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A broken market: can increased access to broken rice decrease food insecurity in Haiti?

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Abstract

Haiti is a unique rice market in the sense that, despite the high poverty rates and dependency on rice as a staple, it relies on imports (80% of total consumption) of high-quality milled rice for which it pays a premium price. Haiti requires that all imported rice have a maximum of 4% broken kernels, which results in Haiti importing one of the most expensive non-fragrant long grain rice in the world. This study implements a non-hypothetical field experiment (300 observations) to elicit which rice attributes Haitians valued as revealed by their purchasing behavior in an open-air market setting. Specifically, we set out to estimate if Haitians would discount broken rice in such a manner that strict import regulations, which keeps cheaper imported broken rice out of domestic markets, continue to be warranted. Our findings suggest consumers (across locations and income groups) were not found to pay more for a reduced amount of broken rice, with the exception of the highest income group. This should signal to policy makers in Haiti that consumers are willing to consume rice with a higher percentage of brokens than the 4% importation standard. This is important from a food security standpoint as rice with a higher broken percentage provides the same nutritional value as rice with a lower broken rate, and can be sourced globally at a discounted price. Allowing imports of rice with higher broken rate could help alleviate food insecurity in Haiti by providing a cheaper alternative to relatively expensive domestic rice and imported rice, which currently has an inflated price due to its high-quality standards imposed by Haitian importers.

Keywords Broken Rice · Haiti · Food Security · Rice Quality

1 Introduction

In 2019, Haiti had the lowest per capita Gross Domestic Product (GDP) in the Western Hemisphere and was one of the most food insecure countries globally with 33% of its population needing food assistance and nearly half of the population, 49%, being chronically undernourished (World Food Program, 2019). Rice is the caloric staple in the Haitian diet and accounted for 30% of daily caloric intake in 2018, an increase from 7% of average daily calorie intake in

1985 (FAO, 2018). While rice has become an increasingly important part of Haitians' diets, domestic rice production has not been able to match this increasing demand. The lack of domestic rice production is due to the lack of sustained investment in agricultural production, irrigation and post-harvest infrastructures that have limited the growth of paddy yields and hampered the quality in the domestic industry. Haitian rice yields have remained stagnant at roughly two tons per hectare (half of the global average) since 2000 as a result of: lack of maintenance of irrigation, declining quality of land, lack of skilled labor, small farm sizes, and farmers having diminishing crucial inputs such as working capital, water access, and access to high quality seeds (Furche, 2013). As a result of these issues plaguing the domestic rice industry it was estimated that 80% of rice consumed in Haiti was imported in 2016, mainly from the United States (Cochrane et al., 2016). Given the close proximity to Haiti and the relative low transportation costs (compared to Thailand, India, Vietnam and other large rice exporters), U.S.

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Table 1 Yield of paddy rice 55/70 on the production of milled rice by U.S. grade, and surplus/deficit of broken rice[a]

Grade	% Broken[b]	Milled Rice Yield (kg)	Head Rice (Kg)	Broken rice (kg)	
				Used in Milled Rice	Surplus/Deficit
U.S. No. 1	4.00%	572.90	550	22.90	127.10
U.S. No. 2	7.00%	591.40	550	41.40	108.60
U.S. No. 3	15.00%	647.10	550	97.10	52.90
U.S. No. 4	25.00%	733.30	550	183.30	-33.30
U.S. No. 5	35.00%	846.20	550	296.20	-146.20
U.S. No. 6	50.00%	1100.00	550	550.00	-400.00

[a]A 55/70 paddy rice yields 550 kg of head rice and 150 kg of broken rice

[b]% of broken rice by weight

long grain rice dominates the imported rice market in Haiti. Although the United States produces less than 2% of the world's total rice crop, the U.S. rice production accounts for more than 10% of the volume of globally traded rice and is the largest exporter of rice to Haiti (USDA, 2013). Haiti is the second largest export market for U.S. long grain rice after Mexico.

Unlike other staple crops like wheat or maize, rice is unique in that after it is harvested, little processing is required before reaching the consumer making its physical appearance a deciding factor in consumer acceptance. Visual qualities of rice such as the percentage of brokens, color, size (length and width) and shape (e.g., length to width ratio) play an important role in rice markets globally with different attributes playing varying roles of importance in different markets (Cuevas et al., 2016; Custodio et al., 2016; Bairagi et al., 2020; Demont et al., 2017). Although the poorest country in the Western Hemisphere, Haiti imports mostly high-quality rice (U.S. #2 long grain with a maximum of 4% broken, hard milled) which is globally priced at a premium. For instance, in December 2020 the average Free on Board (FOB) price for U.S. No. 2, 4% broken was US$ 550/metric ton, relative to US$ 525/metric ton for U.S. No. 3, 15% broken, and US$ 465/metric ton for U.S. No. 5, 20% broken (Creed Rice Co., 2020). Thus, despite the economic difficulties, Haiti imports one of the most expensive non-fragrant long grain rice in the world.

Understanding the milling process of rice is crucial to an understanding of the quality of rice Haiti imports. After the hull and bran have been removed from rough or paddy rice through processing, the resulting polished rice or milled rice is then separated into brokens and head rice. As an illustrative example, if 1 metric ton (mt) of clean paddy rice is delivered to a mill, the rough/paddy rice would be initially milled to remove the hull and bran. Because the hull and bran have mass, the resulting mass of rice would be less than 1 mt. The rice futures market in the United States is traded on an average of 70% milled rice, which means that the milled rice yield (MRY) of 1 mt of paddy rice is 700 kg

(kg). Of this 700 kg of remaining mass, some kernels would remain intact and some would break, creating brokens, during the milling process. The rice futures market in the United States is traded assuming that 55% of the initial mass is whole kernels or head rice yield (HRY). Thus, in this example, there would be 550 kg of head rice for paddy rice with a HRY of 55%. The difference between MRY and HRY is the percentage of the initial mass that are broken kernels, which typically equals 15% (150 kg of brokens) in this example. The ratio 55/70 (HRY/MRY) is the standard on which the futures contracts for paddy rice are bought and sold in the United Sates. Haiti requires a ratio of 67.2/70, resulting in a higher quality, higher priced rice.

Milled rice is graded differently in different markets, but the percentage of broken is consistently used as a proxy for quality. For instance, the U.S. standard for rice (USDA, 2013) classifies milled rice of any type into six grades based on the presence of damaged, chalky, and broken rice kernels, the color and degree of milling of rice, and the presence of red rice kernels. The maximum limit of broken rice (per weight basis) for U.S. milled rice grade No. 1 (highest quality) is 4% (that is, 40 kg of broken rice per mt of milled rice), and for grade No. 6 (lowest quality) is 50% broken rice. Continuing with our example, a 55/70 (HRY/MRY) rice has a 21.4 percent broken rate or (150 kg/700 kg). To better understand the efficiency of producing each U.S. rice grade from a 55/70 paddy rice, Table 1 shows the milled rice yield and surplus/deficit of broken rice obtained from 1 mt of 55/70 paddy rice, the standard in the U.S. market. A metric ton of 55/70 paddy rice yields 572.9 kg of U.S. No. 1 milled rice by mixing 550 kg of whole rice and 22.9 kg of broken rice, and generates a surplus of 127.1 kg of broken rice. The production of milled rice graded No.1 through No.3 generates surpluses of broken rice, whereas the production of milled rice grades No. 4 through 6 generate deficits of broken rice.

The challenge for the rice industry is to balance the quality of the milled rice sold with the quality of paddy rice produced to minimize the surplus of broken rice (illustrated on Table 1), which is sold at a discount vis-à-vis milled rice

(Lyman et al., 2008). Complicating things, the quality of paddy rice, represented by amount of broken rice, is highly variable. Previous studies suggest that the impact of the environment, genotype, and environment-genotype interaction is lower on milled rice yield than broken rice yield (Blanche et al., 2009). Broken rice can have a large variance, even within a country and a growing year, depending on variations in climate, processing, genotype and genotype-by-environment interactions (Siebenmorgen et al., 1998; Lyman et al., 2008). Thus, it is difficult for producers to endogenously control amounts of brokens, and given the existing literature (Counce et al., 2005; Cooper et al., 2008; Lanning et al., 2011) that relates broken percentage to climatic outcomes, there is high amounts of spatial correlation with broken rice within a growing region, increasing the difficulty of the blending process within a country.

The three largest Haitian rice importers, Accra (Mega), Tchako, and Rice Co (Bull) require that imported rice has a maximum percentage broken of 4%. This strict high-quality requirement, even by high-income countries standards, seems counterintuitive in the context of the high food insecurity prevalence, rice per-capita consumption, and dependency on rice imports within Haiti. While these strict standards can result in homogenous rice in the market, it leaves little room for price discrimination for a lower grade, lower priced, rice with a higher percentage of broken kernels. It is likely that given the high standards Haitian importers impose for imported rice and the subsequent price premium it carries, many of the poorest Haitians are either priced out of the market or forced to buy less rice than they would purchase if lower priced rice options were available. If Haiti imported a wide range of rice with varying qualities, vendors could segregate by levels of quality and charge different prices, leading to increased consumer and producer surplus. That being said, this high import quality standard likely benefits Haitian rice producers as it shields them from an influx of lower quality lower priced imported rice. Because brokens are often perceived as being "poor" in appearance, they demand a significantly smaller price at retail – often selling at roughly 40% less than their whole kernel counterparts in 2020 (USDA, 2013). Broken rice provides the identical nutritional content as whole rice and could even combat food insecurity more efficiently than whole rice because of its lower global price. In some low-income countries, 100% broken rice is preferred, e.g., in the Senegambia region consisting of Senegal's northern region (Demont, 2013), Senegal's southern Casamance region (Britwum & Demont, 2021) and The Gambia in between (Britwum & Demont, 2021), and in Mauritania (Demont & Ndour, 2015). The West African context is unique in the world and can be explained by colonial import substitution policies. As such, importing cheaper broken rice as a strategy to combat food insecurity is not a novel idea. Thus, it is important to ascertain whether Haitian consumers express their preferences for broken rice via the price they pay; if not, we argue that importing rice with higher percentage of broken at a lower price may contribute to combat Haiti's chronic food insecurity issue.

Previous studies have found that Haitians prefer domestic (lower quality rice) over imported rice (possibly due to its inflated cost associated with broken import standards) which results in domestic rice often being priced higher than imported rice (Pavilus, 2018). As such, low income consumers in Haiti (59% of the population) are forced to choose between expensive domestic rice and imported rice with inflated prices due to high importation quality standards (IFRC, 2019). This situation leaves consumers with little choice in the effort to combat food insecurity, given rice is the staple crop of Haiti.

This study implements a non-hypothetical field experiment to elicit which rice attributes Haitians value as revealed by their purchasing behavior, and if those values are homogeneous across income groups and rice type (imported and domestic). Specifically, we set out to estimate if Haitians would discount broken rice, and other quality attributes, in such a manner that strict import regulations, which keeps cheaper imported broken rice out of domestic markets, continue to be warranted. If we find that Haitians, specifically poor Haitians, do not discount broken rice, then continuing the strict quality import standards may be unwarranted and likely exacerbates food insecurity. Importantly, we compare preferences between imported and domestic rice. If, all else equal, consumers prefer domestic rice over imported rice, then current high importation standards are unwarranted under the "infant industry" theory. Globally, consumer preferences for rice are heterogenous, and have been shown to be associated with different aspects of quality (Cuevas et al., 2016; Calingacion et al., 2014; Rutsaert et al., 2013). Quality attributes can be broadly grouped into search, experience, and credence attributes. Search attributes, such as price and appearance (e.g., percentage of broken, color, shape, and size) can be evaluated before purchase. Experience attributes, such as texture, taste, and aroma, can be evaluated only after consumption, while credence attributes are those that consumers cannot evaluate themselves (e.g., organic, fair trade) and thus rely on other institutions to ascertain their validity (Cuevas et al., 2016). In this study we focus on preferences for a selected group of search attributes that have been found to matter in other markets worldwide. To our knowledge, this is the first study looking at the market value of rice quality attributes in Haiti, and can serve as a roadmap to conducting consumer preference studies that include other attributes of interest. The results of this study are unique in that this is the first study of its kind to compare revealed preferences to importation policies in a food security context

in Haiti. The results of this study can be used by rice importers/exporters, governments, and NGOs in an effort to help alleviate food insecurity in Haiti.

2 Materials and methods

Unlike similar studies in other low-income countries concerning rice preferences that use hypothetical methods (Fiamohe et al., 2013; Musa et al., 2011), we asses consumer preferences as revealed in a market setting. While not novel in the experimental marketing literature, application of the revealed preference method is novel in evaluating rice preferences in Haiti and eliminates the hypothetical bias often found in experimental auctions and contingent valuation, and replaces a sensory lab setting for a real market purchase.

A total of 292 rice samples were collected across five major rice markets across Haiti in in June 2020. Samples were collected from the Pont-Sonde market in Artibonite, Ouanaminthe market in Nord-Est, Cap-Haitien market in Nord, and Petion-ville and Croix-des-Bouquets markets in West (Port-au-Prince). Acknowledging that certain domestic varieties such as Shella and Shelda are parboiled and sell at a significant premium vis-à-vis imported and even other domestic rice such as TCS-10 (Cochrane et al., 2016; Pavilus, 2018), we restricted the sampling to non-parboiled rice. Considering that almost all imported rice and a large share of the domestic rice is not parboiled, we estimate that the non-parboiled segment represents more than 90% of the rice market in Haiti.

Port-au-Prince is the largest and most diverse city in Haiti, and therefore two major open-air markets were selected to conduct the survey, Croix-de-Bouquet and Petionville. A determining factor in these market selections was a National Coordination of Food Security (CNSA) government document citing these two markets as the most important Port-au-Prince rice destinations for the rice value chain (Valcourt, 1996). Both market districts within Port-au-Prince have large populations (Croix-de-Bouquet at ~ 300,000, and Petionville at ~ 350,000), but Croix-de-Bouquet is known to be a less affluent suburb, and Petionville is known as the most affluent and the cultural capital of Port-au-Prince. These divergent markets were chosen in an attempt to capture the range of diversity of Port-au-Prince consumers.

The Artibonite valley in the central region of Haiti is the largest producer of domestic rice as well as the home to the third largest population center in Haiti, Gonaives. Ponte-Sonde was chosen as a market because of the dominant presence of domestic rice in the market as well as its location as an important crossroads between the two largest Haitian cities, Port-au-Prince and Cap-Haitien. Cap-Haitien was chosen as a market to survey as it is the second largest "urban" center in Haiti, situated on the northern coast with a distinct culture and history.

Ouanaminthe is situated on the border between Haiti and the Dominican Republic, and has a unique language, culture, and dietary habits. Dominican imported rice is prevalent there and it has a reputation of having large amounts of broken rice. The National Institute of Applied Sciences (INSA) of Paris measured some of this exchange in 2002, observing broken rice as a "key product" of exchange in Ouanaminthe between the Dominican Republic and Haiti, mostly in the form of informal exchanges, of which approximately 70% was informally exported from Dominican Republic into Ouanaminthe markets (Damais, 2002). It is also an important part of the value chain for both domestic and imported rice's distribution in the North-West of Haiti.

The survey was available to participants in both French and Creole. A 15-sample pre-test survey was conducted in Fondwa for question validation; these preliminary observations were not used in the final data analysis. The survey team, composed of Haitian natives fluent in both French and Creole, approached potential participants as they exited each respective market and asked if they had purchased rice that day in the market. Those that purchased rice were invited to participate in the survey. If the participant agreed to take the survey they were notified that they would be compensated for their time and that we would need to collect 50 g of the rice the participant just purchased. The potential participant was told that they would be given 200 Haitian Gourdes (HTG) or roughly US$ 1.86 at the end of the survey. Given that the average per capita income in Haiti is US$ 3.28 per day (World Food Program, 2019), the compensation amount was sufficient enough to cover their time and small sample of rice purchased.

Once the collected rice samples were bagged and labeled, participants completed a socioeconomic survey that included questions about gender, age, household size, highest level of education, and average household income, as well as questions about rice purchasing habits. It was important to ascertain how much the participant paid for their entire rice purchase. Rice in Haiti is often sold from open bags which can present a problem as weights are not standardized. There are common volumes (scoops) used in open rice bags, the marmit and the milk box. The marmit is roughly 300 g, one-third of a marmit is called a bwat let (literally a "milk box"). As such, participants were asked how many marmits or milk boxes they purchased so the enumerators could calculate total volume purchased. The participants were then asked how much they paid for that given volume. While this price was not observed, there would be little incentive for the participant to fabricate their answer as they had already been paid for the survey and there would be nothing to gain from lying. Moreover, since participants just purchased the rice in the market, there was a low probability that they would not

remember the price they paid. From this, we could calculate how much each participant paid per kg of rice.

Enumerators then asked questions pertaining to whether participants knew the rice origin, and brand of the rice they purchased. First, participants were asked if they knew the origin (either domestic or imported) of the rice they just purchased. This information is important as local Haitian rice often demands a premium price over imported, mostly American, rice. Local Haitian rice is typically easy to identify visually as it is more "off colored" than the more homogenous white imported rice. Next, consumers were asked if they knew which brand they had just purchased. In Haiti domestic brands like Shella and Shelda sell for 66% premium over the common imported American brands of Tchako and Mega (Cochrane et al., 2016).

Participants were then asked a series of questions about nine rice quality attributes which they considered as being important when purchasing rice. Participants were asked to rank their top five attributes, 1 through 5, with 1 being the most important. The options given were: cleanliness, price, amount of broken rice, amount of chalk, brand, origin, color, money on hand, and other. These options were designed to cover the many reasons Haitians consider when making a rice purchasing decision. Lastly, a question was asked pertaining to income so we could estimate if rice preferences were homogenous across income levels. High income was defined as above 16,688 Gourde/month (216.82 USD/month), low income defined as below 7,750 Gourde/month (100.69 USD/month) and medium income defined as in between these two numbers. These income bins were created with 7,750 Gourde/month being the poverty line in Haiti, and 16,688 Gourde/month is considered above the average income in Haiti.

2.1 Analyzing rice quality

The rice samples underwent a physical analysis at the University of Arkansas Food Science Rice Lab. Broken percentage for each sample was estimated using an indented cylinder grader, Satake Test Rice Grader (Satake TRG-05A). Broken grains are lifted by the indentations and by the cylinder's rotary motion whereas full-length kernels are not. Brokens fall from the indents into an adjustable trough that was calibrated for long grain rice, which can be discharged separately from the rest of the whole-grain rice. The angle of the trough, the cylinder chosen, and the speed of the rotation all factor into the percentage of brokens that are collected, and they were all calibrated for standard long-grain rice according to the procedure outlined by the Satake instruction manual. The length of the drum was 31.5 cm, the diameter of the drum was 25.7 cm, the speed of rotation was 60 rpm, and the angle of rotation was 38°. Each individual sample was tested through this method, then the broken rice was

weighed as well as the head rice to determine a percentage of brokens by weight in the sample using the following equation:

$$Pbr = \left(\frac{Wbr}{Ws} \right) * 100 \tag{1}$$

where *Pbr* is the percentage of broken rice, *Wbr* is the weight of brokens, and *Ws* is the initial weight of the rice sample used.

Estimation of the additional attributes; length, width, chalk, and discoloration, was analyzed by the SC5000 Seed-Count machine. The SeedCount method used a 500-kernel sample of each survey participant's rice, and employed a flat-bed scanner to create a digital image of each individual rice kernel. The SeedCount trays are designed to orientate the seeds on the flat side and the edge, which allows a portion of the seeds to be used to measure length and breadth and the others to measure width or thickness. The average length and width of all rice grains in the tray equaled the given length and width. Calibrated for long grain non-fragrant white rice, any color found in the rice that differed from the standardized white color was seen as a discolored and used towards a percentage discolored based on the entire tray of rice. Furthermore, the SeedCount observes chalk on the surface of the rice by identifying a difference in luminance and gives a score for "Chalk Impact" as a continuous variable between 0–100 based on the percentage of chalk present on each rice grain in the sample. Thus, from the SeedCount results we could quantify what the previous literature (Pavilus, 2018; Furche, 2013) has defined as important search attributes for rice in Haiti; width, length, and chalkiness for each of the 292 total rice samples. This, combined with the broken percentage data from the Satake Rice Grader, were paired with the demographic data collected for each sample and each Haitian survey participant.

While this study does not focus on credence attributes like taste and texture it would be naive to ignore the role they play, specifically in repeat purchases. For example, in 2014 when Vietnamese rice was selling at 60 to 80 percent of US rice, Haitian consumers resisted buying Vietnamese rice given the perceived differences between US and Vietnamese imported rice (Cochrane, 2016). While prices and search quality attributes play an important role in Haitian rice demand, cooking quality and other experience attributes contribute to demand as well.

2.2 Hedonic price model

Hedonic pricing is rooted in Lancaster's theory of demand that states that a product can be described as a bundle of characteristics or attributes (Lancaster, 1971), and that therefore the price consumers are willing-to-pay (WTP) for a product is a function of a combination of the attributes

Table 2 Determinates of Rice Purchases

Sample	Cleanliness	Price	Percentage Broken	Chalk	Brand	Origin	Color	Cash
Pooled	3.10	2.57	4.10	4.47	2.33	2.15	4.15	2.59
Rice Origin								
Imported	2.93	2.48	4.14	4.49	2.37	3.40	4.89	2.27
Domestic	3.39	2.70	4.03	4.45	2.26	1.92	3.55	3.17
Income								
Low	2.57	2.41	3.91	4.58	2.10	2.00	-	2.80
Medium	3.15	2.53	4.21	4.53	2.32	1.61	3.25	2.64
High	3.18	2.63	4.05	4.44	2.38	2.28	4.75	2.52
Market								
Cap Haiten	2.41	2.61	4.00	4.60	2.04	2.29	-	2.96
Croix des Bouquets	3.65	2.36	4.24	4.33	2.64	1.42	3.25	2.42
Ouanaminthe	2.84	2.69	4.12	4.09	2.63	2.81	4.75	2.50
Petion-ville	4.00	2.67	4.09	4.19	2.22	1.57	-	2.16
Ponte Sonde	2.57	2.54	4.02	4.73	2.18	2.30	-	3.65

Ranked factors with 1 being the largest determinate in purchasing rice and 5 being the least

of the product. Consumers make their purchasing choices based on the bundle of attributes that define each product, and the price they pay is considered their revealed willingness to pay for a product (Lusk & Shogren, 2007). Aside from the characteristics of the products, consumers' socio-economic status also impacts their choices. Thus, besides the physical characteristics of rice, we also account for the impact of selected socioeconomic characteristics on the price consumers are willing to pay for rice. This included categorizing the consumers into three income brackets of low, medium, and high, defined as below the poverty line (7,750 Gourde/month) for low, above average income for high (16,688 Gourde/month), and medium in between those two values (World Bank, 2020).

The hedonic price model assumes that the price P_i that consumer i is willing to pay is a function of rice quality attributes, represented by vector X_i, socioeconomic characteristics and location of consumer i, represented by vector Z_i, and market location represented by a vector of dummy variables L.

$$P_i = \alpha X_i + \beta Z_i + \gamma L + \varepsilon_i \tag{2}$$

Different model specifications were tested, including models with interaction between rice quality variables and socioeconomic characteristics of respondents $(X_i * Z_i)$, and subsample models by markets (Ponte-Sonde, Croix-des-bouquets, Petion-ville, Cap-Haiten, and Ouanaminthe), source (imported versus domestic), and income level (low, middle, and high income).

The model is estimated using a log–log functional form using Ordinary Least Squares (OLS), which means that the

coefficients are interpreted as elasticities. Accordingly, the coefficients β_j associated with the attribute j is:

$$\beta_j = \frac{\frac{\partial P_i}{P_i}}{\frac{\partial x_j}{x_j}} \tag{3}$$

The marginal price of rice attribute j is derived from Eq. 2 as follows:

$$\frac{\partial P_i}{\partial x_j} = \beta_j \frac{P_i}{x_j} \tag{4}$$

where P_i is the price paid by consumer i, β_j the coefficient of attribute j estimated from the hedonic model, and x_j represents the mean value of attribute j.

3 Results

Table 2 highlights which attributes consumers indicated they valued the most when purchasing rice. For the pooled sample, consumers ranked origin (domestic or imported), brand (which is likely a proxy for origin) and price, as the top-three attributes, respectively. The three top attributes are all reputation cues which may indicate that consumers have a preconceived notion of what type of rice they want to purchase prior to shopping. Interestingly, broken percentage, color, and chalk, in that order, rank the lowest (in terms of importance) in the pooled sample. In none of the subsets (markets location, income classifications and imported/domestic) does broken rice enter the top four most

influential reasons driving rice purchases. Several important results can be derived from Table 2. First, origin of rice is the most important factor influencing rice purchases identified by the respondents across all subsets. This is likely a function of the strong preference Haitians have for domestic rice (Cochrane, 2016; Furche, 2013; Pavilus, 2018). Second, while there could be correlation between rice brand and other rice quality variables, it appears that broken rice is not a major determining factor when Haitians purchase rice. Lastly, and maybe most important from a food security standpoint, is that cash on hand, was the fourth largest factor when purchasing rice. The fact that cash on hand is a driving factor in the purchasing of the staple crop in Haiti would indicate that rice price is an issue for Haitians.

Table 3 highlights the descriptive statistics for price and selected rice quality attributes in aggregate (pooled), by market, income, and origin. The average kernel length across all samples was 7.09 mm. The average length of domestic rice was statistically longer ($P < 0.5$) than imported rice. Width ranged from 2.04 mm to 2.54 mm, with a mean width of 2.4 mm which did not differ ($P > 0.05$) across the income and rice type (imported and domestic) subsets. The mean price for domestic rice (1.27 USD/kg) is significantly higher ($p < 0.05$), than the mean of imported rice (1.04 USD/kg). which follows the literature that states Haitians prefer domestic rice (Cochrane, 2016; Furche, 2013; Pavilus, 2018). Pricing between domestic and imported samples follows the findings in Table 2 where origin was the primary search attribute which consumers in this study had in determining rice purchases.

Broken percentage has a range of 3.0% to 48.1% with a mean of 15.9%. The most noticeable differences (Table 3) in means across locations were the relative high percentage (24.3%) in Ponte-Sonde, likely due to the high amount of domestic rice grown, purchased and consumed there. Interestingly, the mean broken percentage for imported rice was 10.46% (Table 3) which is higher than the importation maximum of 4%. This could be a function of rice being broken during transportation from port to the market as it is exported in bulk not in bags which increases the likelihood of breaking in transit. A more unlikely explanation could be that wholesalers or retailers are mixing cheaper domestic broken rice varieties such as TCS-10 in with 4% broken rice from the United States to increase their profit margins. Regardless, the actual importation standard (4%) and what is being sold to consumers is more than twice as great as what is required to import rice. Consistent with the findings from previously literature (Cochrane, 2016; Furche, 2013; Pavilus, 2018), domestic rice had a higher and significant ($P < 0.05$) level of brokens (24.34% on average compared to the pooled mean of 15.9% and the imported rice mean of 10.47%). This is important given the fact that imported rice has a range of 3.02 to 31.31% broken (Table 3) but was the

sixth most important attribute that consumers looked for in imported rice (Table 2). It would be expected that consumers would not value broken rice in imported purchases if they were consistently 4%, no or little variation in brokens would result in no concern/discount as all purchases would be similar, but given the large variation found in our samples, this result may suggest that even in the face of a large variance or heterogeneity in samples, broken rice is still not a major factor in imported rice purchases in Haiti.

3.1 Quality impacts

3.1.1 Percentage broken

Table 4 presents the results of the pooled fixed effects regression models. Upon estimation, models were tested for heteroskedasticity. For models which were found to be heteroskedastic, the heteroskedasticity consistent covariance matrix was estimated using HC3 as described by Long and Ervin (2000). In these cases, the robust standard errors were reported. The results for broken are significant ($P < 0.05$) across all specifications and indicate that as percentage of broken increases the price paid decreases, with the exception of Model 1. This counterintuitive finding is explained by the fact that on average domestic rice contains more brokens (13.87 percent more, Table 3) than imported rice, but nevertheless consumers pay a higher price for it. Given the large body of literature which suggests that Haitians prefer domestic rice (Cochrane, 2016; Furche, 2013; Pavilus, 2018), Model 1 is plagued with a collinearity issue between imported rice and broken percentage which is resolved in models 2–5 with the inclusion of an imported dummy (which is robustly significant ($P < 0.01$) and negative).[1]

The results of the broken coefficients in the pooled models 2–5 seem to suggest that while percentage of brokens significantly impact rice price, they play only a small role in determining overall retail price. The largest broken effect in models 2–5 (Model 2) suggests that for every 1% increase in broken rice the average retail price would decrease by only 0.1 percent. To put this in context, the range between the highest and lowest percentage of brokens in our samples was 45.1% (Table 3), which would only equate to a less than 5% (4.51%) change in price. While statistically significant, these results suggest that the retail price of rice in Haiti appears not to be sensitive to high amounts of brokens, all other quality factors being equal. Said another way, the poorest of the poor in Haiti are paying similar prices for low quality (high broken percentage) rice as they are for high quality (low broken percentage) rice, which could impact food security as

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[1] The Pearson' correlation estimate between imported rice and broken rice was -0.67 and -0.65 between imported and discolored.

Table 3 Summary Statistics of Pooled, Location, Income, and Imported/Domestic Quality Attributes Collected from Survey

	Pooled[a]	Ponte-Sonde[b]	Ouanaminthe[b]	Cap-Haitien[b]	Petion-Ville[b]	Croix desbouquets	Low Income[c]	Medium Income[c]	High Income[c]	Imported[d]	Domestic[d]
Price/kg (USD)[e]											
Min	0.46	0.62	0.91*	0.91*	0.79	0.46	0.46	0.62	0.85	0.46	0.62
Mean	1.13	0.96*	1.08	1.06	1.27*	1.30*	1.08	1.13	1.14	1.04	1.27*
Max	5.11	1.39*	2.04*	1.83*	2.56	5.11	2.13	2.56	5.11	5.11	2.56
Length (mm)											
Min	6.55	6.70	6.68	6.64	6.55	6.60	6.88	6.61*	6.55*	6.61	6.55
Mean	7.09	7.17*	7.06	7.07	7.07	7.09	7.17	7.09	7.08	7.06	7.14*
Max	8.08	8.08	7.75	7.51*	7.98	7.69	7.73	8.08	7.79	7.98	8.08
Width (mm)	0	0	0	0	0	0	0	0	0	0	0
Min	2.04	2.12	2.04	2.12	2.08	2.04	2.15	2.04	2.04	2.04	2.04
Mean	2.37	2.36	2.35	2.38	2.40*	2.38	2.37	2.37	2.37	2.38	2.36
Max	2.54	2.53	2.52	2.52	2.54	2.54	2.51	2.54	2.54	2.54	2.54
Chalk Impact (0–100)											
Min	0.00	0.00	0.34	0.47*	0.09	0.12	0.12	0.29	0	0.09	0
Mean	2.71	2.60	2.70	2.89	2.56	2.82	2.30	2.78	2.74	2.69	2.74
Max	21.03	8.27	5.41	21.03	8.31	9.00	3.87	21.03*	9.00	21.03	8.31
Total Colored (%)											
Min	15.30	38.70*	33.1	31.50	30.70	15.30	32.90	15.30	30.70	15.30	38.2*
Mean	51.53	54.78*	49.41	50.53	54.14	48.79	46.74	53.01	51.51	50.51	53.07
Max	87.30	86.10	85.60	86.60	87.30	84.50	86.1	86.6*	87.3	87.3	86.1
Broken (%)											
Min	3.02	3.02	3.69	3.73	5.17*	3.72	3.72	3.02	3.69	3.02	5.88*
Mean	15.97	24.28*	12.98*	12.91*	15.57	13.94	18.80	15.16	15.95	10.46	24.25*
Max	48.08	48.08	46.53	36.3*	41.22	44.34	48.08	47.59	47.58	31.31	48.08*
Observations	292	59	60	59	57	57	28	93	171	175	117

[a] Average for all 292 samples in the dataset

[b] Average for each market sample

[c] Average for each income classification. Significance (* denotes $P<0.05$) pertains to differences (for Medium and High Income) relative to the Low-Income base group. Bootstrapping (10,000 draws) was used to calculate the empirical P values

[d] Average for each type of rice, Imported and Domestic. Significance (* denotes $P<0.05$) pertains to differences between Imported and Domestic rice types

[e] June 17, 2020 exchange rate of 1USD to 106.68 Haitian Gourdes

Table 4 Pooled Regression Model Results

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln Length (mm)	-0.096	-0.049	-0.104	0.084	0.129
	(0.564)	(0.544)	(0.613)	(0.562)	(0.580)
Ln Width (mm)	0.386	0.608*	0.596*	0.442	0.458
	(0.325)	(0.331)	(0.347)	(0.324)	(0.327)
Ln Chalk Impact	0.032**	0.033**	0.035**	0.026**	0.024**
	(0.016)	(0.016)	(0.014)	(0.011)	(0.011)
Ln Broken (%)	0.041*	-0.100***	-0.099***	-0.082***	-0.079***
	(0.024)	(0.030)	(0.030)	(0.028)	(0.028)
Ln Discolored (%)	0.016	-0.021			
	(0.058)	(0.058)			
Imported		-0.270***	-0.268***	-0.386***	-0.383***
		(0.044)	(0.043)	(0.042)	(0.042)
Croix des Bouquets				0.052	0.063
				(0.047)	(0.050)
Ouanaminthe				-0.063**	-0.063**
				(0.030)	(0.030)
Petion-ville				0.062**	0.062**
				(0.030)	(0.030)
Ponte-sonde				-0.329***	-0.326***
				(0.041)	(0.041)
Med Income					0.063
					(0.048)
High Income					0.059
					(0.050)
Constant	4.416***	4.798***	4.833***	4.687***	4.523***
	(1.345)	(1.367)	(1.417)	(1.320)	(1.374)
Observations	292	292	292	292	292
R^2	0.025	0.161	0.161	0.398	0.403

*$p<0.1$; **$p<0.05$; ***$p<0.01$

low-quality rice can be sourced for a reduced price compared to the high quality low broken rice Haiti currently imports.

While the pooled models in Table 4 provide snapshots for Haiti in general, they do not provide broken rice specific coefficients for different segments of the Haitian population. Given that different markets across Haiti likely represent heterogeneous preferences for rice, Table 5 estimates market specific broken rice coefficients. In all locations besides Petion-ville (where increased brokens are associated with a small and significant discount), broken percentage had no ($P>0.10$) effect on rice price. One argument for this seemingly counterintuitive result is that consumers cannot tell the difference between samples with varying levels of brokens and thus rice sellers take advantage of their lack of ability to discriminate. Regardless of the reason, there seems to be little justification to restrict lower quality imported rice out of the Haitian market given there is no price discount associated with it. From a vendor/wholesaler standpoint, this finding is advantageous as there appears to be no discount associated with a rice with higher brokens (and lower priced) rice compared to a more expensively sourced higher quality (lower brokens) rice. These results could be a function of the fact there is no clear labeling system indicating broken percentage that can be trusted. Consumers could care about the percentage of brokens in their rice but because it's difficult to visually distinguish they will require an effective extrinsic quality attribute labeling system to ensure intrinsic quality in terms of brokens is rewarded.

Table 6 shows the results of the hedonic price model for imported and domestic rice. Interestingly, there was no statistical ($P>0.10$) effect of broken rice on domestic rice price, despite it having a high broken rate (Table 3). This would seem to be positive news for the Haitian rice supply chain as consumers are estimated not to discount broken rice within the range of broken rice observed in this study. Conversely, it was found that there is a discount associated with higher percentages of broken rice for imported rice. This marginal (0.07% per every 1% change in broken percentage) but statistically significant ($p<0.05$) discount is likely a reflection of the perception that imported rice is of a higher quality

Table 5 Market Specific Regression Results

	Cap-Haitien	Croix des bouquets	Ouanaminthe	Petion-ville	Ponte-sonde
Ln Length (mm)	-0.035	2.508	0.749	0.024	0.012
	(0.699)	(2.683)	(0.651)	(0.562)	(0.392)
Ln Width (mm)	0.433	1.103	0.550*	0.076	-0.302
	(0.382)	(1.674)	(0.311)	(0.464)	(0.391)
Ln Chalk Impact	0.007	-0.015	0.036	-0.027	0.022*
	(0.024)	(0.039)	(0.038)	(0.025)	(0.012)
Ln Broken (%)	-0.002	-0.043	-0.025	-0.096*	0.063
	(0.042)	(0.086)	(0.054)	(0.054)	(0.043)
Imported	-0.249***	-0.555***	-0.104	-0.610***	0.026
	(0.070)	(0.116)	(0.086)	(0.063)	(0.071)
Medium Income	0.098	0.134	0.149**	-0.064	0.071
	(0.113)	(0.120)	(0.066)	(0.056)	(0.049)
High Income	0.056	0.12	0.032	-0.069	0.043
	(0.106)	(0.152)	(0.060)	(0.048)	(0.028)
Constant	4.564***	-0.618	2.840*	5.472***	4.596***
	(1.338)	(6.620)	(1.495)	(1.267)	(0.954)
Observations	59	57	60	57	59
R^2	0.315	0.421	0.203	0.757	0.1

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

than domestic rice, and thus the standards associated with it are likely internally higher for consumers. Again, these findings are robust with the collective findings for all model specifications for brokens—they affect price but only marginally. Important from a food security standpoint, the difference between the highest and lowest brokens for imported rice (Table 3) was 28.29% which would indicate a price reduction of 2.06%. This should signal rice importers, NGOs, and government agencies in Haiti that they could actively consider sourcing cheaper rice with higher percentage brokens to help combat the high food insecurity rate in Haiti.

Income could also be a factor where broken rice manifests itself as being inferior, with higher income consumers being willing and capable of paying higher prices for rice that was perceived to be higher quality rice. Table 7 shows the results of the hedonic price models by income group. Again, high income was defined as above 16,688 Gourde/month (216.82 USD/month), low income defined as below 7,750 Gourde/month (100.69 USD/month) and medium income defined as those consumers who fall between. These numbers were determined as 7,750 Gourde/month is the poverty line in Haiti, and 16,688 Gourde/month is considered above the average income in Haiti. Table 7 indicates that only high-income consumers pay a discount ($P < 0.10$) for broken rice. These results are in line with previous research in low-income countries that low levels of brokens are seen as a symbol of quality, and oftentimes, wealth for rice consumers (Tomlins et al., 2007). Demont et al. (2017) found similar results in West Africa where the more consumers value low broken rates, the less they are willing-to-pay for domestic

rice relative to imported rice. There is no statistically significant ($p > 0.10$) impact of broken rice on the price paid by middle and low-income consumers. These findings again strengthen the argument to lessen import restrictions with regards to brokens in an effort to source cheaper (higher broken percentage) rice to help the poorest of the poor. This would only benefit the poor with the naive assumption that lower quality (brokens greater than 4%) imported rice would be priced lower in market such that partial welfare gains could captured by low- and middle-income consumers.

3.1.2 Length and width

The effects of length and width are not as robust as the findings for broken rice. Length was not significant ($P > 0.10$), regardless of the model specification. This could be attributed to the fact that all rice in our sample was classified as long grain (thus there were no medium or short grain rice for comparison). Wider kernels resulted in higher prices in the high-income consumers and the Ouanaminthe market subsets and in all other instances there was no statistically significant ($P > 0.10$). Importantly, the length to width ratio (LWR) was also modeled in place of its individual components for each of the regression presented in Tables 4–7. The LWR is often used in rice quality analysis as the ratio of the two components are important in some markets (for example Iraq prefers long and skinny kernels). This being said, R^2 measures were robustly higher for the individual components compared to the LWR and as such LWR results were not reported.

Table 6 Imported/Domestic Model with Location and Income

	Imported rice	Domestic rice
Ln Length (mm)	1.170	-0.673
	(0.966)	(0.527)
Ln Width (mm)	0.444	0.422
	(0.488)	(0.428)
Ln Chalk Impact	-0.002	0.005
	(0.015)	(0.019)
Ln Broken (%)	-0.070**	0.036
	(0.030)	(0.056)
Croix des bouquets	-0.015	0.289***
	(0.058)	(0.093)
Ouanaminthe	0.011	-0.133*
	(0.029)	(0.069)
Petion-ville	-0.022	0.302***
	(0.029)	(0.079)
Ponte-sonde	-0.067	-0.286***
	(0.054)	(0.061)
Medium Income	0.061	0.114*
	(0.070)	(0.063)
High Income	0.038	0.056
	(0.077)	(0.058)
Constant	2.138	5.690***
	(2.298)	(1.240)
Observations	176	116
R^2	0.077	0.68

*p <0.1; **p <0.05; ***p <0.01

4 Discussion

Haiti is a unique rice market in the sense that, despite the high poverty rates and dependency on rice as a staple, it relies on imports of high-quality milled rice for which it pays a premium price. These high import standards are importer and not government imposed, which would suggest that this strict importation policy is not part of a protectionist policy to grant opportunities for the domestic industry to develop. Further, this study and previous literature suggests that there is a strong revealed preference for domestic rice over imported rice in Haiti, which further questions the presence of high importation quality standards if the markets appear not to be perfect substitutes for one another. One possible explanation for importers wanting to delineate high quality imported rice from lower quality, yet higher priced domestic rice, could be to ensure visual market segmentation. That is, since labels and standards are not enforced in Haiti, rice vendors may want to ensure that consumers know, via visual assessment, which rice is imported and which rice is produced domestically to ensure the premium of domestically produced rice is captured. One way of doing this is to ensure

that imported rice has less brokens at a rate which is visibly discernable to consumers.

Of the findings of this study, the most robust is that consumers (across locations and income groups) were not found to pay more for a reduced amount of broken rice, with the exception of the highest income group. This should signal to policy makers in Haiti that consumers are willing to consume rice with a higher percentage of brokens than the 4% importation standard. This is important from a food security standpoint as rice with a higher broken percentage provides the same nutritional value as rice with a lower broken rate, and can be sourced globally at a discounted price. Allowing imports of rice with higher broken rate could help alleviate food insecurity in Haiti by providing a cheaper alternative to relatively expensive domestic rice and imported rice, which currently has an inflated price due to its high-quality standards imposed by Haitian importers. The extent to which rice with a higher broken rate will be actually accepted by Haitian consumers remains to be seen and requires further, more detailed, market analysis. For instance, consumers may be concerned about the changing cooking characteristics of rice with higher broken percentage and how that may affect the texture and overall appeal of traditional rice dishes. While the existing literature suggests that the hardness and

Table 7 Imported Regression Results

	Low Income	Medium Income	High Income
Ln Length (mm)	-3.215	-0.261	0.345
	(2.365)	(0.506)	(0.947)
Ln Width (mm)	-0.840	-0.439	1.079**
	(1.950)	(0.339)	(0.489)
Ln Chalk Impact	-0.06	0.063**	0.018
	(0.069)	(0.026)	(0.014)
Ln Broken (%)	-0.092	-0.027	-0.113***
	(0.130)	(0.049)	(0.034)
Imported	-0.540*	-0.391***	-0.383***
	(0.258)	(0.088)	(0.051)
Croix des bouquets	0.092	0.025	0.112
	(0.206)	(0.069)	(0.080)
Ouanaminthe	-0.048	-0.001	-0.078**
	(0.184)	(0.065)	(0.033)
Petion-ville	0.208	0.006	0.086**
	(0.181)	(0.056)	(0.039)
Ponte-sonde	-0.395	-0.382***	-0.270***
	(0.248)	(0.099)	(0.044)
Constant	12.384*	5.988***	3.695*
	(6.340)	(1.104)	(2.214)
Observations	28	93	171
R^2	0.442	0.42	0.454

*p <0.1; **p <0.05; ***p <0.01

stickiness of cooked rice is not much affected by the broken percentage of cooked rice, it also suggests differences in behavior across rice varieties (Saleh & Meullenet, 2013) that will need to be further explored.

Across all samples the largest difference between brokens (max – min) resulted in a price difference of only 4.44%, a small amount given that price in the same samples ranged from $0.46/kg to $5.08/kg. Importers strongly favor importing rice with a maximum of 4% broken rice, but there appears to be a disconnect in the supply chain because imported rice averaged 10.47% broken. This difference is likely due to handling and transportation once in Haiti. The result of brokens not driving price either indicates that middle- and lower-class Haitians don't have a large aversion to broken rice, or that rice vendors are not pricing rice accordingly. This result, the main of this study, can have large implications for food security in Haiti as it suggests the import standard of 4% or less of brokens should likely be removed or altered to a rate which is more in line with global standards of 15%. Importantly, this study does not suggest that Haitians are simply willing to accept any amount of broken rice when purchasing rice. The maximum level of brokens in this study was 48.1% and inferences above that percentage cannot be made. There is likely a percentage of brokens which Haitians would be willing to purchase but possibly not consume again if it changes the cooking properties or texture of the rice. Further research is warranted on this important matter. Rice is unique in that it is very cultural and not properly understanding its role in the socio-cultural context of Haiti could possibly undermined any food security enhancing effort.

As of 2020, U.S. broken rice sold for 41% less than head rice. This price difference is not being reflected in the sales price of imported rice in Haiti. This could be due to the fact that vendors assume that the imported rice they are selling has a mean of 4% broken when in reality it is higher (10.47%) and thus they price accordingly. When asked, a large American Rice exporter to Haiti stated that on average they assume a 4 to 6% breakage due to transport from the US to Haiti. Thus, 4% broken rice on the docks of the US can land in Haiti at 8 to 10% but vendors could still charge consumers the 4% rate as that is what the vendor paid as well. If rice with increased broken percentage was allowed into Haiti and vendors priced this lower priced rice accordingly, the difference could allow the low-income population in Haiti to either eat more rice or eat the same amount of rice and increase their disposable income for other goods, both of which will lead to welfare gains. The results of this study are important because they suggest that the current import standards are hampering food security in Haiti.

The other important finding of this study is that Haitian's prefer Haitian rice.. This has important implications for the Haitian rice industry as it struggles with production and quality issues. This finding, which runs parallel with previous studies, would suggest that money within the Haitian rice industry should be focused on increasing yield and area and not necessarily quality. While it is evident that Haiti will not be self-sufficient in rice production in the near future, the rice industry in Haiti should feel confident, from a demand standpoint, about its future given the high level of preference for local rice over imported higher quality rice. That being said, if quality importation standards are lowered, poor Haitian rice producers could face more competition from cheaper imports, which could negatively affect their livelihoods.

This study also gives credence to U.S. rice exporters who are trying to get lower priced rice into Haiti. Broken rice produced in the United States is often funneled off into the pet food industry at a substantial reduction in price by volume. If U.S. broken rice can obtain better access to the Haitian market there are possible Pareto gains. U.S. rice producers would be better off as they would obtain a better price than what the pet food market provides, and Haitian consumers would be better off as they would have access to cheaper rice (which it appears they are indifferent to, with regards to brokens). Haitian importers could be made better off too by segmenting the market by percent brokens and obtaining rents on each segment. Regardless of how the broken rice enters Haiti, it is evident that cheaper rice on the plates of the poor across Haiti is a better solution for global food security than in the bags of pet food.

Declarations

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Matthew Richardson recently completed his Master's in Food Science at the University of Arkansas. His research focused on the optimization of broken rice through understanding sensory and economic preferences worldwide. Through working with a team at University of Fondwa in Haiti and the University of Arkansas - Fayetteville, Matthew was able to focus on Haiti and their specific rice preferences as well as investigate sensory preferences of rice in Arkansas. He is now an Associate Food Scientist at Newly Weds Foods in Cincinnati, OH.

Dr. Nalley received a B.S. degree in agricultural and development economics with minors in development studies and European history from The Ohio State University. He received his M.S. degree in agricultural economics from Mississippi State and his Ph.D. from Kansas State University in 2007 in agricultural economics with an emphasis on international policy. Dr. Nalley has gained

international attention for modeling the effects of climate change (increased temperature, increased frequency and intensity of extreme heat events, increased salinity, decreased rainfall, etc.) on rice, maize and wheat yields. Furthermore, Dr. Nalley's research provides insight into achieving sustainable global rice, maize and wheat production in the face of climate change, while also incorporating integrated research approaches across economic, agronomic, soil, biological, hydrologic, and other scientific disciplines.

Dr. Durand-Morat's research focuses primarily on the sustainability of rice production and consumption, agricultural policies, and international development. Dr. Durand-Morat's current research topics include the impact of climate change on rice production in Southeast Asia, the impact of trade policies and production subsidies on the global rice economy, the assessment of production technologies on the sustainability of rice production and food security situation, and consumer behavior for specific rice quality attributes. Most of Dr. Durand-Morat research is primarily multidisciplinary in nature, and includes collaborations with agronomists, hydrologists, chemical engineers, and political scientists among other disciplines.

Phil Crandall is a professor at the University of Arkansas working in the research areas of: novel methods for training food industry employees, food safety in both the basic and applied aspects and functional food ingredients. Dr. Crandall teaches a dual level Food Chemistry course for undergraduates and graduate students in Food Science. Phil directs MS and PhD students.

Andrew Scruggs has an undergraduate degree in International Economics at the University of Notre Dame and a Masters in International Development from the Paris School of International Affairs at Sciences-Po in France. Andrew has worked at the University of Fondwa (UNIF) since 2018, and, as the Director of Strategic Partnerships, coordinates all international relations and partnerships for UNIF. Andrew also works closely with the UNIF Department of Research, acting as one of the research coordinators for a broad socio-economic household survey recently completed by UNIF in the rural village of Fondwa.

Lesly Joseph is an agronomist and statistician, specializing in biostatistics. Lesly was born in the Limonade community of Haiti and completed his undergraduate degree in agronomy at the Universite d'Etat d'Haiti in 2014. He then went on to complete a masters in tropical agriculture with Atlantic International University in Hawaii (degree completed online) in 2015. Finally, he was awarded a full scholarship plus living stipend to complete a second masters in Belgium by 2019. He completed this second masters in Agro-Environmental Sciences at Ghent University, one of the oldest and most prestigious universities in Belgium, which is consistently ranked in the top 100 universities in the world and among the top research universities in continental Europe. After completing this degree, he returned to Haiti in 2019 to join the UNIF team as a professor of research methodology. In 2021, he was named the new Dean of the School of Agronomy.

Jérôme Chouloute is an agronomist with a master's in project management and over ten years of project management experience in Haiti. Especially, he has worked on projects with Food for the Poor, the United Nations, and the Ministry of Agriculture in Haiti working on subjects such as smallholder farming access to markets, rice production in Artibonite and the Nippes region, and irrigation access for smallholder farmers. He is currently the Director of Student Affairs at UNIF while also teaching classes in the agronomy school. His research interests lie in irrigation, water access, fish farming, and rice production.
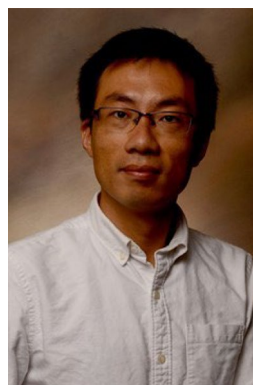
Wei Yang is a program associate in the Department of Agricultural Economics and Agribusiness at the University of Arkansas. He received Masters in Agricultural Economics and Statistics. His specialties are experimental design and data analysis.