was 56 thousand ha (FAO, 2018[3]). On the other hand, rice yields in Haiti remain steady and are low by international standards. In the last decade, rice yields in Haiti averaged 1.7 metric tons of milled rice, relative to 3.6 and 3.5 metric tons for the Caribbean and Central American regions, respectively (USDA PSD, 2018).

[3] Calculated from FAO data (see fig 8)

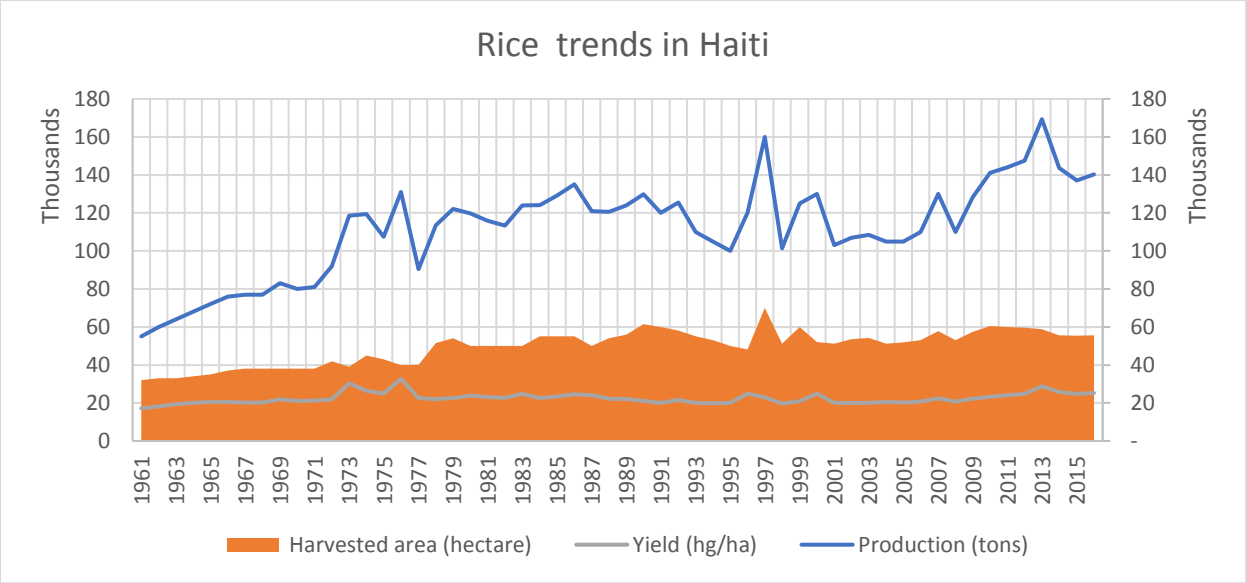


Figure 5 - Rice production trend in Haiti (FAO, 2018)

This low productivity is explained by many reasons such as lack of credit, low education to the farmers, expensive fertilizers, natural disasters (droughts), and lack of adequate irrigation (MARNDR, 2016). Rice is produced during 3 seasons (campaigns) in Haiti: spring, fall, and winter seasons (Table 1). Spring, also referred to as the main crop, accounts for most of the rice production. The Artibonite Valley accounts for most of the rice production in Haiti (Figure 6).

Table 1. Seasons to plant and harvest rice in Haiti

Season	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March
Spring	P	P		H	H								
Fall						P			H				
Winter										P			H

Source: MARNDR, 2016

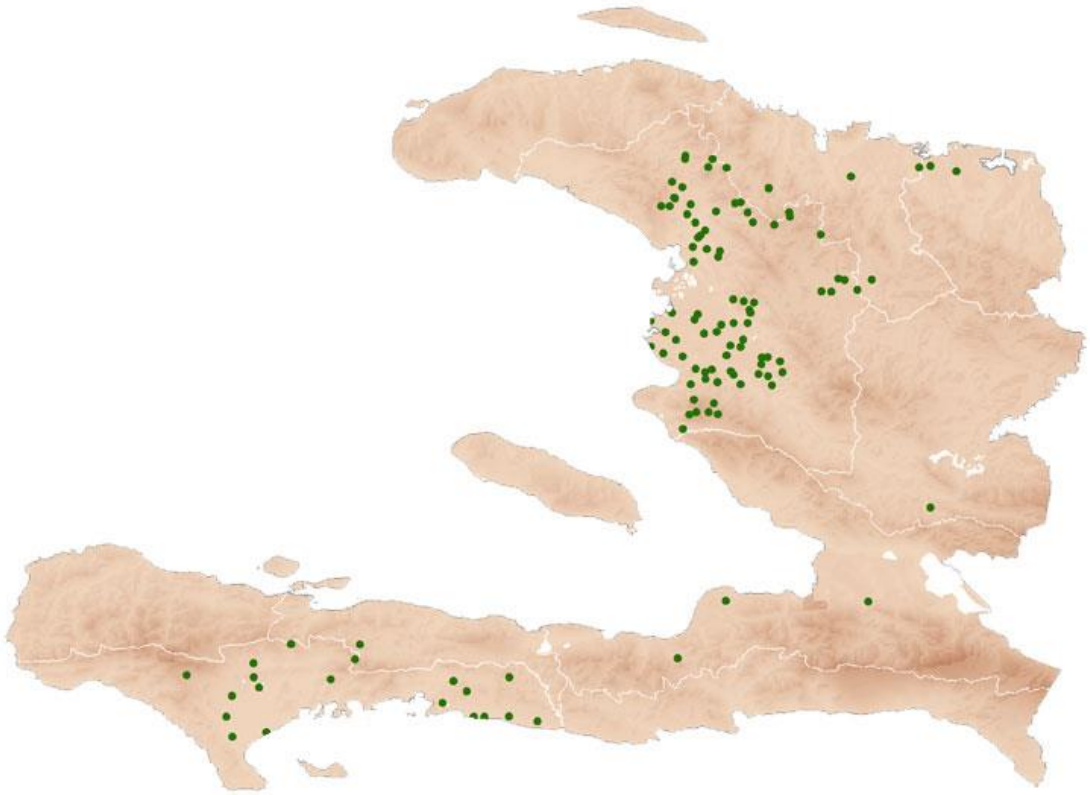


Figure 6. - Zones of Rice Production in Haiti (IRRI Ricepedia[4])

Rice Consumption

Rice consumption increased significantly following the trade liberalization promoted by the World Trade Organization (WTO) and IMF in the late 1980s. Rice consumption in Haiti was small before the 1980s, and Haiti was self-sufficient in rice (Cochrane et al., 2016). Rice consumption and demand increased sharply after Haiti opened its rice market in 1986. According to FAO (2018), the contribution of rice to the caloric intake of a Haitian consumer increased from 5% in 1961, 8% in 1974, 19% in 1990, and 27% in 2013 (Figure 7).

[4] Each dot represents 500 hectares

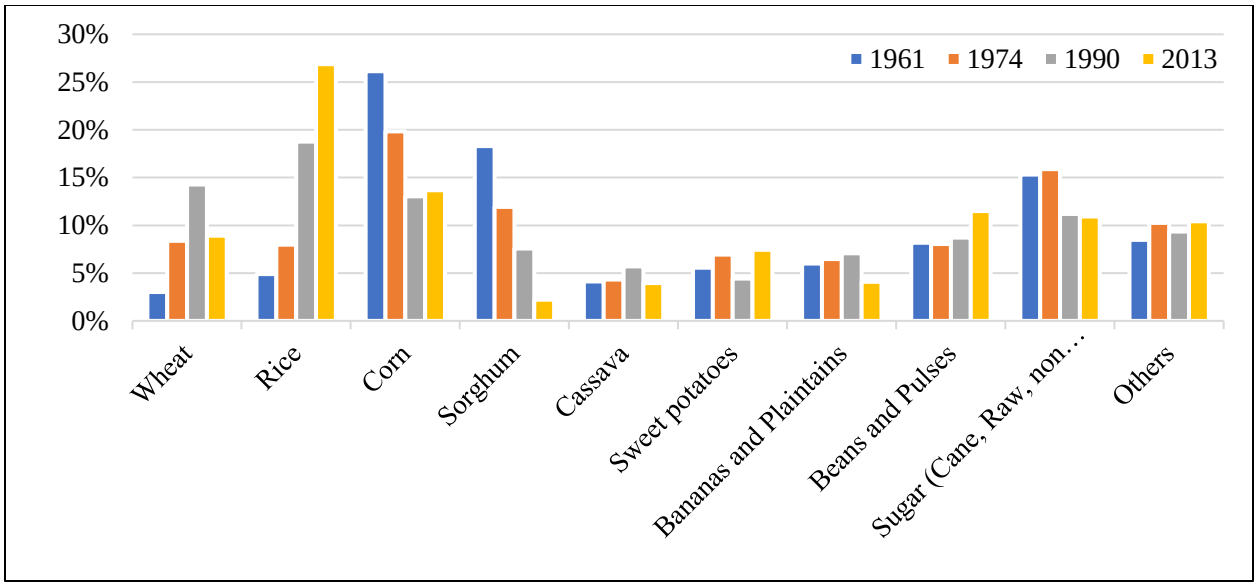


Figure 7. Share of caloric intakes from the staple's food (FAO, 2018)

The importance of rice as a source of calories can be explained by the increase in rice supply per capita (Figure 8). From 1961 to 1982, rice supply per capita almost doubled, moving from 8.17 kg per capita to 15.08 kg per capita, respectively. The upward trend in per-capita rice supply accelerated thereafter, reaching 42.75 kg per capita in 2013.

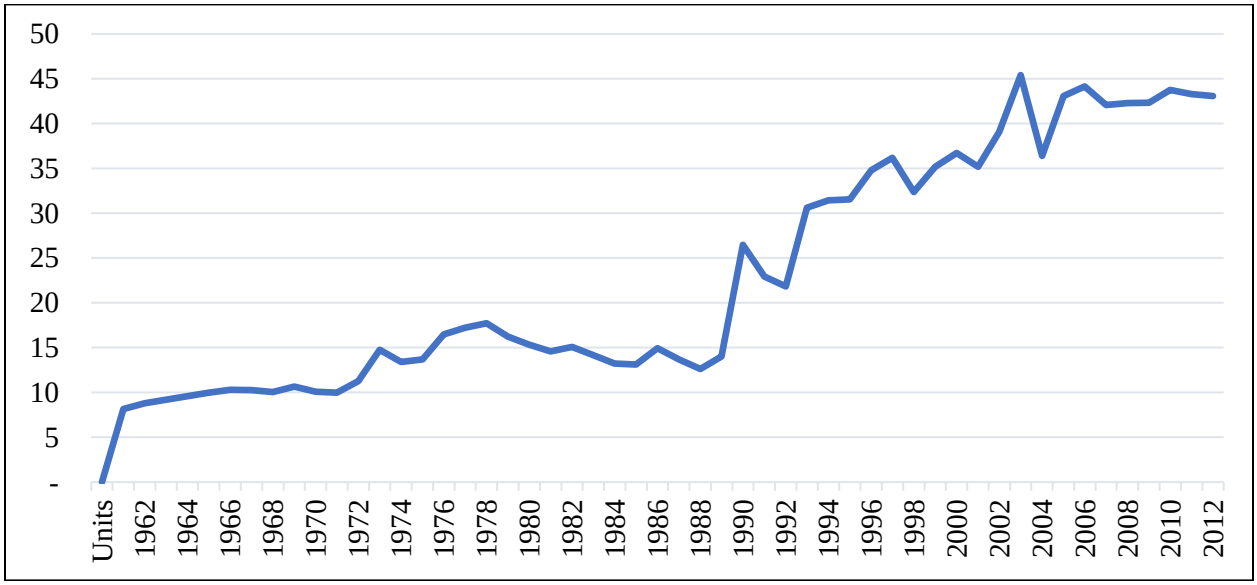


Figure 8. Evolution of the Rice Supply in Haiti (KG/capita) (FAO, 2017)

Rice imports

As rice emerged as the main commodity in the Haitian diet, rice imports become more prevalent (Figure 9). Rice imports grew from an average of 33 thousand tons in 1985-1990 to more than 389,000 tons in 2008-2013, and account for over 80 percent of Haiti's total rice supply (MARNDR, 2016). The United States is the main rice supplier to Haiti, accounting for over 80 percent of the total Haitian rice imports. The U.S. exports almost 10% of its rice production to Haiti, making it its second largest market for long grain rice after Mexico (Cochrane et al., 2016). Vietnam is the second largest supplier of rice to Haiti.

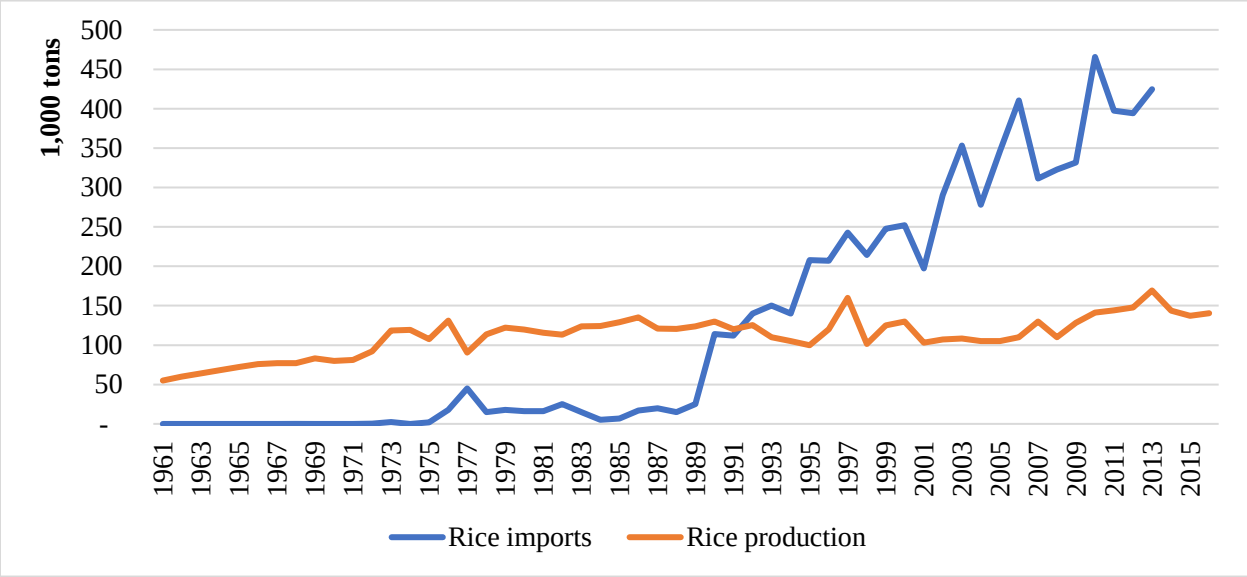


Figure 9. Evolution of rice imports and production in Haiti (FAO, 2018)

Rice Market

The data released by FAO (2018) showed that the rice supply (domestic production plus imports) in 2013 was as much as 5 times higher than what it was in 1961 (Figure 9). In terms of prices, domestic rice tends to be more expensive then imported rice (see fig 8). According to Cochrane et al (2016), the most known varieties are the "TCS-10", "Sheila", and "Madan Gougousse"

where the last two are parboiled rice. Imported rice from the United States is non-parboiled. The parboiled rice is rice that is" partially boiled" in the husk, and because of the boiling process, parboiled rice is a better source of fiber, calcium, potassium and vitamin B-6 than the regular white rice (USDA, 2017).

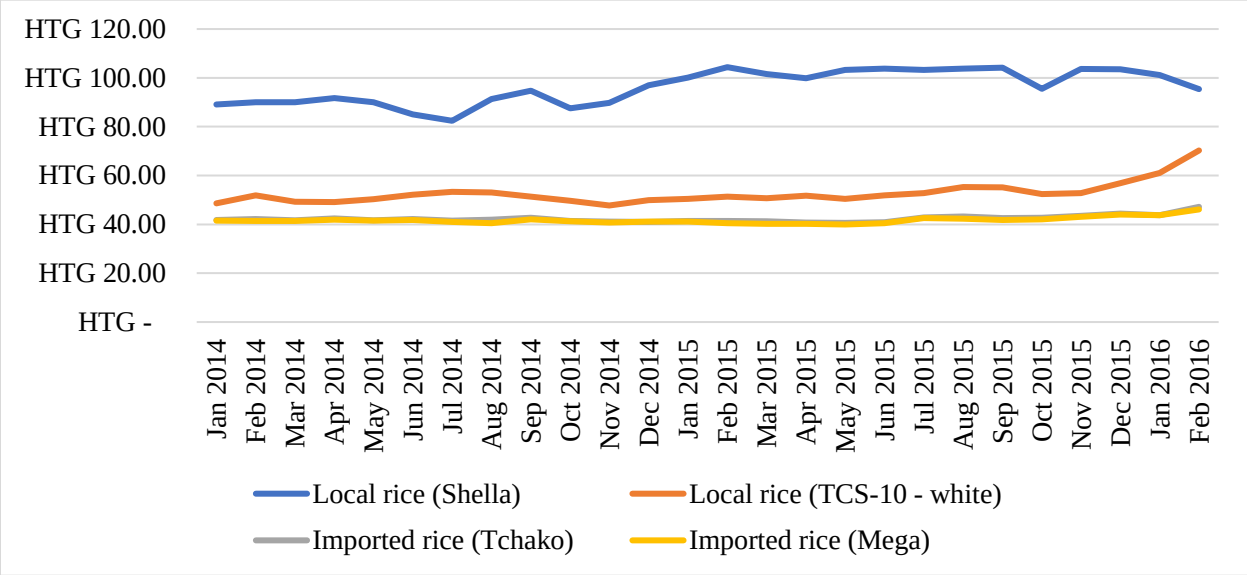


Figure 10. Trend in retail price of rice (MARNDR, 2017)

The brands Sheila and TCS-10 are locally produced rice, while Tchako and Mega are imported rice from the United States.

Rice Policy Options

The increasing importance of rice in the Haitian diet shapes the Haitian agricultural policy landscape and debate. Haitian officials, International Organizations and even foreign governments have worked together to tackle the food insecurity issue in Haiti. Consequently, many decisions have been made and policies implemented.

The generation of price incentives via import tariffs has been one of the ways proposed to improve domestic production. According to WTO (2018), Haiti relied on high import tariffs of

50% to protect its domestic market before the trade liberalization of the 1980s, but since then has lowered the level of protection significantly (it administers a 5% import tariff since 2016). This is a low level of protection relative to other Caribbean countries such as the Dominican Republic and Cuba, which administer a 20% and 15% import tariff on milled rice in 2016, respectively (WTO, 2018). Investment in agricultural infrastructure is another route to increase rice supply. It is perceived as a good solution to be paired with higher import tariffs. Given the significant price gap between imported and domestic rice, how far should the tariffs go up to turn the population toward the local rice? In fact, from January 1994 to February 2016, the average price of the two most popular locally produced rice varieties were more than two times the average price of the two most popular imported rice varieties in Haiti (MARNDR, 2017).

According to Furche (2013), the Ministry of Agriculture of Haiti needs specific technical skills to manage and implement the agricultural programs and recommends that the government invests in a deep capacity building program at the institutional level for the Ministry of Agriculture. Considering that most Haitian rice farmers are using dated production practices, Furche (2013) suggests that investment be made in agricultural infrastructure and human capital to foster productivity growth. Having in mind the financial and technical supports from organizations such as the IDB and USAID, many actions have been taken to improve the agricultural production level in Haiti, and particularly for rice production. Those institutions have conducted research to look for the main bottlenecks of the agricultural sector. They have been hiring consultants to discover potential solutions for empowering Haitian farmers. In the case of rice, support to farmers has been unsuccessful to enhance the expected results during the last 40 years (Wilcock & Jean-Pierre, 2012).

Objectives

The Haitian Government and other non-governmental organizations are vocal about supporting local rice farmers to boost domestic rice production and ameliorate food insecurity. One way to increase the competitiveness of the domestic rice supply chain is to consider the needs of consumers in the formulation of strategies to increase domestic production. For instance, knowing the rice attributes that matter to Haitian consumers and the ones they prefer can help rice breeders develop varieties that match consumer preferences. However, little is known about the rice attributes that Haitian consumers value the most. This paper aims to fill the gap in the literature regarding consumer preferences for rice quality attributes in Haiti. The objective of this research is to assess consumer preferences for rice in Haiti. In particular, we assess the consumer valuation for selected rice attributes: retail price; the percentage of broken grains in the bag; the rice origin; and the parboiling state of the rice (parboiled or not).

Hypothesis

The first hypothesis is that information about parboiled rice has a positive effect on consumer choices for parboiled rice. Given the nature of the information treatment, this hypothesis also means that Haitian consumers are conscious about their health.

The second hypothesis to be tested is that, everything else equal, Haitian consumers prefer domestic over imported rice. Although US imported rice accounts for 80% in the rice supply in Haiti, it is of interest to know whether this dominance is due to price competitiveness or quality attributes.

The third hypothesis is that Haitian consumers favor rice with low presence of broken, and therefore offer a premium for low percentage of broken rice.

Literature review

Rice (Oryza sativa L.) is the staple food for more than half of the world's population, with the majority located in rapidly growing low-income countries (Maclean et al., 2013). Around 90% of global rice is produced in Asia. Rice is mainly produced for domestic consumption and only around 7% of total rice production is traded internationally. Rice exports are highly concentrated, with five countries (India, Thailand, Vietnam, Pakistan, and the United States) accounting for over 90% of total rice exports (Dorosh and Wailes, 2010). The thinly traded nature of the global rice market makes it very vulnerable to supply shocks in the main exporting countries. For instance, the implementation of a rice export ban by India, Vietnam, and Cambodia in 2007 caused a rice price spike that led to an additional 105 million people being pushed into poverty (World Bank, 2013). The global rice market is also very vulnerable to production disruptions in relevant importing countries. For example, in the 2017/18 rice season, Bangladesh experienced significant production losses due to a combination of floods and localized pest problems, which led to a 50-percent price increase in the domestic market and an expansion of rice imports of around one million metric tons (USDA, 2017). Considering the prevalence of rice consumption across the globe, many researchers have elicited rice consumers' preferences in several countries. Conducting such task had led them to question the rice attributes that consumers value the most and how much they are willing to pay for those attributes.

Quality attributes can be classified in many ways. One classification groups the attributes into "intrinsic attributes" such as taste, color, texture, and length, and "extrinsic attributes" such as price, packaging, and brand (Cuevas, Pede, McKinley, Velarde & Demont, 2016). For example, price, packaging, and label are extrinsic attributes that are easy to identify by the consumer and influence its decision to purchase. On the other hand, consumer's evaluation of intrinsic

attributes such as taste, ease of cooking, and texture can be assessed only after consuming the rice product (Cuevas et al., 2016). Another classification distinguishes between search, experience, and credence attributes. Visual characteristics of rice grains, such as size, cleanliness, and presence of broken rice, are examples of search attributes. Experience attributes, such as cooking or organoleptic characteristics, influence the consumer's decision to continue acquiring the good or not. Credence attributes (organic production, fair-trade, origin of production) are those that the consumers cannot evaluate or verify themselves. Therefore, they rely on the third parties such as producer organizations or the government to verify the claims (Cuevas et al., 2016).

Many researches focus on the search and experience attributes since they are either visible to the consumer or experienced by him (Adair, Beachel, Jodon, Johnton, Thysel, Green, et al., 1966; Graham, 2002; Tomlins, Manful, Gayin, Kudjawu, Tamakloe, 2007).

Review of rice consumer preferences

Africa is one particular place where many researches have been conducted on preferences for rice attributes, and it has been found that the prevalent accepted search attributes for rice are quite different depending on the place. Five main rice types are predominant in the West and Central Africa: long grain white rice, broken rice, parboiled rice, aromatic rice, and round grain (Rutsaert, Demont & Verbeke, 2013). According to Tomlins, Manful, Larwer, and Hammond (2004) US imported rice is most generally preferred in three locations in Ghana: Upper East, Accra and Kumasi. In the Tamale metropolis in Ghana, rice aroma and its origin are the main factors influencing people's behavior when purchasing rice (Anang, Adjetey, Abiriwe, 2011). In

Brunei, age influences the preferences for local and imported rice where younger individuals value imported rice more than local but elders prefer local rice (Galawat & Yabe, 2010).

In the Philippines, income is not a factor that influences consumers' choice to purchase long grains (Cuevas et al., 2016). In Turkey, people prefer local rice but purchase US rice since it is less expensive than the domestic rice and price is the main factor that influences their choice when purchasing (Azabagaoglu &Gaytancioglu, 2009). On the contrary, preferences for local rice is divided in Ghana with men preferring local rice and women preferring imported raw and parboiled rice (Tomlins et al., 2004). However, Senegalese consumers prefer non-parboiled broken rice and are more influenced by experience attributes such as taste, ease of cooking (Fall, Gningue, Ndir, & Ndour, 2007). In Benin, where rice is parboiled, its consumption has considerably increased the last 50 years; local consumers have developed preference for imported rice based on the fact that they perceive its quality to be superior to domestic rice (Demont, Zossou, Rutsaert, Ndour, Mele & Verbeke, 2011).

The perception of rice attributes is not the only trait that varies from one place to another. People's willingness to pay for a product also depends on demographic factors. As an example, it has been found in China that positive opinion about Genetically Modified (GM) rice and willingness to pay (WTP) for GM rice are positively correlated, while the elderly people are more reluctant to pay a higher premium for GM rice (Cluskey & Loureiro, 2003). Demont et al., (2011) aimed to study the impact of providing information about an innovative way to parboil rice on the Beninese WTP for local rice. They found that Beninese consumers are willing to pay a premium for the improved parboiling technology while 91% of the sample preferred parboiled rice to non-parboiled rice. A study in Senegal about willingness to pay and willingness to

upgrade from a non-fragrant[5] rice to a fragrant rice (Diagne, Demont & Ndour, 2017) has showed that the simple visual characteristics of both fragrant and non-fragrant 100 percent broken rice have sufficed to make 74% of the consumers in Dakar want to upgrade to the fragrant rice. Furthermore, they are willing to pay a 20% price premium for the upgrade. However, after tasting the fragrant and non-fragrant rice samples, only 50% of the consumers were willing to upgrade (Diagne et al., 2017). On the other hand, the urban consumers are not willing to pay any premium to upgrade from a 100 per cent broken rice to any other superior quality 100 per cent broken rice (Demont, Rutsaert, Ndour, Verbeke, Seck & Tollens, 2012).

The literature review shows the importance of knowing about consumers' preferences and WTP for rice attributes such as locally produced rice, GM rice, and parboiled rice. This study is motivated by the fact that little is known about Haitian preferences and WTP for rice.

[5] Fragrance rice: type of Basmati and Jasmine rice with a specific aroma. For further details on fragrant rice, see (Ganoupoulos, Argiriou & Tsaftaris, 2011)

Chapter 2: Materials and Methods

Many methods are available to elicit consumer preferences for goods and services. Stated Preference (SP) and Revealed Preference (RP) methods are the most common methods to do so. The RP method relies on consumer preferences revealed through purchasing habits, while SP involve asking individuals questions that can be used to infer economic values. SP methods present an advantage to RP in the sense that they allow the researcher to elicit preferences for a good or a service that is not available in the market yet (Brownstone, Bunch & Train, 2000). Furthermore, given that the consumers' behavior is studied in real market situations in the RP mode, there is risk of a lack of variations across the good or service attributes. Multi-attribute SP methods allow for the evaluation of multiple attributes simultaneously. Another potential advantage of SP over RP relates to the fitness of the RP data both in terms of time (e.g., time-series RP analysis may not be suited to analyze a particular event that happen in a given time) and aggregation. A well-designed CE can help overcome these limitations (Lusk and Tonsor, 2016).

One of the advantages of RP over SP is the availability of historical RP data that allows to use RP methods ex-post. Moreover, RP allows capturing the respondents' behavior in real market situations, and thus reduces potential problems with hypothetical biases of certain SP approaches such as contingent valuation and hypothetical choice experiments. Non-hypothetical SP methods, such as non-hypothetical choice experiments, help reduce the impact of hypothetical bias.

State Preferences Methods: Contingent valuation and Multi- Attribute Valuation

According to Merino-Castello (2003), there are two categories of SP methods: Contingent Valuation (CV) and the Multi-Attribute Valuation (MAV), (Figure 11). MAV allows researchers

to elicit consumers' preferences for more than one attribute while the CV allows to elicit preferences for one attribute. Furthermore, CV does not allow to measure trade-offs across variation in the attribute's levels.

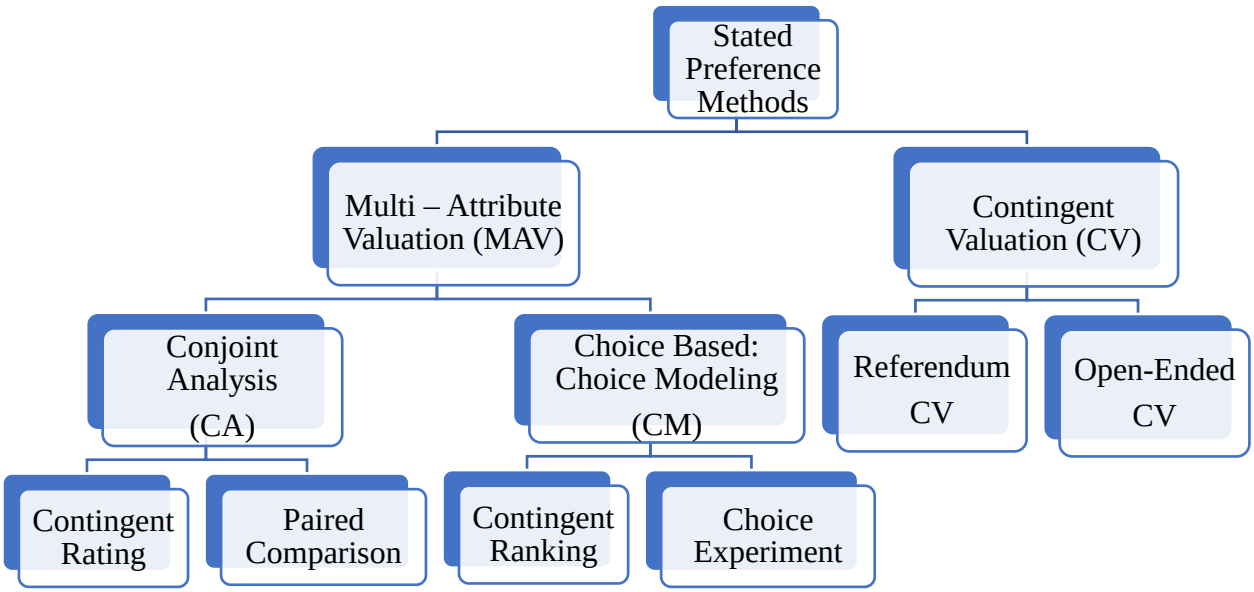


Figure 11. Classification of the State Preference Methods (Merino-Castello, 2003)

The MAV methods can be classified into preference-based approaches (also known as Conjoint Analysis or CA) and choice-based approaches (known as Choice Modeling or CM).

CA has its origins in psychology and evolved out of the theory of "Conjoint Measurement", which is purely mathematical and concerned with the behavior of number systems, not the behavior of humans or human preferences. Therefore, Conjoint Measurement theory (and therefore CA) is inconsistent with economic demand theory (Louviere, Flynn, & Carson, 2010). On the other hand, CM is consistent with economic demand theory in a way that it directly measures human behavior through their preferences for different attributes. CA is an attempt to elicit human behavior through numbers that a human has assigned to some product attributes for ranking purposes, whereas CM directly examines human behavior. Another limitation of CA is

that it is not possible to measure the respondents' economic values for the attributes, which is exactly what CM is good at. CM allows to measure the economic values that the respondents associate to every attribute.

The objective of this study, namely to assess consumer preferences for multiple rice quality attributes, and the limitations of the CA methodology described above, narrows the methodology to the family of CMs, namely: Contingent Ranking and Choice Experiment.

The Contingent Ranking asks the respondents to rank the options according to their preferences, while Choice Experiment (CE) asks respondents to choose their most preferred option. CE is strongly rooted in the Random Utility Theory (RUT). CE also allows researcher to measure the relative utility weights for the different product qualities called attributes. Doing so, the researchers can determine the trade-off from varying the attribute levels (Merino-Castello, 2003).

This paper uses a hypothetical CE to elicit consumers' preferences for selected rice quality attributes in Haiti.

Hypothetical CE may suffer from hypothetical bias (Murphy, Allen, Stevens, & Weatherhead, 2005). Since the respondents' choices imply no economic consequences, they tend to overstate their willingness to pay (Carlsson & Martinsson, 2001; Lusk and Schroeder, 2004; Carpenter & Harrison, 2004; Murphy et al., 2005). In this study, I follow the literature and use cheap talk to control for the potential hypothetical bias (Cummings and Taylor, 1999; Lusk, 2003; Loureiro, Gracia & Nayga, 2006). Cheap talk consists of informing respondents about the potential hypothesis bias that may happen while revealing their stated preferences. Given this known bias, they are asked to act as if they were in a real market situation (Ladenburg, Dahlgaard, & Bonnichsen, 2011).

Experimental Design

The respondents were provided with seven (7) choice sets of three (3) unlabeled alternatives. For each choice set, respondents were asked to choose between a "no-buy" option and two types of rice that differ in terms of the retail price, the percentage of broken rice, the parboiling state, and the rice origin (Figure 12). Table 2 shows the set of attributes and attribute levels used in this study.

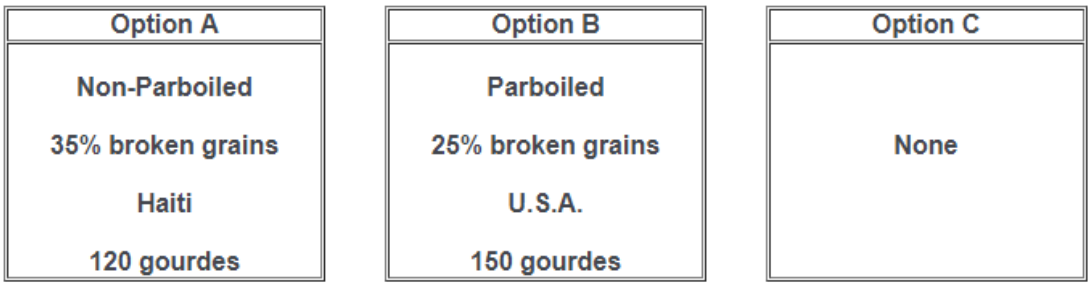


Figure 12. Example of a choice set used in this study

Table 2. Attributes and attributes levels

Attribute	**Level**
Retail price (HTG/5 pounds = 2.27 kg)	HTG 210, HTG180, HTG 150, HTG 120
Percentage of Broken	5%, 15%, 25%, 35%
Parboiled	Yes (Parboiled)
	No (Non-Parboiled)
Origin	United – States (USA)
	Haiti

The attribute "Price" has four levels (HTG210, HTG180, HTG150, and HTG120). Those retail prices for a 5-pound bag are based on the prices observed in February 2016 and inflated in August 2017 (Inflation Index = 315.30, in August 2017 and 258.7 in February 2016).

Given the significance of imported rice from the United States, and the narrative about substituting imported rice to domestic rice, origin has two levels (USA and Haiti).

The percentage of broken kernels is considered as one of the properties to base the rice quality (Dalen, 2003). The United States export rice with 4% of broken rice to Haiti. The assumption that has been made is that the US imported rice arrives in Haiti in 5% to 10% due transportation issues. According an interview that I have with the President of RACPABA, a cooperative of farmers in Haiti, the milling industry produces rice with between 25% and 35% of broken kernels. Given the significant difference between 25% and 5%, a mid-point has been added (15% of broken grains).

Imported rice from the United States is non-parboiled rice while domestic rice is mostly parboiled. According to Wilcock and Jean-Pierre (2012), the process of parboiling rice increases the parboiled production cost. There is a non-parboiled variety produced in Haiti, the TCS-10; however, the parboiled rice looks to be more appreciated (Cochrane et al., 2017). Parboiled is then included as one quality attribute as well as an information treatment in the CE. Knowing the relative utility weight of substituting a non-parboiled to a parboiled rice is important for policymaking. Based on many discussions with consumers, it appears that they do not know any differences between parboiled and non-parboiled rice other than the aspects like the color and the aroma. Therefore, it seemed important to measure if there would be any treatment effect if the consumers were more informed about this difference.

Given the fact that it took a relative long time to complete the survey and that HTG 3000 were offered to the respondents, it was necessary to know if the respondents were attentive while taking the survey. Therefore, trap questions were used to measure the respondents' attention

(Malone & Lusk, 2017). The trap questions method aims to identify respondent inattention (Oppenheimer, Meyvis, and Davidenko, 2009). In many cases, the inattention may be due because the respondent values the attributes differently, causing him to pay attention more or less to some attributes (Cameron, & DeShazo, 2010). In both cases, whether the respondents are indifferent to one or several attributes, or simply they have a strong preference for one attribute, there is still an attention bias that needs to be considered (Hole, 2012).

Trap choice questions were inserted randomly in the survey. The design of the trap choice questions was identical to the choice sets except that two rice options that were identical in all attributes and attribute levels except for price. Under the assumption of utility maximization, attentive respondents will choose the option with the lowest price or the no buy option if rice is not chosen in that choice set. The trap has been associated with the attribute price based on the fact that consumers' attention is most likely driven by salient attributes such as quality and price (Bordalo, Gennaioli, & Shleifer, 2013). Figure 13 below shows an example of a trap choice question.

Option A	Option B	Option C
Parboiled	Parboiled	
5% broken grains	5% broken grains	None
U.S.A.	U.S.A	
180 gourdes	185 gourdes	

Figure 13. – Example of a trap question used in this study

The literature is unclear on how to treat responses that fail the trap questions. Removing the respondents who have failed the trap questions is the best option to more accurate estimates (Oppenheimer et al., 2009). Indeed, inattention in survey research has been found to have negative consequences on policy making (Malone and Lusk, 2016). On the other hand, eliminating those observations can lead to some sampling bias if the sample size is small (Berinsky, Margolis, and Sances, 2014; Lancsar and Louviere, 2006). In this study, the responses that failed the trap question were removed.

After the choice questions, the respondents had to answer to a set of socio – economic set of questions such as gender, income, household size, preferences for attributes such as stickiness, aroma, and color.

The experimental design includes an information treatment regarding parboiled rice. The sample was also randomly split into a control and a treatment group to measure the impact of receiving information about parboiled rice on consumers' preferences. Those in the treatment group were provided the nutrition facts for the parboiled and non-parboiled rice (Figure 14).

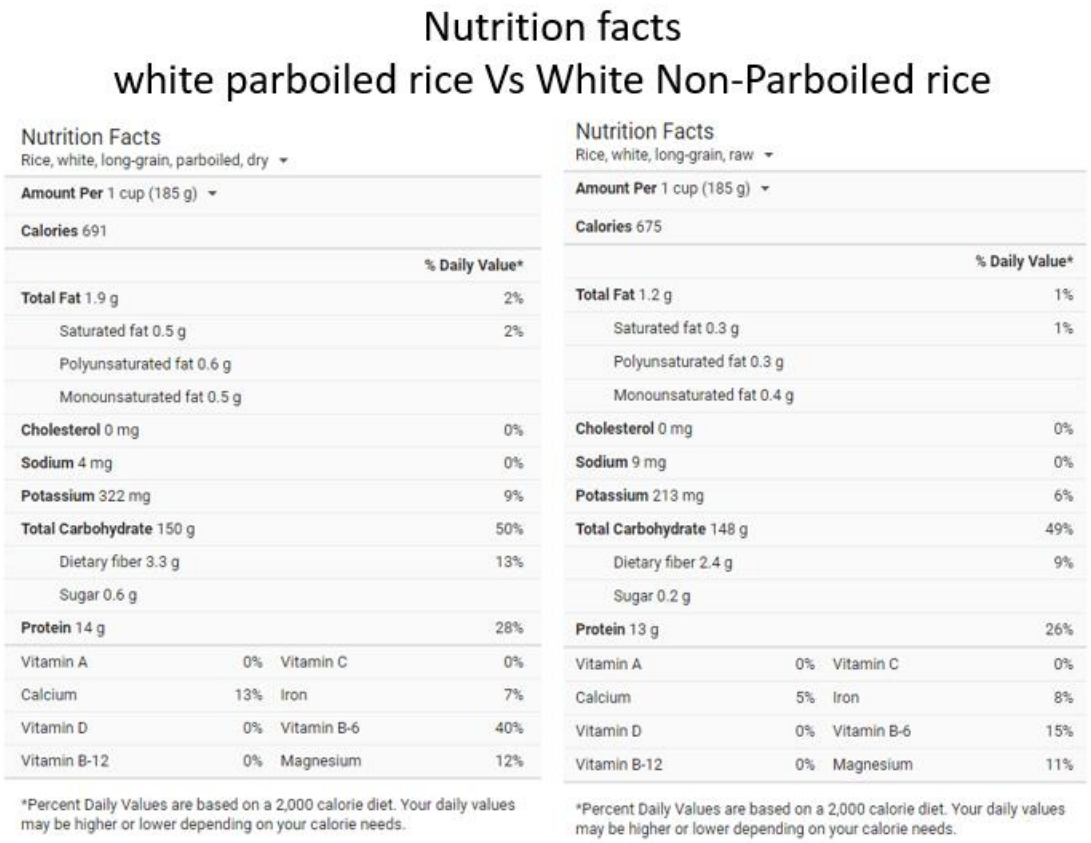


Figure 14. Difference between Parboiled and Non-Parboiled rice - Nutrition facts

Survey Implementation

With the help of four enumerators, we surveyed 252 consumers in Port-au-Prince, Haiti, in January 2018 to collect data about consumer preferences for selected rice quality attributes. The enumerators were trained on the administration of the choice experiment. The training consisted on 3 sessions of 2 hours each, in which the enumerators were introduced to objective of the study, the CE methodology, and the importance of closely following the research protocol. The enumerators took and administered the survey several times before going to the field. A pretest of 50 surveys was conducted to help calibrating the attributes levels following a Bayesian

approach (Ferrini & Scarpa, 2007; Sandor & Wedel, 2001; Scarpa, Campbell, & Hutchinson, 2007).

Each respondent received HTG300 (around US$ 5) as incentive to participate. Initially, the goal was to develop representative rice samples of each rice alternative for respondents to observe the characteristics before stating their choice. After investing significant time to develop the rice samples, logistic issues arose that limit the use of the samples, including: (1) high risk of contamination of the rice samples; (2) time constraints to show the rice samples to the respondents; and (3) cost of transportation of the samples from one site to another. The fact that no rice samples have been presented to the respondents can constitute limitations to this research, however, given the Haitian consumers' experience in considerably eating rice for the last three (3) decades, this make them quite sophisticated rice consumers, consequently this experience can alleviate this drawback.

Model Specification

The science of consumer's behavior is backed up by the Random Utility Theory (Lancaster, 1966; Adamowicz, Louviere, & Swait, 1998). According to Lancaster (1966), the consumer's utility of consuming any given good is a combination of individual utilities for the good attributes. That means that the consumer's utility can be decomposed into attribute utilities:

$$U_{ijt} = -\alpha_i p_{ijt} + X_{ijt}^T \beta_i + \varepsilon_{ijt} \quad (1)$$

Where i, j, and t represent the individual, choice alternatives, and choice set, respectively. The term U_{ijt} represents the utility function derived by individual i from alternative j in round t, p_{ijt} is the variable price, and $X_{ijt}$is the non-price variables (in this study, Broken, Origin and Parboiled). The scalar α_i and the vector β_i are the price coefficient and the coefficients matrix associated to the matrix of attributes X_{ijt} while ε_{ij} is the random error including all the other factors that are unobservable in the model. This model is used in preference space (Sarrias &Daziano, 2017). However, in WTP space, Sarrias and Daziano (2017) state that by dividing the coefficients matrix by the price coefficient α the model becomes:

$$U_{ijt} = -\alpha_i p_{ijt} + X_{ijt}^T(-\alpha \frac{\beta}{\alpha}) + \varepsilon_{ijt} \quad (2)$$

$$U_{ijt} = -\alpha p_{ijt} + X_{ijt}^T(-\alpha\gamma) + \varepsilon_{ijt} \quad (3)$$

With γ the WTP parameter vector. Given that the consumer's utility depends on his choice, under the assumption that the consumer is rational, he will make the choice that will maximize his utility. Nevertheless, researchers have realized that consumers sometimes make choices not compatible with utility maximization, which can be explained by excluded random variables affecting consumers' utility (ε_{ijt}). Lack of information, measurement errors, and even

inattention are identified to be part of the random component of the utility function. The Random Utility Theory states that the researcher does not observe U_{ijt} but rather observes a representative utility $\widehat{U}_{ijt}$ (Adamowicz, Louviere, and Swait, 1998; Loureiro & Umberger, 2007).

$$U_{ijt} = \widehat{U}_{ijt} + \varepsilon_{ijt} \quad (4)$$

The probability that respondent i in choice set t chooses alternative j, P_{ijt}, is:

$$P_{ijt} = Prob\left(U_{ijt} > U_{int}; n = 1, 2, \dots, j; \quad n \neq j\right) \quad (5)$$

$$P_{ijt} = Prob\left(\widehat{U}_{ijt} + \varepsilon_{ijt} > \widehat{U}_{int} + \varepsilon_{int}; n = 1, 2, \dots, j; \quad n \neq j\right) \quad (6)$$

$$P_{ijt}\left(\varepsilon_{ijt} - \varepsilon_{int} > \widehat{U}_{int} - \widehat{U}_{ijt}; n = 1, 2, \dots, j; \quad n \neq j\right), \quad (7)$$

Based on (4) and the attributes selected in this study, the specific form of the utility function is:

$$U_{ijt} = ASC + \beta_1 Price_{ijt} + \beta_2 Origin_{ijt} + \beta_3 Parboiled_{ijt} + \beta_4 Broken_{ijt} + \varepsilon_{ijt} \quad (8)$$

Alternative choice models can be specified based on the assumptions about the distribution of the unobserved error term (ε_{ijt}) and the functional form of the utility function. The multinomial logit model (MNL) assumes the error term are independent and identically distributed (iid) with a Gumbel (Type I Extreme Value) distribution, which implies that errors (1) are uncorrelated over alternatives; (2) have the same variance for all alternatives; and (3) are uncorrelated over time. Because of the assumptions about the distribution of the error term, the MNL model implies taste homogeneity across respondents and no correlation among alternatives. However, there is a vast literature showing that consumer preferences for many food products, including rice, are generally heterogeneous (Aoki et al., 2017; Khanal, Adhikari, & Wilson, 2017; Gracia, 2014;

Onozaka & McFadden, 2011; Scarpa et al., 2005). The random parameter logit (RPL) model relaxes some of the limitations of MNL and allows for heterogeneity across the respondents' preferences and correlation across the parameters. (Hess & Train, 2017). The RPL model does not control for potentially higher correlation between the two rice purchasing alternatives and the no-buy option. One way to account for it is to make two buying alternatives share an extra zero-mean error component, capturing the difference in variance between these and the opt-out alternative (Bazzani et al., 2017; Gracia et al., 2014, 2012; Scarpa et al., 2007, 2005). The third model, the RPL – EC with correlated parameters, is more flexible than the standard RPL – EC in that it allows for the coefficients to be correlated among themselves.

In this research, three models have been specified: MNL, an RPL model with gender heterogeneity (RPL), an RPL Error Component model (RPL – EC) with non-correlated parameters, and an RPL – EC model with correlated parameters.

Each model is specified separately for the control group that does not receive information about parboiled rice, and for the treatment group that receives the information. The control group has 546 observations against 540 for the treatment. This total of 1086 observations stands for 1086 choices made by 181 respondents who did not fail the trap questions (181 * 6).

According to Sarrias and Daziano (2017), WTP-space model allows to directly get the conditional distribution of the parameters WTP for each respondent, which is helpful for comparison between the control and the treatment group. This is why this paper uses a WTP-space model instead of a preference-space by dividing the coefficients matrix by the price coefficient. However, a preference space model has allowed to estimate the marginal utility for the attributes for both the control and the treatment group. Then the WTP was derived for comparison purpose. And, all the modeling was done using the software R.

Chapter 3: Results and Discussion

Descriptive statistics

The demographic characteristics of this final sample are shown in the Table 3. After removing the 71 respondents who failed the trap question, the sample was reduced to 181 respondents. Women represent 51.9% of the sample, in line with national statistics IHSI (2015) Around 56% of the respondents are between 18 and 30 years old, and just 14% are 45 years and more. Considering that the experiment took place in urban areas, it makes sense that more than 60% of the sample has no farm background while they do not know what parboiled rice is before taking the survey (59.7%). The respondents also reported that just 3.3% of the sample are living alone while 72% are living within a 4-people household size or more. In terms of income distribution, more than 66% of the respondents earn less than HTG40000 a month (equivalent to USD $600.00) while only 11.6% earn more than HTG130000 (equivalent to USD $1950.00). The majority of Haitian consumers (60.8%) purchase rice on the street markets, and only 8.8% buy rice in supermarkets. The remaining 30.4% use the channel of their neighborhood stores to purchase rice.

Table 3 - Descriptive table in %

Demographic	**Sample**	**Port-au-Prince and Pétion-Ville**
Observation	181	1,305,713[6]
Gender (%)		
Female	51.9	51.88
Male	48.1	48.12
Age (%)		
18 - 30	56.3	32.81[7]
31 – 45	29.8	21.25[8]
46 – 60	12.2	36.78[9]
Older than 60	1.7	5.01[10]
		4.15[11]
Income distribution (%)[12]		
Low Income	66.3	NA
Mid income	22.1	NA
High Income	11.6	NA
Knowledge of the parboiled rice before taking the survey (%)		
Yes	40.3	N/A
No	59.7	N/A
Household size (%)		
1	3.3	NA
2	8.8	NA
3	16	NA
4	23.8	NA
5	18.8	NA
More than 5	29.3	NA
Store (%)		
Supermarkets	8.8	NA
Street Markets	60.8	NA
Neighborhood Stores	30.4	NA
Farm Background (%)		
Yes	39.2	NA
No	60.8	NA

[6] Population Totale, de 18 ans et Plus, Ménages et Densités Estimés en 2015, IHSI. This the combined amount for both rural areas for Pétion-Ville and downtown Port-au-Prince.
[7] The range for this share goes from 0 to14 years old. Source: CIA World Factbook
[8] The range for this share goes from 15 to 24 years old. Source: CIA World Factbook
[9] The range for this share goes from 25 to 54 years old. Source: CIA World Factbook
[10] The range for this share goes from 55 to 64 years old. Source: CIA World Factbook
[11] The range for this share goes beyond 65 years old. Source: CIA World Factbook
[12] Low Income – It is less than USD $600 monthly. Mid income goes from USD $600 to USD $1950. High income goes above of USD $1950

More than 60% of them cook their own food at least 2 days a week, while 21% cook 5 days or more a week. Rice consumption is prevalent in Haiti. Indeed, 32% of the respondents reported that they consume rice more than 5 days a week, against 3.3% who said they eat rice just once a week. Stocking rice at home is common practice in Haiti. Less than 10% report having no rice stored at home, while 44.8% report having rice stocks for more than 3 weeks.

Table 4. Individuals Cooking, consumption and stock of rice

How often do they Cook at home	%
I am not the one cooking	39.2
2 days a week	17.7
3 days a week	13.3
4 days a week	8.8
5 days a week or more	21
How often do they Consume rice	%
Once a week	3.3
2 days a week	12.2
3 days a week	27.6
4 days a week	24.9
5 days a week or more	32
Stock of rice at home	%
I do not have any stored rice in my house	9.4
For 1 or 2 days	5.5
For 3 to 5 days	15.5
For 2 weeks	24.8
For 3 weeks or more	44.8

Preferences for three rice attributes have been also measured across the sample (Table 5). The respondents were asked to state their preference for some rice attributes such as stickiness, color, and aroma. Table 5 shows that 68% of the respondents prefer rice that separate when cooked (versus sticky rice accounting for 12.7%). Almost half of the sample also prefer yellow rice against 16.6% for white rice. It is important to note that parboiled rice tends to be yellow in Haiti while the imported (non-parboiled) rice is white. However, both varieties are long grain. In terms of aroma, over half of the respondents prefer rice with mild aroma. One remark that many respondents made regarding this question is that the local rice tends to have a strong aroma that they dislike.

Table 5. - Preferences distribution across the respondents

Rice stickiness	**Observations = 181**
Sticks	12.7
Separates	68
Indifferent	19.3
Rice Color	
Yellow	49.2
White	16.6
Slightly creamy	21.5
Indifferent	12.7
Rice Aroma	
Mild	54.1
Strong	20.4
Indifferent	25.4

Regarding cooking practices, table 6 shows that the majority of Haitian consumers always wash their rice before cooking.

Table 6. Cooking practices that Haitian consumers most commonly use to cook rice

Always wash rice before cooking	62.4%
Always wash rice before cooking and boil it with an exact level of water without draining after rice is cooked	17.7%
Always wash rice before cooking and stir-frying in oil or fat before boiling with an exact level of water	9.9%
Always wash rice before cooking, stir-frying in oil or fat before boiling with an exact level of water, and boil it with an exact level of water without draining after rice is cooked	6.1%
Boil it with an exact level of water without draining after rice is cooked	1.7%
Stir-frying in oil or fat before boiling with an exact level of water	1.1%
Other practices	1.1%

When asked about the main substitutes for rice, 21 respondents reported that the main substitutes to rice is potato, yam, manioc, and plantain. Spaghetti comes in second place as a substitute to rice.

Table 7. Frequency of food substitutes to rice among the respondents

Substitute foods to rice	**Frequency of the responses**
Beans	2
Cereals	2
Fruits and Vegetables	2
Spaghetti	5
Potato, Yam, Manioc, Plantain	21

The respondents were randomly assigned to a control and treatment group to measure whether providing information about the differences between parboiled and non-parboiled rice has an impact on attribute valuation. Table 8 presents the demographic distribution across the control

and treatment group. All the p-value are greater than 10%, meaning that the distribution was randomized.

Table 8. Randomization of the Sample

Category	**Control group**	**Treatment group**	**Chi-Square test**
Sample size	91	90	
Gender (%)			p = 0.51
Female	49.5	54.4	
Male	50.5	45.6	
Age (%)			p = 0.44
18 - 30	50.5	62.2	
31 – 45	34.1	25.6	
46 – 60	13.2	11.1	
Older than 60	2.2	1.1	
Income distribution			p = 0.41
Low Income	70.3	62.2	
Mid income	20.9	23.3	
High Income	8.8	14.4	
Knowledge of the parboiled rice before taking the survey (%)			p = 0.42
Yes	37.4	43.3	
No	62.6	56.7	
Household size (%)			p = 0.3
1	3.3	3.3	
2	7.7	10	
3	22	10	
4	24.2	23.3	
5	18.7	18.9	
More than 5	24.1	34.5	
Store (%)			p = 0.88
Supermarkets	9.9	7.8	
Street Markets	60.4	61.1	
Neighborhood Stores	29.7	31.1	

Model Results

Table 9 presents the MNL estimates for the marginal utility in preference space for the control and treatment groups. The results suggest that price produces a disutility for the consumers. Given the economic theory that individuals make choices that maximize their utility under constraint such as income (Adamowicz, Louviere, and Swait, 1998), the negativity of the price coefficient is as expected for both groups. The attributes percentage of broken rice and origin are both statistically significant at the 1% level. The percentage of broken rice negatively affect utility while local rice positively impact utility for both groups. Parboiled rice has no statistically significant impact on the respondents' utility across the control group but has a positive and statistically significant impact on the utility in the treatment group. This suggests that providing the information about parboiled rice is positively influential.

Table 9. Marginal utility estimates for the selected rice quality attributes from the MNL model in preference space for the control and the treatment group

Parameter	**Coef**	**No info**	**With info**
Price	μ	-0.008***	-0.007***
		(0.002)	(0.002)
Broken	μ	-0.017**	-0.013*
		(0.006)	(0.006)
Origin	μ	1.133***	1.201***
		(0.106)	(0.109)
Parboiled	μ	0.072	0.289**
		(0.102)	(0.105)
ASC_NoBuy	μ	-2.909***	-2.675***
		(0.389)	(0.385)
N		546	540

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 10.- WTP for the selected rice quality attributes in HTG (local currency) for a 5-pound bag derived from the MNL model in preference space for the control and the treatment group

WTP deriving from the MNL model – Control Group				
	Estimate	Std. Error	t-value	Pr(> | t|)
Broken	-2.183	0.886	-2.465	0.014 *
Origin	146.610	36.022	4.070	0.00005***
Parboiled	9.271	13.437	0.690	0.490
WTP deriving from the MNL model – Treatment group				
	Estimate	Std. Error	t-value	Pr(> | t|)
Broken	-1.725	0.891	-1.936	0.053.
Origin	161.987	40.189	4.031	0.0001***
Parboiled	39.000	17.223	2.264	0.024 *

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

The WTP for the attributes allow determining the premiums and discounts that the respondents are willing to pay or accept to purchase rice.

Table 11. Attribute premiums and discounts in percentage across control and treatment groups for the MNL

	Control Group	**Treatment Group**
Rice, baseline price	HTG 376.27***	HTG 360.90***
Broken	-0.58%*	-0.48%.
Local	38.96%***	44.88%***
Parboiled	2.46%	10.81%*

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

To calculate the premiums and discount for one attribute j, for j=Broken, Local, and Parboiled, this equation is followed:

$$\beta_{ASC_{NoBuy}} * (1 + \%) = \beta_{ASC_{NoBuy}} + \beta_j \quad (9)$$

$$(1 + \%) = 1 + \frac{\beta_j}{\beta_{ASC\_NoBuy}} \quad (10)$$

$$(\%) = \frac{\beta_j}{\beta_{ASC\_NoBuy}} \quad (11)$$

Dividing the coefficient of the attribute j by the constant of the Alternative Specific Constant gives you the premium or discount of the respondents for this attribute. The Table 11 from the MNL model suggests that the control group is willing to pay a statistically significant premium of 38.96% for local rice, a significant but small discount of 0.58% for every 1% increase in broken rice and are indifferent (no discount or premium) regarding parboiled rice. Respondents in the treatment group are also willing to pay a statistically significant premium of 44.88% for local rice, are indifferent about the percentage of broken rice (the coefficient is not statistically different from zero) but are willing to pay a statistically significant premium for parboiled rice. These results highlight the positive effect of information about parboiled rice on the utility and WTP for parboiled rice in Haiti.

Considering the limitations of the MNL model cited in Chapter 3, this paper utilizes more flexible models, such as the random parameter logit (RPL) with gender interaction to account for taste heterogeneity and gender interaction, and RPL with error component (RPL-EC) to account for differences in variance between the no-buy and the two rice alternatives. To each of the RPL and RPL-EC, we also look for correlation among the random parameters while all the models are in WTP space. The tables 12 and 13 shows the results for those models.

Table 12 - Uncorrelated and correlated RPL with gender affecting the variation of parboiled rice

	CG - RPL	TG - RPL	CG - Cor.RPL	TG - Cor.RPL
ASC_NoBuy	-3.624***	-3.542***	-3.340***	-3.597***
	(0.287)	(0.313)	(0.275)	(0.331)
Broken	-0.021*	-0.018	-0.010	-0.016
	(0.010)	(0.011)	(0.009)	(0.012)
Origin	1.569***	1.767***	1.481***	1.736***
	(0.199)	(0.230)	(0.198)	(0.234)
Parboiled	0.017	0.825**	-0.092	0.833**
	(0.215)	(0.254)	(0.237)	(0.266)
Parboiled.Female	0.067	-1.183***	0.138	-1.174***
	(0.302)	(0.347)	(0.304)	(0.349)
sd.Broken	0.054***	0.065***	0.024.	0.064***
	(0.011)	(0.012)	(0.013)	(0.012)
sd.Origin	1.221***	1.370***	1.215***	1.358***
	(0.219)	(0.239)	(0.23)	(0.241)
sd.Parboiled	0.793**	0.992***	0.994***	0.988***
	(0.241)	(0.237)	(0.217)	(0.236)
sd.Broken.Broken			0.024	0.064***
			(0.013)	(0.012)
sd.Broken.Origin			1.198***	0.197
			(0.241)	(0.313)
sd.Broken.Parboiled			-0.325	0.062
			(0.269)	(0.246)
sd.Origin.Origin			0.203	1.344***
			(0.372)	(0.243)
sd.Origin.Parboiled			-0.687	-0.016
			(0.352)	(0.285)
sd.Parboiled.Parboiled			-0.641	-0.986***
			(0.381)	(0.236)
N	546	540	546	540
Log-likelihood	-378.310	-350.037	-381.760	-349.778
BIC	807.041	750.407	832.849	768.763
AIC	772.620	716.074	785.520	721.555

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 13 - Uncorrelated and correlated RPL-EC with gender affecting the variation of parboiled rice

	CG - RPL.EC	**TG - RPL.EC**	**CG - Cor.RPL.EC**	**TG - Cor.RPL.EC**
ASC_NoBuy	-4.547***	-5.637***	-3.345***	-4.224***
	(0.643)	(0.948)	(0.401)	(0.536)
Broken	-0.023*	-0.019	-0.018	-0.013
	(0.010)	(0.010)	(0.012)	(0.011)
Origin	1.569***	1.602***	1.664***	1.829***
	(0.211)	(0.213)	(0.234)	(0.246)
Parboiled	0.079	0.738**	0.017	0.941**
	(0.208)	(0.237)	(0.258)	(0.306)
Parboiled.Female	0.076	-0.829**	0.051	-1.136**
	(0.295)	(0.320)	(0.339)	(0.377)
sd.Broken	0.048***	0.045**	0.418	1.74***
	(0.014)	(0.014)	(0.505)	(0.514)
sd.Origin	1.331***	1.322***	0.055***	0.047***
	(0.263)	(0.249)	(0.011)	(0.012)
sd.Parboiled	0.708**	0.683*	1.376***	1.47***
	(0.235)	(0.301)	(0.262)	(0.277)
sd.Broken.Broken			0.418	-1.741***
			(0.505)	(0.514)
sd.Broken.Origin			-0.034*	-0.019
			(0.015)	(0.015)
sd.Broken.Parboiled			-1.080***	1.090***
			(0.262)	(0.315)
sd.Origin.Origin			-0.043***	0.043**
			(0.012)	(0.014)
sd.Origin.Parboiled			0.818**	0.688*
			(0.259)	(0.298)
sd.Parboiled.Parboiled			0.239	0.708
			(0.378)	(0.478)
sd.Buy	2.208***	3.520***	0.835***	0.952***
	(0.624)	(0.696)	(0.219)	(0.222)
sd.Broken.Buy			0.214	-0.028
			(0.260)	(0.256)
sd.Origin.Buy			-0.252	-0.209
			(0.254)	(0.304)
sd.Parboiled.Buy			0.463	0.513
			(0.499)	(0.519)

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 13 - Uncorrelated and correlated RPL-EC with gender affecting the variation of parboiled (con't)

	CG - RPL.EC	**TG - RPL.EC**	**CG - Cor.RPL.EC**	**TG - Cor.RPL.EC**
sd.Buy.Buy			-0.613	-0.774*
			(0.365)	(0.352)
N	546	540	546	540
Log-likelihood	-371.424	-341.875	-374.841	-335.133
BIC	799.572	740.374	844.222	764.640
AIC	760.848	701.750	779.682	700.266

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Comparing AIC and BIC values for both the uncorrelated and correlated RPL models, for both control and treatment groups, the AIC and BIC values are lower than the AIC/BIC values for the correlated models. Therefore, the uncorrelated is a better model to the correlated one, which means that the correlated terms did not improve the model. Indeed, the correlated terms are not significant either.

The results provided by the models are consistent and robust, however, one model is chosen: the uncorrelated RPL with error component.

In the literature of model selection criteria, Sarrias and Daziano (2017) suggest to select the model with the minimum of Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC). However, they recognize that sometimes, the AIC or the BIC may not help in selecting a model. While the AIC and BIC are two selection criterions to select the model that better fits the data under study (Burnham & Anderson, 2004), there is some difference between them. First, Burnham and Anderson (2004) state that AIC identifies the model that minimizes information loss during the data modeling; thus the data analyst is more interested in the information that the data is telling than in the data modeling itself. The minimum AICi value among the different models k suggests that the model "i" is the model that reduces information

loss. Furthermore, AIC relies on the number of estimated parameters of the model. On the other hand, BIC does not depend on the number of parameters in the model, and it is independent to information provided by the data. BIC is supposed to reveal the "true model". Nevertheless, Burnham & Anderson (2004) pointed out that such model does not exist. In this case, AIC does not allow determining which model is better. Indeed, none of the models does have the minimum AIC values for both control and treatment groups. On the contrary, BIC suggests that the uncorrelated RPL with Error Component (with gender heterogeneity) is the closest model to the true model. This model has both minimum BIC values for the control and the treatment groups.

Uncorrelated RPL – EC model

The RPL – EC is an advanced form of the standard RPL model. While the utility function from choosing one attribute is "additive separable", including the error component helps having an additive term taking into account more than one alternative (Hoyos, 2010). The RPL-EC model allows to control for differences in correlation between the no-buy and the two rice alternatives. Table 13 contains the results for the estimated parameters for both groups. The coefficient sign of ASC_NoBuy is negative as expected for both groups and is statistically significant across both groups at 1% level. The respondents in the control group are willing to pay HTG 454.66 ($3 for 1 kg) for a 6lbs bag of rice against HTG 563.74. (USD $3.72) for the same bag when exposed to the information about difference between parboiled and non-parboiled rice (Table 14). This corresponds to a 24% increase of the WTP.

The percentage of broken rice is negative and statistically significant at the 5% in the control group and 10% in the treatment group. Respondents in the control and treatment groups discount HTG 2.27 and HTG 1.85 for every 1% increase in broken rice. The standard deviation (σ) of the

parameter Broken is statistically significant at 0.1% level across both groups; this corroborates the hypothesis that the parameter Broken is a random parameter.

Respondents from the control and treatment groups are willing to pay a premium for local rice. Broken is also statistically significant at 0.1% level. The average WTP for the control group is HTG 156.95 for a 6lb bag (USD$1.04 per kg) against HTG 160.18 for the treatment group (USD$1.06 per kg). The parameter Origin is also a random parameter. Its standard deviation (σ) is significant in both groups at 0.1% level.

The results also suggest that providing information about the difference between parboiled and non-parboiled rice is influential. Indeed, the parboiled coefficient is statistically not different from zero in the control group, but statistically significant and positive in the treatment group with an average WTP of HTG 73.83. The standard deviation of the parameter parboiled is significant in both groups at 0.1% level.

The sign of the parameter "parboiled.female" is negative and is statistically significant in the treatment group. This suggests that gender affects the respondents' WTP for parboiled rice, with women having a lower WTP than men. This significant difference among men and women in WTP for parboiled rice may be explained by the fact that women make the food purchasing decision in the household and do have more experience than men in doing so.

Conditional Distribution for the random parameters

The findings presented above show that there is taste variation across respondents, and therefore WTP behaves as a random variable. The distribution of the conditional WTP of the random parameters (origin, parboiled, and broken) for the RPL-EC model can be seen below (Figures 14 and 15). The Figure 15 shows the conditional distribution for the WTP for the three random rice

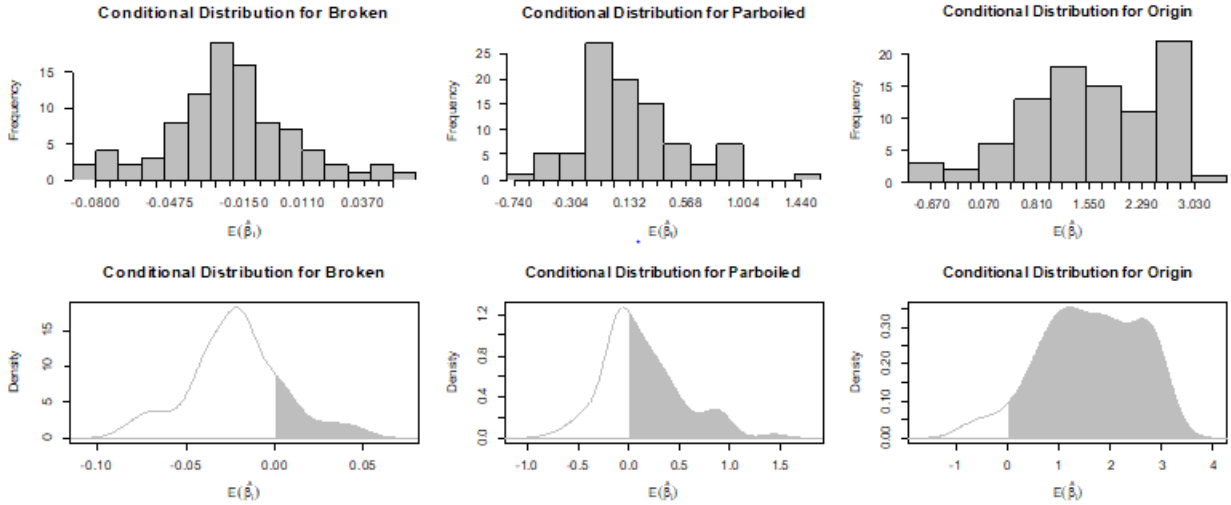
quality parameters (broken, parboiled, and origin) across the control group. It shows a large concentration of discounts for broken grains and parboiled rice (negative WTP) among the non-informed respondents. The figure 15 shows the conditional distribution for the WTP for the random parameters across the treatment group.

Table 14. - Attribute premiums and discounts in percentage form across control and treatment groups for the 3 models

	Correlated RPL-EC		**Standard RPL**		**RPL - EC**	
	Control	Treatment	Control	Treatment	Control	Treatment
Rice Base	HTG 334.53***	HTG 422.40***	HTG 362.40***	HTG 354.19***	HTG 454.66***	HTG 563.74****
Broken	-0.53%	-0.31%	-0.58%**	-0.50%	-0.50%*	-0.33%
Origin	49.74%***	43.30%***	43.28%***	49.88%***	34.52%***	28.41%***
Parboiled	0.50%	22.28%***	0.46%	23.29%***	1.73%	13.10%**

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 15.- Conditional distribution for the random parameters within the control group of the RPL-EC model

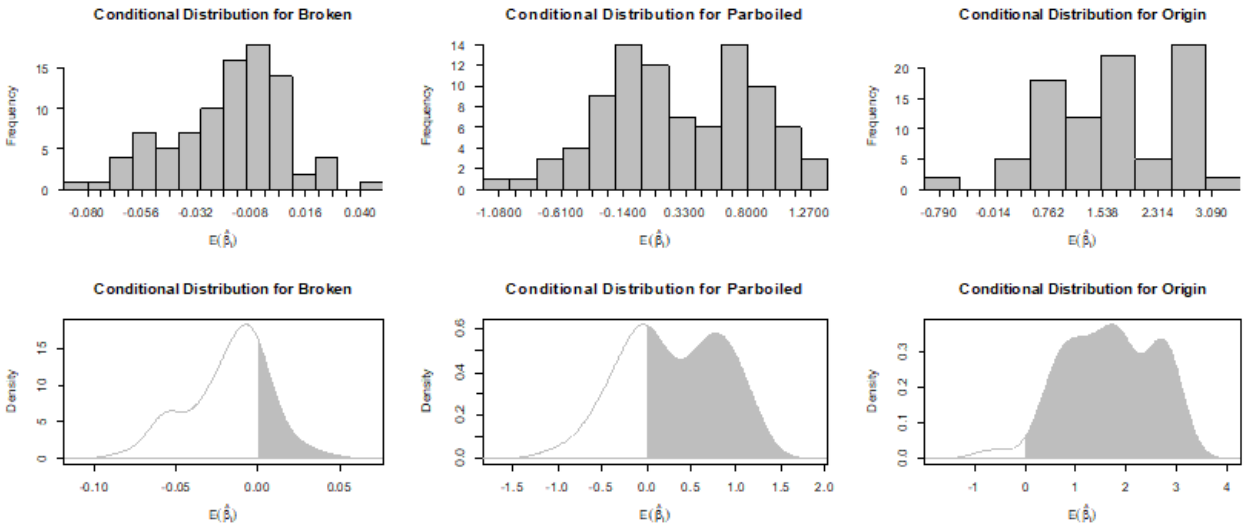


The histogram plots show the total distributions of the WTP for each random parameter whether it is a premium (positive WTP) or a discount (negative WTP). The density plots show the concentration of the positive WTP (the premium). Among the respondents in the control group, few people are willing to pay a premium for broken rice while the concentration of respondents

who are willing to pay for a premium is wider for local rice. Note that parboiled was not significant in the control group. For both types of graph, the term $E(\hat{\beta})$ refers to the WTP in HTG.

The situation differs in the treatment group where the concentration to pay a premium for parboiled rice is larger than the positive concentration in the control group. There is a slight change in the concentration for paying a premium for local rice and for broken rice in the treatment group. However, it is hard to determine whether the WTP to pay for an attribute within the control group is in average greater than the WTP for the same attribute within the treatment group. Therefore, this paper uses a t-test to determine if the WTP distribution for each attribute varies significantly between the control and the treatment group.

Table 16.- Conditional distribution for the random parameters within the treatment group of the RPL-EC model



The table 16 shows that in the RPL-EC model, the respondents in the treatment group are willing to pay more than those in the control group for parboiled at 95% confidence interval, and there are no significant differences for broken and origin.

Table 17 - Hypothesis tests for significant differences in WTP for the Broken, Parboiled and Origin attributes between information treatment and no information control groups in the RPL – EC with gender heterogeneity

Hypothesis Tests (T-tests)	**Broken**	**Parboiled**	**Origin**
H_0: $(WTP^{Treat} - WTP^{Contr}) = 0$			
Treatment	-0. 0185	0.7383	1.6018
Control	-0.0227	0.0786	1.5695
p-value	0.1518	0.0137	0.2979

Considering the results of all three models, the attribute origin has the highest WTP across the models and treatment groups. Previous studies have found similar country-of-origin effects. For example, Aoki, Akai, and Ujiie (2017) find that U.S. rice is less preferred than domestic rice in both Japan and Thailand, and that Japanese consumers are willing to pay less for U.S. rice than Thai consumers are. Lee, Han, Nayga Jr., and Yoon (2014) find that Korean consumers prefer domestic rice over Chinese and U.S. rice. Demont, Rutsaert, Ndour, and Verbeke (2013) find a strong urban bias against domestic rice in Senegal. However, Schnettler, Ruiz, Sepúlveda and Sepúlveda (2008) find no significant country of origin effect for consumers in Chile.

The results also confirmed the hypothesis of this study regarding the impact of information about parboiled rice on consumers' choice. In all the three models, providing information about the difference between parboiled and non-parboiled rice has a positive influence on consumers' utility. Respondents in the treatment group are willing to pay a significant premium for parboiled rice, while respondents in the control group are indifferent about the parboiled attribute.

Haitian Women WTP for Parboiled Rice

All the models (RPL and RPL-EC, correlated and uncorrelated) suggest that women are willing to pay less for parboiled rice than men when they are informed about the difference between parboiled and non-parboiled rice. One possible reason for this is that Haitian women generally do the cooking and make household purchases and therefore might behave in a way that is more consistent with actual household budget constraints. The finding that women are willing to pay less for parboiled rice than men is somewhat surprising, however, because parboiled rice is more nutritious than ordinary rice. Consequently, this paper also investigates other explanations for women's lower WTP for parboiled rice using the survey data.

First, a subset sample taking account of women only has been created following by a battery of models and tests. Table 18 displays the results for two models, a basic RPL and an RPL with the heterogenous variable "Knows_Parboiled" (KP). Note that the variable KP captures whether the respondents were familiar with what parboiled rice is before taking the survey, and it takes a value of "1" when the answer is yes, and "0" otherwise. Those respondents with previous knowledge of parboiled rice may have preconceived ideas about parboiled rice that conflict with the information provided in the treatment.

When modeling using only women, the WTP for parboiled is not significant regardless of accounting for previous knowledge and regardless of treatment, though the estimate does change signs to be positive on the information treatment once accounting for previous knowledge. In this case, women with previous knowledge and information do exhibit significantly lower WTP for parboiled rice at the 10% level. Men, on the other hand, demonstrate significant and positive WTP for parboiled in both of the information treatments, while those with previous knowledge do not have significantly different preferences for parboiled regardless of treatment. Because of

their familiarity with cooking and making household purchases, women may be more likely to have previous knowledge about parboiled rice (frequencies by gender) and have different preconceived ideas about parboiled rice than men, and these facts could explain why women have a lower WTP for parboiled and why only men demonstrate increased WTP for parboiled in the presence of the information treatment.

Table 18 - RPL models - The basic model and the RPL with the heterogeneous variable "Knows_Parboiled"

	No Info - basic RPL	With info - basic RPL	No Info - knows-RPL	With info - Knows-RPL
ASC_NoBuy	−2.971***	−3.585***	−3.005***	−3.765***
	(0.399)	(0.422)	(0.402)	(0.443)
Broken	−0.007	−0.010	−0.009	−0.010
	(0.014)	(0.016)	(0.014)	(0.016)
Origin	1.678***	1.791***	1.705***	1.647***
	(0.275)	(0.343)	(0.278)	(0.274)
Parboiled	0.243	−0.273	0.069	0.103
	(0.229)	(0.253)	(0.284)	(0.290)
sd.Broken	0.062***	0.078***	0.064***	0.079***
	(0.017)	(0.016)	(0.017)	(0.017)
sd.Origin	1.014***	1.657***	1.050***	1.227***
	(0.294)	(0.367)	(0.301)	(0.291)
sd.Parboiled	0.715*	1.073**	0.723**	0.869**
	(0.285)	(0.342)	(0.279)	(0.314)
Parboiled.Knows_Parboiled			0.477	−0.845.
			(0.470)	(0.488)
N	270	294	270	294
Log-likelihood	−183.740	−197.170	−183.203	−193.753
BIC	406.670	434.125	411.193	432.976
AIC	381.481	408.340	382.406	403.507

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Adding the variable KP helps capturing the women's behavior regarding their knowledge about parboiled prior the survey. A likelihood ratio test is required to estimate whether adding KP to the basic model does improve it or not. Table 18 shows that adding the interaction variable

Parboiled.Knows_Parboiled did not bring much in comparison to the basic RPL model for the control group whereas adding this data help fit the data better for the treatment group at 10% interval of confidence.

Table 19 - Comparing basic RPL model to heterogeneous model with Knows-Parboiled affecting Parboiled

	#Df	LogLik	Df	Chisq	Pr(>Chisq)
1	7.0000000	-183.7403634	NA	NA	NA
2	8.0000000	-183.2027937	1.0000000	1.0751393	0.2997875

Table 20 - Likelihood Ratio Test to compare the basic model to the KP model (Treatment group)

	#Df	LogLik	Df	Chisq	Pr(>Chisq)
1	7.0000000	-197.1701477	NA	NA	NA
2	8.0000000	-193.7534450	1.0000000	6.8334053	0.0089469**

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

For comparison purpose, the table 4 gives handful insights for men. The models suggest that men are inclined to be pay significantly more for parboiled rice when they are better informed.

Table 21 - Results for men - basic RPL and added heterogenous variable

	No Info - base RPL-Male	With info - base RPL-Male	No Info - knows-RPL	With info - Knows-RPL
ASC_NoBuy	−4.276***	−3.502***	−4.155***	−3.506***
	(0.454)	(0.483)	(0.456)	(0.483)
Broken	−0.025	−0.023	−0.030*	−0.022
	(0.013)	(0.014)	(0.013)	(0.014)
Origin	1.480***	1.662***	1.473***	1.668***
	(0.290)	(0.321)	(0.308)	(0.325)
Parboiled	0.040	0.782***	−0.073	0.639*
	(0.221)	(0.238)	(0.297)	(0.324)
sd.Broken	0.044**	0.041*	0.044**	0.042*
	(0.015)	(0.019)	(0.015)	(0.018)
sd.Origin	1.351***	1.308***	1.573***	1.319***
	(0.295)	(0.388)	(0.370)	(0.386)
sd. Parboiled	0.918**	0.746*	0.994**	0.730*
	(0.309)	(0.351)	(0.369)	(0.354)
Parboiled.Knows_Parboiled			−0.021	0.290
			(0.461)	(0.451)
N	276	246	276	246
Log-likelihood	−189.045	−151.333	−189.349	−151.127
BIC	417.432	341.204	423.661	346.297
AIC	392.089	316.666	394.698	318.254

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Given that the model suggests that better informed women are willing to pay less for parboiled, some extra variables have been added to the model to investigate what determines this reluctance to pay for parboiled rice.

RPL and RPL EC Models with extra heterogenous variables

The modeling takes into account the variables (i) aroma (value 1 when the respondent claims she prefers mild aroma and value 0 otherwise), (ii) Knows_Parboiled (value 1 when the respondent claims she knew what parboiled rice was prior taking the survey and value 0 otherwise), and (iii) Healthy_Rice (value 1 when the respondent claims that nutrition facts written on a rice bag is important to her when she purchases rice, and value 0 otherwise). While they are all affecting the respondents' WTP variation for the random parameter "parboiled", only the variable Healthy_Rice is affected to the random parameter "origin". This set up were chosen to capture whether the choice to pay less for parboiled is determined by the fact that women knew what parboiled is before taking the survey or not, or whether that providing healthier rice to their household is important or not, or whether their preference for mild aroma has something to do to their reluctance to pay a premium for parboiled rice which has a reputation to have a strong aroma. Moreover, this set up also helps analyzing whether those women are willing to pay a premium for local rice because they would think that local rice is healthy.

First, aroma does significantly affect women's WTP for parboiled rice after being better informed on parboiled rice in both models. The interval of confidence is however better in the RPL model (5% against 10% for the RPL-EC). On the other hands, the women who knew what parboiled rice was prior the survey, were significantly willing to pay less for parboiled rice (-0.831) in the RPL – EC while prior knowledge of parboiled rice is not statistically significant in the RPL model.

Table 22 - RPL model with heterogenous variables affecting the WTP for parboiled and local rice

	CG - RPL	**TG - RPL**
ASC_NoBuy	-2.925***	-3.546***
	(0.373)	(0.401)
Origin	2.856***	0.549
	(0.658)	(0.509)
Parboiled	-0.271	-0.081
	(0.673)	(0.458)
Parboiled.aroma	0.339	1.094*
	(0.466)	(0.522)
Parboiled.Knows_Parboiled	0.525	-0.649
	(0.501)	(0.500)
Parboiled.Healthy_Rice	0.145	-0.911
	(0.683)	(0.575)
Origin.Healthy_Rice	-1.364*	1.499*
	(0.674)	(0.600)
sd.Broken	0.065***	0.077***
	(0.017)	(0.016)
sd.Origin	1.026***	1.410***
	(0.301)	(0.421)
sd.Parboiled	0.740**	0.958*
	(0.276)	(0.403)
N	270	294
Log-likelihood	-180.902	-189.403
BIC	417.789	435.643
AIC	381.804	398.807

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

The result in the RPL-EC model (Table 23) suggests that a woman who knew what parboiled rice is before taking the survey wanted to pay HTG 83.1 less than a woman whose did not know the difference between parboiled and non-parboiled rice before taking the survey. In the RPL model, she also wants a discount (HTG 64.9), but this discount is not statistically significant. This suggests that those who had prior knowledge of parboiled rice were disappointed by the information provided whereas the other women were positively affected. The variable

Healthy_Rice captures whether the respondents are influenced or not by the nutrition facts written on rice bags are when purchasing rice. It takes the value 1 when the answer is yes and 0 otherwise. Therefore, we attempted to measure how this variable affects women's WTP in the control and treatment groups.

Table 23 - RPL – EC model with the heterogenous variables affecting the WTP for parboiled and local rice

	Control – RPL – Error Component	Treatment - RPL – Error Component
ASC_NoBuy	-4.253***	-6.381***
	(0.906)	(1.281)
Broken	-0.013	-0.006
	(0.013)	(0.014)
Origin	2.511***	0.495
	(0.640)	(0.505)
Parboiled	-0.371	-0.143
	(0.593)	(0.427)
Parboiled.aroma	0.288	0.867.
	(0.417)	(0.475)
Parboiled.Knows_Parboiled	0.308	-0.831.
	(0.448)	(0.470)
Parboiled.Healthy_Rice	0.292	-0.344
	(0.596)	(0.555)
Origin.Healthy_Rice	-1.070	1.587**
	(0.661)	(0.602)
sd.Buy	2.096***	4.579***
	(0.555)	(1.071)
sd.Broken	0.037	0.058**
	(0.026)	(0.019)
sd.Origin	0.937**	1.107***
	(0.318)	(0.327)
sd.Parboiled	0.426	0.654*
	(0.531)	(0.283)
N	270	294
Log-likelihood	-176.695	-179.357
BIC	420.571	426.916
AIC	377.389	382.713

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

The results have suggested that better informed women who actually care for nutrition facts written on the rice bags are significantly willing to pay more for locally produced rice (1.587) than those who do not pay attention to the nutrition facts on the rice bags. In both models, although the coefficients signs are the same, women who pay attention to nutrition facts written on a bag of rice (Healthy_Rice) show no significant difference on their WTP to pay for parboiled rice comparing to the women who do not pay attention to the section nutrition facts written on the bag of rice. This suggest that even hough women care for healthy food for their children, they do not rely too much on rice to provide the necessary nutritive elements to their household. However, this study does not have the necessary elements to back up this hypothesis.

Table 24 - RPL-EC models with a variable “Health_Rice” affecting women’s WTP for parboiled and local rice

	Control-EC-HR	Treatment-EC-HR	Control-EC-HR2	Treatment-EC-HR2
ASC_NoBuy	−4.665***	−7 . 111***	−4 . 180***	−7 . 540*
	(0.966)	(1 . 732)	(0 . 772)	(2 . 993)
Broken	−0.011	−0 . 011	−0 . 008	−0 . 006
	(0.013)	(0 . 013)	(0 . 012)	(0 . 012)
Origin	1.593***	1 . 642***	2 . 534***	0 . 517
	(0.275)	(0 . 309)	(0 . 650)	(0 . 470)
Parboiled	−0.186	0 . 172	−0 . 115	0 . 107
	(0.541)	(0 . 465)	(0 . 590)	(0 . 463)
Parboiled.Healthy_Rice	0.418	−0 . 384	0 . 309	−0 . 205
	(0.591)	(0 . 533)	(0 . 639)	(0 . 546)
sd.Buy	2.759***	4 . 696***	1 . 850***	4 . 280*
	(0.739)	(1 . 253)	(0 . 492)	(1 . 916)
sd.Broken	0.043*	0 . 034	0 . 031*	0 . 026
	(0.018)	(0 . 019)	(0 . 015)	(0 . 017)
sd.Origin	1.036***	1 . 352***	1 . 023**	0 . 973**
	(0.290)	(0 . 375)	(0 . 326)	(0 . 308)
sd.Parboiled	0.828*	0 . 975**	0 . 813*	1 . 029*
	(0.353)	(0 . 317)	(0 . 371)	(0 . 449)
Origin.Healthy_Rice			−0 . 960	1 . 478**
			(0 . 665)	(0 . 553)
N	270	294	270	294
Log-likelihood	−178.456	−187 . 668	−175 . 832	−184 . 564
BIC	407.298	426 . 488	407 . 649	425 . 964
AIC	374.912	393 . 336	371 . 664	389 . 128

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Chapter 4: Conclusions

Information is important for any individual when making decision (Adamowicz, Louviere, & Swait, 1998). This led the hypothesis that being more informed about the difference between parboiled and non-parboiled rice is supposed to influence the respondents' choice. An implicit hypothesis ties to this one: the Haitian consumer does not know what parboiled rice is. Another hypothesis is about the Haitian consumer's preferences for local rice over imported rice instead that imported rice has a wide market share than local rice. The higher market share of the U.S imported rice over the local rice might be due to the fact that domestic rice is much more expensive. The other hypothesis is that Haitian consumers highly dislike broken grains. The U.S imported rice is long grain and 4% broken grains; while the parboiled domestic rice is also long grain. The consumers are then familiar with long grain rice. The third hypothesis was factors such as gender, income and level of education do have a significant influence on the WTP for parboiled, Broken, local rice. The last hypothesis was about the influence of factor such as gender on the respondents' preferences and WTP for rice.

Regarding to the first hypothesis, one insight provided by this paper is that Haitian consumers in urban areas such as Port-au-Prince, who represent a solid concentration of rice consumers, do not know the difference between parboiled and non-parboiled rice. They have reported that up to 60% did not know what parboiled rice meant before taking the survey. Furthermore, being exposed to the information about this difference positively influences their choice, increasing their WTP for parboiled rice. Statistically insignificant in the control group with an average premium of 0.9% across all three models, parboiled become statistically significant in the treatment group averaging a 19.6% premium. This finding confirms the hypothesis about the information processing influence.

Another finding is that the respondents ask for discount for broken rice across all three models. However, the discount is small comparing to the two other variables (origin and parboiled). Furthermore, the respondents show some inconsistency regarding their WTP for broken grains across the models in terms of significance. This suggests that Broken is not a strong attribute to be considered, but, given that no sample was actually provided to the respondents, one should be careful about this result.

Regarding the role that gender plays in WTP for rice, it appears that there is no significant difference between women and men until information about parboiled and non-parboiled rice has been shared. Although the WTP for parboiled rice increased when the respondents are exposed to the information, females do have a lower WTP than males. It has been found that the strong aroma which is one intrinsic attribute of parboiled rice is one reason

This result may have something to see with the hypothetical bias. Since women make the purchasing decision in the household, they might have been less affected by the hypothetical bias than the male who have less experience in purchasing food.

Everything else equals, the findings of this study indicate that respondents are willing to pay more for local than imported rice. The standard RPL and the correlated RPL-EC indicate that the respondents are willing to pay a premium up to 50% to purchase local rice relative to the same quality of imported rice. The respondents in control group across the three models are willing to pay on average HTG 160 more for local rice against HTG 173 in the treatment group, which represents an 8% increased. Could the information be accounted for this increase? Given that local rice is parboiled and considering that US imported rice is non-parboiled white rice, there could be some positive correlation between parboiled and local rice. The correlated RPL – EC has shown that there is a positive correlation between parboiled and local rice (See the term

sd.Origin.Parboiled Appendix A, table 26). If the sample of this study is representative of the overall population, the findings do have serious implications for the rice market in Haiti in terms of public policy and private sector.

Insights on women should be greatly considered given their role on the household. The findings have suggested that women who claimed that they pay attention to the nutrition facts written on the bag of rice have more likely to pay more than those who do not. Therefore, it appears that a communication campaign to educate women on the importance of nutrition facts is required to market domestic rice. Given that women do have the purchasing power in the household, their WTP has a better chance to be closer to the reality than men's WTP.

Public Policy

In terms of implications, this paper suggests that the Haitian government require that all rice be labelled (parboiling state, origin) and should also include nutrition facts, which is not the fact yet in the market. The fact that it is not required to label rice bags in markets suggests that there is no standard for rice commercialization in Haiti. Considering that this paper suggests that the consumers are willing to pay more for local rice if only local rice does reach the same level of quality with the U.S imported rice, rice parboiling state and percentage of broken grains are two important attributes should the government decide to support the development of the local rice industry. This paper offers interesting insights to develop rice standards for Haiti. First, the attributes such as parboiled and broken grains can help defining standards related to the parboiling process (adequate machinery and technology, boiling time, adequate temperature), and also the different rice length and the milling process (type of machinery per every class of percentage of broken grains). Once the investors know Haitian are willing more for local rice, having some guidelines about how to develop this local rice would be essential. Another

important aspect is that the development of the rice chain value also requires a distinction between rough and milled rice. Therefore, some investors may prefer investing in the milling industry while others can focus on increasing production yields. In both cases, both groups of investors need clear rice standards whether it is rough or milled rice. This paper points out that parboiled rice and reducing the percentage of broken rice should be the focus of future rice standards for Haiti.

Since this study reveals that 90% of the sample use either street markets or neighbor stores to purchase rice, where rice is sold in open bags, it is a must to run educational campaign to educate the consumers that they can easily identify the parboiled and the non-parboiled rice. Given the lack of education of many Haitian, a label could be developed for the local rice and one for the parboiled rice. It would be a visual "brand" that is associated to the key attributes such parboiled rice and local rice that whenever the consumers see only one or both symbol on a rice bag, they can identify the rice. There is also the fact that the consumers would be willing to pay a small premium for a lower percentage of broken rice. However, more studies should be done in that direction to have more information about the consumers preferences for rice with varying levels of broken rice. Having information about this attribute can be important for the milling industry before making the decision to support farmers to improve their milling industry on a big scale.

Private sector

The rice sector is lucrative for the rice importers. This paper gives them insights about their clients. Knowing what the Haitian consumers prefer and how much they are willing to pay for it is useful to the rice suppliers. It will support them in developing a business case for rice that can benefit both the consumers and the suppliers. In the effort to boost the rice domestic supply, there can be a partnership public – private to support rice farmers developing a rice variety that

matches the consumers' preferences and budget. The imported rice in Haiti is white, non-parboiled and 4% broken grains while this study suggests that 49.2% of the sample prefer parboiled rice; that people are willing to pay up to 23% more to purchase parboiled rice when they know what parboiled rice is; that people are willing to pay up to 50% premium for local rice; and that the percentage of broken rice is not that important to them.

These findings imply that the government is right to be vocal about substituting local for imported rice. The fact that Haitian consumers are willing to pay a significant premium for locally produced rice and the fact also that providing information about parboiled rice has a positive impact on the respondents' willingness to pay for parboiled rice are two main findings that show that there is an opportunity for the domestic rice sector to grow and to provide to the Haitian market with more parboiled rice. The results lead us to suggest that investment in parboiling plants may generate a higher return than investments in more modern milling technologies to lower the percentage of broken rice. In fact, parboiling rice in Haiti has largely contributed to increase the final product price. Investment in the adequate technology that is able to significantly decrease its cost would be a positive gain for the investors. This leads the debate again to the role of the government in developing the parboiling process standards that the investors can follow.

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Appendix A

Table 25 - RPL model - Female affecting all the random parameters

	CG-RPL	**TG-RPL**	**CG-Cor-RPL**	**TG-Cor-RPL**
ASC_NoBuy	−3.575***	−3.546***	−3.576***	−3.513***
	(0.285)	(0.308)	(0.301)	(0.322)
Broken	−0.022	−0.016	−0.019	−0.039*
	(0.012)	(0.016)	(0.013)	(0.017)
Origin	1.461***	1.744***	1.423***	2.147***
	(0.267)	(0.320)	(0.276)	(0.426)
Parboiled	0.035	0.930***	−0.053	0.953**
	(0.211)	(0.268)	(0.233)	(0.309)
Broken.Female	0.001	0.005	−0.002	0.027
	(0.017)	(0.019)	(0.017)	(0.021)
Origin.Female	0.266	−0.033	0.289	−0.321
	(0.369)	(0.413)	(0.379)	(0.508)
Parboiled.Female	0.081	−1.229***	0.025	−1.228**
	(0.297)	(0.359)	(0.314)	(0.399)
sd.Broken	0.051***	0.062***	(0.051***	0.063***
	(0.010)	(0.012)	(0.011)	(0.011)
sd.Origin	1.282***	1.364***	1.27***	1.717***
	(0.223)	(0.268)	(0.237)	(0.296)
sd.Parboiled	0.755**	0.891***	0.847***	1.061***
	(0.231)	(0.240)	(0.241)	(0.253)
sd.Broken.Broken			−0.051***	−0.063***
			(0.011)	(0.011)
sd.Broken.Origin			−0.059	0.743**
			(0.353)	(0.272)
sd.Broken.Parboiled			−0.085	0.097
			(0.224)	(0.248)
sd.Origin.Origin			1.268***	1.547***
			(0.243)	(0.267)
sd.Origin.Parboiled			−0. 349	−0.097
			(0.307)	(0.306)
sd.Parboiled.Parboiled			−0.767**	1.053***
			(0.234)	(0.247)
N	546	540	546	540
Log-likelihood	−377.340	−351.057	−376.609	−345.644
BIC	817.706	765.029	835.152	773.078
AIC	774.680	722.114	779.218	717.288

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 26 – RPL-EC models - Female affecting all the random parameters

	CG-RPL-EC	**TG-RPL-EC**	**CG-Cor-EC**	**TG-Cor-EC**
ASC_NoBuy	−4.792***	−5.423***	−4.640***	−4.417***
	(0.706)	(0.778)	(0.706)	(0.522)
Broken	−0.023*	−0.024**.**	−0.018	−0.024
	(0.012)	(0.014)	(0.015)	(0.014)
Origin	1.383***	1.728***	1.584***	1.760***
	(0.254)	(0.303)	(0.302)	(0.313)
Parboiled	0.011	0.791***	−0.118	0.858**
	(0.200)	(0.235)	(0.246)	(0.286)
Broken.Female	0.012	0.013	0.006	0.020
	(0.016)	(0.018)	(0.019)	(0.019)
Origin.Female	0.412	−0.049	0.085	0.157
	(0.373)	(0.375)	(0.379)	(0.397)
Parboiled.Female	0.228	−0.962**	0.144	−1.111**
	(0.298)	(0.309)	(0.327)	(0.358)
sd.Buy	2.026***	2.721***	0.938***	0.969***
	(0.552)	(0.536)	(0.23)	(0.242)
sd.Broken	0.035***	0.044***	2.593***	1.834***
	(0.010)	(0.012)	(0.698)	(0.514)
sd.Origin	1.246***	1.338***	0.044**	0.048***
	(0.222)	(0.262)	(0.014)	(0.012)
sd.Parboiled	0.738**	0.754**	1.569***	1.504***
	(0.225)	(0.245)	(0.311)	(0.274)
sd.Broken.Broken			−2.593***	−1.834***
			(0.698)	(0.514)
sd.Broken.Origin			−0.010	−0.020
			(0.014)	(0.015)
sd.Broken.Parboiled			0.904*	0.923**
			(0.355)	(0.290)
sd.Broken.Buy			−0.465**.**	−0.051
			(0.247)	(0.273)
sd.Origin.Origin			0.043**	0.043**
			(0.015)	(0.013)
sd.Origin.Parboiled			0.899**	0.592*
			(0.284)	(0.297)
sd.Origin.Buy			−0.223	−0.267
			(0.249)	(0.336)

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 26 – RPL-EC models - Female affecting all the random parameters (con't)				
	CG-RPL-EC	**TG-RPL-EC**	**CG-Cor-EC**	**TG-Cor-EC**
sd.Parboiled.Parboiled			−0.914* (0.400)	1.028** (0.376)
sd.Parboiled.Buy			0.234 (0.344)	0.103 (0.407)
sd.Buy.Buy			−0.747*** (0.215)	−0.925*** (0.258)
N	546	540	546	540
Log-likelihood	−370.391	−339.153	−366.209	−334.509
BIC	810.111	747.514	839.563	775.974
AIC	762.782	700.307	766.418	703.018

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Table 27 - RPL -EC model and an added RPL-EC model with heterogenous variable aroma affecting Parboiled

	No Info - EC	With info - EC	No Info - Model EC-aroma	With info - Model EC-aroma
ASC_NoBuy	−4.837***	−7.156***	−4.452***	−5.535***
	(1.029)	(1.739)	(0.903)	(1.224)
Broken	−0.011	−0.011	−0.009	−0.008
	(0.011)	(0.013)	(0.012)	(0.015)
Origin	1.619***	1.642***	1.730***	1.823***
	(0.269)	(0.307)	(0.307)	(0.311)
Parboiled	0.205	−0.120	−0.219	0.640
	(0.201)	(0.233)	(0.529)	(0.490)
sd.Buy	2.821***	4.746***	2.160**	3.501***
	(0.750)	(1.242)	(0.698)	(1.045)
sd.Broken	0.023	0.034	0.036**	0.053*
	(0.017)	(0.018)	(0.012)	(0.022)
sd.Origin	0.956***	1.330***	1.079***	1.229***
	(0.263)	(0.364)	(0.294)	(0.276)
sd.Parboiled	0.593	0.994**	0.871*	0.918**
	(0.344)	(0.312)	(0.396)	(0.342)
Parboiled.aroma			0.225	−0.522*
			(0.287)	(0.263)
N	270	294	270	294
Log-likelihood	−177.494	−187.928	−176.170	−184.961
BIC	399.776	421.324	402.726	421.075
AIC	370.988	391.856	370.340	387.922

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Comparing the basic model to the aroma model, the added variable does not improve the basic model for the control group, however, significantly does for the treatment group (Tables 7 and 8).

Table 28 - Likelihood ratio test between the basic RPL-EC and the RPL-EC with the heterogenous variable aroma affecting WTP for parboiled rice – Control group

	#Df	LogLik	Df	Chisq	Pr(>Chisq)
1	8.0000000	-177.4942282	NA	NA	NA
2	9.0000000	-176.1702129	1.0000000	2.6480306	0.1036783

Table 29 - Likelihood ratio test between the basic RPL-EC and the RPL-EC with the heterogenous variable aroma affecting WTP for parboiled rice – Treatment group

	#Df	LogLik	Df	Chisq	Pr(>Chisq)
1	8.0000000	-187.9277792	NA	NA	NA
2	9.0000000	-184.9611774	1.0000000	5.9332036	0.0148582*

Asterisks indicate significance. *** = 0.01, ** = 0.05, * = 0.1

Appendix B

Q1 Select your preferred option.

order1 = AB

Option A

Non-Parboiled

35% broken grains **Haiti**

120 gourdes (1)

order1 = AB

Option B

Parboiled **25% broken grains** **U.S.A.**

150 gourdes (2)

order1 = BA

Option A

Parboiled **25% broken grains** **U.S.A.**

150 gourdes (2)

order1 = BA

Option B

Non-Parboiled

35% broken grains **Haiti**

120 gourdes (1)

Option C **None** (3)

End of Block: B1.Q1

Start of Block: B1.Q2

End of Block: B4.Q7.Trap

Start of Block: store

Q62 Which marketing channel do you more often use to purchase rice?

- ○ Supermarkets (1)
- ○ Street markets (2)
- ○ Neighbor stores (3)

End of Block: store

Start of Block: cook

Q80 How often do you cook your own food?

- ○ I am not the one who cooks in my household (1)
- ○ 2 days a week (2)
- ○ 3 days a week (3)
- ○ 4 days a week (4)
- ○ 5 days a week or more (5)

End of Block: cook

Start of Block: consume

Q66 How often does your household consume rice?

- Once a week (1)
- 2 days a week (2)
- 3 days a week (3)
- 4 days a week (4)
- 5 days a week or more (5)

End of Block: consume

Start of Block: stock

Q68 How would you evaluate your stock of rice in your house right now?

- I do not have any stored rice in my house (1)
- For 1 or 2 days (2)
- For 3 to 5 days (3)
- For 2 weeks (4)
- For 3 weeks or more (5)

End of Block: stock

Start of Block: sticky

Q70 Regarding rice stickiness, do you prefer rice that:

- sticks (1)
- separates (2)
- I am indifferent (3)

End of Block: sticky

Start of Block: aroma

Q72 Regarding aroma, do you prefer rice that has:

- Mild aroma (1)
- Strong aroma (2)
- I am indifferent (3)

End of Block: aroma

Start of Block: color

Q74 Regarding rice color, do you prefer rice that looks:

- Yellow (1)
- Slightly creamy (2)
- White (3)
- I am indifferent (4)

End of Block: color

Start of Block: rank

Q76 Could you rank the following characteristics of cooked rice based on your own preferences?
(1 = most preferred. You can rank more than characteristic at the same level, for instance, if you value stickiness and aroma the most, then put 1 for both)

_____ Stickiness (1)
_____ Size (length) (2)
_____ Aroma (3)
_____ Color (4)

End of Block: rank

Start of Block: cook_methods

Q78 Mark the cooking practices / methods you most commonly use to cook rice?

- ☐ Always wash rice before cooking (1)
- ☐ Boil rice with an exact level of water without draining after rice is cooked (2)
- ☐ Stir - frying in oil or fat before boiling with an exact level of water (3)
- ☐ Other (4) _____

End of Block: cook_methods

Start of Block: rice_sub

Q82 For which food(s) do you substitute with rice?

- ☐ Maize / Corn (1)
- ☐ Wheat (2)
- ☐ Sorghum (3)
- ☐ Other (4) _____

End of Block: rice_sub

Start of Block: other_attr

Q84 Would you tell us other rice attributes that really matter for you that we do not mention in this study (It can be one, two or three attributes,)?

- 1 (1) _____
- 2 (2) _____
- 3 (3) _____

End of Block: other_attr

Start of Block: farming

Q86 Do you or your family have a farming background (owning a farm, used to produce food, or even selling food)?

- Yes (1)
- No (2)

End of Block: farming

Start of Block: gender

Q88 Gender

- Male (1)
- Female (2)

End of Block: gender

Start of Block: age

Q90 Age

- 18 - 30 years (1)
- 31 - 45 years (2)
- 46 - 59 years (3)
- 60 years or more (4)

End of Block: age

Start of Block: hh_size

Q41 How many people live in your household?

_____

End of Block: hh_size

Start of Block: children

Q94 How many children (under 18 years old) live in your household?

- None (1)
- One child (2)
- Two children (3)
- Three children (4)
- Four children (5)
- More than four children (6)

End of Block: children

Start of Block: married

Q96 What is your marital status?

- Married (1)
- Widowed (2)
- Divorced /Separated (3)
- Cohabitant (4)
- Single (5)

End of Block: married

Start of Block: education

Q98 What is the highest level of education that you have completed?

- Elementary school or less (1)
- High school (2)
- College or equivalent (3)
- Graduate School (4)
- Other (5) _____

End of Block: education

Start of Block: income

Q100 Average monthly household income

- ○ Less than HTG 25000 (equivalent to USD $395) (1)
- ○ Between HTG 25000 and HTG 40000 (2)
- ○ Between HTG 40000 and HTG 65000 (3)
- ○ Between HTG 65000 and HTG 90000 (4)
- ○ Between HTG 90000 and HTG 130000 (5)
- ○ Between HTG 130000 and HTG200000 (6)
- ○ More than HTG 200000 (7)

End of Block: income

Start of Block: Parb_New_Info

Q102 Did you know what parboiled rice was before taking this survey?

- ○ Yes (1)
- ○ No (2)

End of Block: Parb_New_Info

Start of Block: Parb_info

Q107 Do you know what parboiled rice is now?

- ○ Yes (1)
- ○ No (2)

End of Block: Parb_info

Start of Block: Nutrition facts_Food

Q104 20- Do Nutrition Facts influence your choice when purchasing **FOOD**?

- Yes (1)
- I am NOT SURE that I know what that means (2)
- No (3)

End of Block: Nutrition facts_Food

Start of Block: Nutrition Facts_Rice

Q106 21- Do Nutrition Facts influence your choice when purchasing **RICE**?

- Yes (1)
- I am NOT sure that I know what that means (2)
- No (3)

End of Block: Nutrition Facts_Rice

Start of Block: EvMW1

Ev1
In this section, we invite you to rate your answers from 1 to 7, where 1 = "never" and 7 = "all the time".
When engaged in an activity, my attention tends to remain focused on what I'm doing, without

really wandering off in other directions, such as my thoughts or feelings or daydreams.

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW1

Start of Block: EvMW2

Ev2
I notice the details in my current realm of experience and activity.
where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW2

Start of Block: EvMW3

Ev3
My attention is focused more on what I am doing and experiencing as opposed to what I am thinking, feeling, and imagining. where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW3

Start of Block: EvMW4

Ev4
My mind is often distracted by thoughts or feelings about things that are not relevant to what I’m doing at the time.
where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW4

Start of Block: EvMW5

Ev5
My mind easily wanders away from what I am currently engaged in doing or experiencing.
where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW5

Start of Block: EvMW6

Ev6
I find myself getting lost in my internal thoughts or feelings.
where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW6

Start of Block: EvMW7

Ev7
I don’t pay attention to what is going on in what I’m doing because I’m daydreaming, worrying, or otherwise distracted, where 1 = “never” and 7 = “all the time”

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)

End of Block: EvMW7

Appendix C

To:	Cleeford Pavilus
From:	Douglas James Adams, Chair IRB Committee
Date:	01/04/2018
Action:	**Exemption Granted**
Action Date:	01/04/2018
Protocol #:	1712087721
Study Title:	Assessing Consumers' Preferences for Rice in Haiti

The above-referenced protocol has been determined to be exempt.

If you wish to make any modifications in the approved protocol that may affect the level of risk to your participants, you must seek approval prior to implementing those changes. All modifications must provide sufficient detail to assess the impact of the change.

If you have any questions or need any assistance from the IRB, please contact the IRB Coordinator at 109 MLKG Building, 5-2208, or irb@uark.edu.

cc: Alvaro Durand-Morat, Key Personnel

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Figure 15 - Protocol Exemption from IRB