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Consumer Preferences for Sustainable Rice Practices in Nigeria

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Consumer Preferences for Sustainable Rice Practices in Nigeria

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Abstract

Improving the sustainability of rice production is important given its position as a global staple and its environmental footprint. The adoption of sustainable practices can generate positive externalities such as lower environmental pollution and improved working conditions for rice industry workers that could be capitalized via the design of consumer-based marketing strategies. The Sustainable Rice Platform (SRP) initiative aims at advancing the adoption of sustainable practices in rice production. We assess consumers' perceptions of the SRP sustainability indicators using the Best-Worst Scaling approach to rank SRP sustainability attributes according to their preference shares and examine the effects of demographic characteristics and rice purchasing habits on these shares. The results show that Nigerian consumers have a strong preference for sustainability indicators associated with food safety and health and safety, and that preferences are robust across households' demographic and consumption characteristics. Our results can help guide private and public sustainability policy development and investment in Nigeria's rice economy that are grounded in consumer preferences for such attributes.

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Dedication

I dedicate this thesis to my mother, Mrs Franca Okpiaifo. Thank you for all you have invested in me.

Table of Content

Table of Tables

Table of Appendix Tables

Introduction

Rice is a staple for over half of the global population, most of which live in low- and lower-middle-income countries (Dawe, Pandey, & Nelson, 2010). Rice production occupies around 160 million hectares or 11 percent of the world's arable land, and is conducted mainly by small-scale producers that depend on it as a source of calories and income.

Global rice production needs to double by 2050 to meet the projected demand at current market prices (Ray, Mueller, West, & Foley, 2013). This will put significant pressure on natural resources and the environment. Rice production is intensive in the use of water, with a global average water footprint of 1,325 m^3 ton^{-1} (Chapagain & Hoekstra, 2010). Hence, rice is a major user of irrigation water accounting for approximately 40 percent of the world's irrigated water demand (SRP, 2019a). Rice is also considered a major anthropogenic source of methane (CH_4) and nitrous oxide (N_2O), accounting for up to 19 percent of global CH4 emissions and 11 percent of global agricultural N_2O emissions (US-EPA, 2006; Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). In addition, the excessive and sometimes improper use of chemical inputs, mainly nitrogen fertilizer (an important input in rice production), can increase greenhouse gas (GHG) emissions and other environmental problems such as soil acidification (Guo, et al., 2010) and water pollution (Diaz & Rosenberg, 2008). From the information above we can infer that the challenge for the global rice sector in the coming decades is to foster significant growth to satisfy the growing demand in a way that is compatible with the increasing resource and environmental constraints. Moreover, sustainability also includes aspects of social equity, in particular gender equality and women's empowerment.

The concept of sustainable development was introduced in the late 1980s by the World Commission on Environment and Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, ch 2, 1). Hence, sustainable development is a holistic concept that recognizes the need to integrate different systems (e.g., economy, agronomy, and environment) in order to achieve the sustainable goals. In the agricultural context, sustainability is commonly defined along three pillars or objectives: environmental, economic, and social (Latruffe, et al., 2016), that is, economically viable, socially supportive and ecologically sound (Western SARE, 2012). There has been a proliferation of agricultural voluntary sustainability standards and sustainability indicators in the last 20 years, which in many cases have benefited policy analysis (Diazabakana, et al., 2014). Voluntary sustainability standards are voluntarily accepted by stakeholders with the aim of increasing output while decreasing adverse effects on the environment and the community (Cashore, Auld, & Newsom, 2004; Foley, et al., 2011; Garnett, et al., 2013; Milder, et al., 2014). These standards typically consist of four components; the standard per-se, assurance systems to guarantee the application of the standards, the development of sustainability labels to differentiate the goods produced sustainably in the market, and training and technical assistance activities to ensure the standards are understood and applied properly. Agricultural sustainability standards are prominent in coffee, cocoa, palm oil, tea, cotton, sugar, soybeans, and bananas (Potts, et al., 2014), but less relevant in field crops such as rice, corn, and wheat which occupy more than 50 percent of the global crop area.

The Sustainable Rice Platform (SRP) Standard for Sustainable Rice Cultivation is the world's first voluntary sustainable standard for rice. First introduced in 2015 and updated in 2019, the standard applies to all farm-level processes in rice production, including postharvest processes under the farmer's control, and it is a tool for practitioners in public and private sectors to drive wide-scale adoption of climate-smart sustainable best practices (SRP, 2019b). The SRP standard comprises 41 requirements and 12 performance indicators, namely, Farm profitability, Labor productivity, Productivity: Grain Yield, Food safety, Water use efficiency, Nutrient-use efficiency: Nitrogen, Nutrient-use efficiency: Phosphorus, Pesticide-use efficiency, Greenhouse gas emissions, Worker health and safety, Child labor and Women Empowerment (SRP, 2015). The SRP Standard works by allocating scores for different compliance levels of the various requirements, and establishing minimum score thresholds needed to claim that a farmer is "working towards sustainable rice cultivation" or producing "sustainably cultivated rice".

The overarching goal of this study is to investigate the importance of sustainable rice production practices as defined by the SRP to the Nigerian consumers as a way to improve the formulation of consumer-based sustainable policies. Concerns have been raised about the validity of the approaches used for the definition of sustainability standards and the uncoordinated coexistence and lack of governance (Derkx & Glasbergen, 2014; de Olde, et al., 2016). Furthermore, there is little evidence of consumer feedback used in the development of sustainability standards, when in reality the success of such standards depend on consumers' willingness and ability to pay a premium for products produced following sustainable practices. Globally, studies of consumers' perception of sustainability in rice have been more focused on areas such as organic labels, fair trade labels, and eco-friendly labels (Ruekkasaem & Sasananan, 2017; Aoki, Akai, & Ujiie, 2017; Rahnama, 2017; Tu, Can, Takahashi, Kopp, & Yabe, 2018). Sackett, Shupp, and Tonsor, (2013) examined U.S. consumer perceptions of sustainable rice production practices as defined by the United States Department of Agriculture (USDA), and Nguyen et al. (2018) find evidence that Vietnamese consumers are willing to pay a premium for sustainable-produced rice. To the best of our knowledge, our study is the first to assess consumer preferences for rice sustainability indicators in Nigeria.

Nigeria is Africa's most populous country, and it is projected to be the third most populous country in the world by 2050 (National Population Commission, 2018). Rice is the second most important staple in Nigeria accounting for 10.5 percent of the average caloric intake (FAO, 2019) and 6 percent of household expenses (Johnson, et al., 2013). Nigeria is the second largest producer of rice in Africa due to a 70 percent growth in production in the last decade (USDA – FAS, 2019), and is projected to continue growing over the next decade. Rice is produced mainly by small-scale farmers (80 percent of which farm less than a hectare) under rain-fed conditions, which leads to a relatively low yield productivity (Takeshima & Bakare, 2016). Consumption growth has outpaced production growth, making Nigeria the second largest importer of rice after China in the last decade with an average of 2.4 million metric tons a year, a situation expected to continue in the coming decade (Durand-Morat, Chavez, & Wailes, 2019).

Nigeria was selected for this study because of its prospects to deploy the SRP Standard. Historically there has been limited vertical integration in the Nigerian rice supply chain, which undermines its competitiveness by lowering the productivity and increasing the transaction costs along the chain, resulting in relatively small profit margins for the agents along the domestic rice supply chain (Johnson & Ajibola, 2016). However, private and public efforts are ongoing to improve this situation. Numerous private and public stakeholders are investing to improve the productivity and sustainability of the rice supply chain, by advancing climate-smart technologies (e.g., system of rice intensification, integrated pest management), promoting vertical integration (e.g., out-grower schemes, financing), and investing in more efficient milling equipment.

Thus, the dynamic nature of the rice sector and the potential benefits of improving its competitiveness and sustainability make Nigeria a good market to assess consumers' views and preferences on sustainable rice production practices.

By identifying consumer preferences for sustainability attributes in rice production, our study aims to contribute to one and three of the components of voluntary sustainability standards outlined above, namely, help in the development of the sustainability standards and labeling/marketing strategies for sustainable rice in Nigeria. The results of the study will be important to help stakeholders develop strategies to deploy the SRP standard in the Nigerian context taking into consideration the preferences of consumers. This consumer-based approach can improve the odds of a successful marketing strategy by matching the sustainable indicators advanced by farmers with those most preferred by consumers. Furthermore, consumer preferences for sustainability indicators can help refine the SRP Standard, for instance by developing different weighting schemes for the Standard themes based on consumer preferences that could lead to market premiums for SRP rice. Finally, the findings of this study will also help in formulating more effective sustainable rice production policies and investments that take into consideration the preferences of consumers.

Materials and Methods

Experimental Design

Sustainability Attributes

The SRP Standard (v 1.0)[1] consists of 46 requirements and 12 performance indicators. The Standard is being implemented by various stakeholders in the global rice industry such as Olam, IFC (a member of the World Bank group), Loc Troi, and Mars Foods.

Table 1 presents the 12 SRP performance indicators as defined by the SRP, which were presented to each respondent as part of the background information. Each attribute was explained thoroughly by the enumerators to ensure that the respondents understood them.

Best-Worst Scaling

The Best-Worst Scaling approach (BWS) was developed by Louviere and Woodworth (1990), but was formally published by Finn and Louviere (1992) when they investigated consumers' degree of concern for issues relating to food safety. It is a scaling approach in which respondents are asked to choose their most preferred and least preferred choices among a set of items. BWS was developed as an extension of Thurnstone's (1927) paired comparisons method (Cohen, 2009; Finn & Louviere, 1992). According to Finn and Louviere (1992), BWS "models the cognitive process by which respondents repeatedly choose the two objects in varying sets of three or more objects that they feel exhibit the largest perceptual difference on an underlying continuum of interest" (p. 13). In this study, the underlying continuum of interest is the degree of importance and the items/objects are the various sustainability attributes.

[1] The SRP standard was updated in 2019 to v 2.0, but we couldn't use the updated version because the survey for this study was conducted in 2018. There were only a few changes in the PIs in the update.

Table 1. Sustainability attributes as defined by the SRP Standard

Attributes	Definition
Farm Profitability	Total income from rice production (per hectare)
Labor Productivity	Work needed (number of days) to produce a kilogram of rice
Productivity: Grain Yield	Rice (paddy per kilogram) produced per hectare of land
Food Safety	Rice (milled per kilogram) produced that is safe[2] to eat
Water-use Efficiency	Rice (paddy per kilogram) produced per liter of water applied
Nutrient-use efficiency: Nitrogen	Rice (paddy per kilogram) produced per kilogram of Nitrogen applied
Nutrient-use efficiency: Phosphorus	Rice (paddy per kilogram) produced per kilogram of Phosphorus applied
Pesticide-use efficiency	Degree to which the amount of pesticide used matches the amount needed (0-100 score)
Greenhouse gas emissions	Methane emissions per hectare (contributes to global warming)
Health and safety	Use of production practices that promote worker health and safety (0-100 score)
Child labor	Employment of children in rice production[3] (0-100 score)
Women Empowerment	The power of women to make decisions about rice production and their own wellbeing (0-100 score)

Source: SRP, 2015.

BWS was developed in order to overcome the shortcomings of traditional rating scales (Finn & Louviere, 1992). BWS has some advantages over traditional rating scales such as; BWS has a higher discriminatory rate between items, that is, it forces the respondents to discriminate between the items in the choice set, in contrast to traditional rating scales in which respondents can declare the same degree of importance to multiple items. In BWS, researchers can transform choices into probability scale that can be analyzed and measured, in contrast to traditional rating scales whose theoretical scaling properties are often unknown (the intervals are often assumed). BWS surveys provide richer data with less burden on respondents because it collects more

[2] This definition was simplified for the benefit of the respondents "safe" here is defined as the percentage of milled rice that falls within safety requirements for heavy metals, pesticide residues and mycotoxins

[3] Employment of children under 15 as seasonal/permanent workers and children under 18 in hazardous work conditions

information in a simple way (Bazzani, Gustavsen, Nayga, & Rickertsen, 2018; Jaeger, Jorgensen, Aaslyng, & Bredie, 2008; Cohen, 2009; Cohen & Neira 2003; Hein, Jaeger, Carr, & Delahunty, 2008; Marti, 2012). These improvements over the common rating scales have spurred the popularity of BWS.

BWS is divided into three types or cases depending on the nature of the choice sets. In Case 1, also referred as the Objects Case, the choice sets are a list of objects (e.g., goods or services), while in Case 2 (Profile Case) the respondents have to consider a profile of each attribute/object before selecting their most and least preferred options. In Case 3 (Multi-Profile Case), the attributes each have multiple profiles which the respondents must consider before selecting the most and least preferred attributes (Flynn & Marley, 2014; Marti, 2012). This study uses the Objects Case because we are interested in how consumers assess each of the components (objects) included in the SRP PIs.

We use a Nearly Balanced Incomplete Block Design (BIBD) to organize the 12 attributes into 12 choice sets, with each choice set containing 4 attributes. The BIBD ensures that the occurrences and reoccurrences of the objects within the choice sets are constant, that is, each object appears the same number of times in each choice set, thereby reducing the possibility of respondents making unintended assumptions about the objects based on their arrangements in the design. The choice sets also have equal number of items and the items are orthogonally located so that the items are paired the same number of items across the choice sets (Flynn & Marley, 2014). Due to restricted choice sets and attributes per choice sets, researchers may face difficulties in generating a BIBD and so use a Nearly BIBD which relaxes the orthogonality requirement and has the same features of the BIBD (Lagerkvist, Okello, & Karanja, 2012; Thomson, Crocker, & Marketo, 2010; Orme, 2005; Bazzani, Gustavsen, Nayga, & Rickertsen, 2018).

The optimal number of choice sets and items within each choice set is still a subject of discussion and has been shown to have impacts on the results of BWS studies. This is perhaps due to respondent fatigue and cognitive difficulty (Byrd, Widmar, & Gramig, 2018; Maynard, Hartell, Lee Meyer, & Hao, 2004). Cohen (2009) suggested that 4-6 items per set may be optimal for most respondents and tasks. Each attribute was repeated 4 times across the choice sets (to prevent respondents from making unintended assumptions about the objects) with each compared to each other 1.09 times giving a D-efficiency score of 99.7%. In order to achieve randomization and control for any effect of the order of choice sets (Cohen, 2009), 5 versions of the questionnaire were designed in which the sequence of the choice sets and the items within the choice sets were randomized.

Table 2 illustrates one of our choice sets. Respondents were asked to select the least and most important attribute among the 4 sustainability attributes shown in each choice set.

Table 2. Example of a choice set used in this study.

Which of the following sustainability attributes is most important to you and which is least important to you when you consider the purchase of rice and how it was produced? Please, check only one attribute as the most important and only one attribute as the least important

Least Important	**Attributes**	**Most Important**
	Farm Profitability (Total income from rice production)	
	Productivity: Grain Yield (Rice produced per hectare of land)	
	Nutrient-use Efficiency: Phosphorus (Rice produced per unit of P applied)	
	Pesticide-use Efficiency (Degree to which the amount of pesticide used matches the amount needed)	

Finn and Louviere (1992) established that the BWS method models the process by which respondents choose the pair that maximizes the perceptual difference on the scale of interest. It is assumed that the respondent identifies all possible pairs, evaluates the difference on the underlying dimension for every pair and chooses the pair that maximizes this difference (Finn & Louviere, 1992; Marti, 2012). The Maximum difference (Max-diff) model is the most commonly used in BWS studies, especially in Case 1 studies.

In a choice set containing *J* items there are J x (J-1) possible best-worst combinations that the respondent can choose from. In the effects coding, each choice set will have J x (J-1) lines. In our study, the 4 items per choice set result in 12 possible best-worst combinations, which multiplied by the 12 choice sets per respondent yields 144 total lines per respondent. In each best-worst combination, the "bests" were coded as 1 and the "worsts" as -1, the dependent variable (the choice variable) was the coded as 1 for the chosen combination and 0 for the other combinations. Table 3 (shown in appendix) shows an example of effects coding for one choice set in which the respondent choses the 12^{th} pairing – Pesticide-use Efficiency (PE) as the Best and Nutrient-use Efficiency; Phosphorus (NEP) as the worst.

Data Collection

Primary data was collected and used for this study. A survey was conducted in selected neighborhoods in Lagos State. Lagos State is located in South-Western Nigeria and has the largest population (24.6 million as of 2015) of Nigeria's 36 states. Six neighborhoods were randomly selected with 25 participants from each, 150 in total. To ensure a representative sample, the neighborhoods were selected across the 3 income levels; low income, middle income and high income, with 2 neighborhoods per income level. In each neighborhood, 1 marketplace[4] was selected as the venue for the survey. The survey was conducted using structured paper questionnaires which contained background information (a table containing the 12 attributes and their definitions), survey instructions, the choice questions and some socio-economic and rice

[4] The names of the marketplaces are Fagba, Ikeja, Yaba, Abule-egba, Oshodi and Obawole.

purchasing habits questions. The respondents were approached randomly by an enumerator and asked a screening question (Do you usually buy the rice your household consumes?) which then qualified/disqualified them to participate in the study. The purpose of the screening question was to identify consumers who make rice purchasing decisions. The qualified respondents were presented with a consent/instructions form which; introduced the survey, explained that it was an anonymous survey and that the respondents would be compensated for their time with a token amount after the survey was completed, stressed the importance of their responses and contained names and contact information of the investigators. They were also assured that they were free to stop participating in the survey at any time. At the end of this information was a consent statement and a space for the respondents' signature. The consent/instructions form was read by the respondents and the contents explained to them after which they signed it. The enumerators then moved on to the choice questions sheet, the first page contained the background information and survey instructions which they carefully explained. The respondents were then presented with an example BWS choice question (the content of this question was not related to the study) which was simple, this was necessary to ensure that they understood how to fill the questions correctly. The respondents then went on to answer the choice questions. Each enumerator stayed with each respondent during the process of filling the survey in case the respondent needed further clarification.

Econometric Analysis

The data was analyzed using a discrete choice framework consistent with the random utility and Lancaster consumer theories (McFadden, 1974; Lancaster, 1966), which assumes that consumer $\boldsymbol{n}$ chooses alternative *j* in choice set *t* with the objective of maximizing his/her utility $\boldsymbol{U_{njt}}$,

$$\boldsymbol{U_{njt}} = \boldsymbol{V_{njt}} + \boldsymbol{\varepsilon_{njt}} \tag{1}$$

Where $\boldsymbol{V_{njt}}$ is a systematic component that can be observed by the researcher, and $\boldsymbol{\varepsilon_{njt}}$ is the unobserved error term which is assumed to be independent of $\boldsymbol{V_{njt}}$. Since respondents pick the choice that will maximize their utility, respondent *n* will pick alternative *j* over alternative *k* when

$$\boldsymbol{U_{njt} > U_{nkt} \ for\ all\ j \neq k} \tag{2}$$

Since BWS studies require the respondent to choose a pair (best and worst) of the alternatives, he will choose the best (*b)* and worst (*w)* alternatives when;

$$\boldsymbol{U_{nbt} - U_{nwt} > U_{nit} - U_{njt}\ for\ all\ b \neq w\ and\ i \neq j} \tag{3}$$

(Bazzani, Gustavsen, Nayga, & Rickertsen, 2018)

The probability of a respondent making a choice depends on the distance between the best and worst variables. The assumption is that respondents will choose the best-worst pair that have the largest distance between them. This latent unobservable distance between the best and worst alternatives (*bw*) is measured as;

$$\boldsymbol{D_{bw} = \delta_{bw} + \varepsilon_{bw}} \tag{4}$$

Where $\boldsymbol{\delta_{bw}}$ represents the measurable difference between *b* and *w*, and $\boldsymbol{\varepsilon_{bw}}$ represents the random error term. The probability of choosing *bw* in a choice set *t* is then given as;

$$\boldsymbol{P(bw/t) = P\left(\delta_{bw} + \varepsilon_{bw} > \delta_{ij} + \varepsilon_{ij}\right) for\ all\ bw \neq ij\ in\ t} \tag{5}$$

Using a Multinomial Logit Model (MNL), with the assumption that the error terms are independent and identically distributed (iid), the probability that the respondent will choose *bw* in choice set *t* then becomes

$$\boldsymbol{P(bw/t) = \frac{\exp(\delta_{bw})}{\sum_{ij}\exp(\delta_{ij})}\ for\ all\ ij \neq bw\ in\ t} \tag{6}$$

Rewriting the measurable difference, we get;

$$\boldsymbol{\delta_{bw} = \beta_b - \beta_w} \quad (7)$$

The probability can then be re-written as;

$$\boldsymbol{P(bw/t) = \frac{\exp(\beta_b - \beta_w)}{\sum_{ij}\exp(\beta_i - \beta_j)} \; for \; all \; ij \neq bw \; in \; t} \quad (8)$$

(Marti, 2012)

To prevent the dummy variable trap, a reference location must be specified, that is, one of the items should be dropped as the reference location. This is usually the lowest ranking item. The dummy variable trap is a situation in regressions where perfect collinearity exists between the independent variables. This prevents the regression from solving. To avoid this, one of the dummy variables is dropped and becomes the base category. In this case, Grain Yield was dropped (because it was consistently rated least) and the level of importance attached to the attributes were estimated relative to Grain Yield.

In order to account for heterogeneity in the preferences of the respondents, we estimated a Random Parameter Logit (RPL) model. The RPL is a discrete-choice model which allows for variations in preferences and uses simulation methods (Maximum Log-likelihood) to provide estimates of mean and standard deviation for each coefficient (Train, 2003). The RPL model assumes that coefficients vary across the population according to some distribution (usually normal). The equation for each attribute in the RPL model is specified as;

$$\boldsymbol{\beta_{nj} = \overline{\beta_j} + \sigma_j \mu_{nj}} \quad (9)$$

Where $\boldsymbol{\overline{\beta_j}}$ and $\boldsymbol{\sigma_j}$ represent the mean and standard deviation of $\boldsymbol{\beta_j}$ respectively and $\boldsymbol{\mu_{nj}}$ represents the random error term which is assumed to be normally distributed. We estimated a correlated and uncorrelated RPL model to assess the impact of correlated coefficients, and use the Log-Likelihood, AIC and BIC estimates to assess the goodness of fit of the MNL and correlated RPL model.

To enable ease of interpretation, preference shares (an estimate of how much importance each attribute has over the others or the probability that an attribute is picked as more important than another) for each attribute was then estimated using the RPL model. The preference share is specified as;

$$\boldsymbol{S_j} = \frac{\boldsymbol{exp\widehat{\beta_j}}}{\sum_{ij} \boldsymbol{exp\widehat{\beta_i}}} \tag{10}$$

To examine the heterogeneity in preferences, we estimated the preference shares for some of the socio-economic variables. The variables examined are age, education, gender, household income, opinion on global warming a result of human activities, the rating of global warming effects, attention paid to rice labels and rice purchasing location. We divided each variable into two sub-groups and estimated the preference shares for each sub-group.

To make inferences about statistical variability between preference shares in a group, we estimated a Krinsky and Robb (1986) bootstrapping procedure to generate confidence intervals for each share. This procedure has been utilized to construct 95% confidence intervals for shares in BWS studies. The intervals can then be examined for overlapping, which would denote no significant statistical difference (Byrd, Widmar, & Gramig, 2018). We also examined the preference shares for attributes between sub-groups for statistical differences, using a complete combinatorial test. This test was developed by Poe, Giraud and Loomis, (2005) and it has been utilized in other BWS studies (Wolf & Tonsor, 2014; Byrd, Widmar, & Gramig, 2018).

A simpler method for analyzing the data, which was introduced by Finn & Louviere (1992) and has been used by many other researchers (Auger, Devinney & Louviere 2007; Marti, 2012; Cohen, 2009), is the Individual – level scaling method. This method involves counting for each item, the number of times it was picked as best and subtracting the number of times it was picked as worst. This enables the calculation of the BW score and produces individual-level scales for each of the items.

Results and Discussion

Socio-economic Variables

Table 3 presents the descriptive statistics of the relevant socio-economic and demographic variables from the sample. Sixty five percent of the respondents were between the ages of 21 to 45, and the average household size was 5.1. These values are similar to the results of the Lagos Household Survey (Lagos Bureau of Statistics, 2014). The majority (79.3%) of participants were females, which is not surprising given that women are usually in charge of food purchases. The vast majority of the respondents (58%) of our survey have a university or equivalent degree, compared to 32% of the population according to Lagos Bureau of Statistics (2014), which implies that our sample is overeducated relative to the population.

The rice consumption results in Table 4 show that all the respondents consume rice at least once daily, which supports the fact that rice is the main staple consumed by Nigerians. Similar to previous studies in Nigeria, we find that consumers consume more imported (59.3%) than domestic rice (Gyimah-Brempong, Johnson, & Takeshima, 2016; Kuku-Shittu & Pradesha, 2013; FMARD, 2011; Johnson et al., 2013; Akaeze, 2010), and buy their rice mainly in open markets (70%) (Basorun, 2012; Alfred & Adekayode, 2014; Lancon et al., 2003). This could be because the markets have relatively cheaper prices than the retail shops and supermarkets (Basorun, 2012). The majority of the respondents pay attention to labels of food (88.7%)/labels of rice (81.3%), which is in line with the findings from other studies such as Oghojafor et al. (2012), who found that 80% of the respondents report that they read food labels and 66% report that they comprehend what they read on these labels. The discrepancy between the percentage of those that pay attention to labels of food most times (38.7%) and rice most times (66%) could mean that consumers are more concerned about the labels on rice than on other foods.

Table 3. Socio-economic characteristics of the respondents

Variable (Category)	**Sample (%)**	**Population (Category)**	**Population (%)**
Age			
<20 years	16	15-17	2
21-45	65.3	18-45	61.0
46-60	16.7	46-64	28
>60 years	2	>64	9
Household size (Average)	5.1		5
Gender			
Female	79.3		57
Male	20.7		43
Education			
<Primary school	1.3		5
Primary school	0		17
Secondary school	23.3		29
University or equivalent	58		32
Graduate	17.3		
Household average monthly income			
<N30,000	6.7	<N20,000	11
N30,000 – N50,000	18.7	N20,000 – N39,000	26
N50,000 – N70,000	21.3	N40,000 – N59,999	27
N70,000 – N150,000	28.7	N60,000–N100,000	25
>N150,000	24.7	>N100,000	11

The purpose of the questions on climate change were to understand the respondents' perceptions of climate change and its effects. This is because the literature shows that climate change is perceived by consumers to be a bigger problem in developed countries than in developing countries (Pugliese & Ray, 2009). However, we found that majority (63%) of our respondents agree that humans cause global warming and a mean rating of 3.6 for the effects of global warming, denoting a strong perception of global warming. These findings are similar to those of Ogbeide and Ele (2015) who found a strong perception among consumers for “Climate change is real” (mean rating of 6.0) and “Climate change is caused by human activities” (mean rating of 5.3) on a rating scale of 1-7. We asked the respondents to indicate, using a scale of 0-5, how well they trust 5 rice-related institutions, with 0 representing no trust and 5 representing most trusted. The results on the trust level for the various institutions show that the respondents have the least amount of trust for rice marketers and government-owned research institutes and the highest amount of trust for rice farmers and privately owned research institutes. Many of the respondents mentioned that the reason for their distrust for rice marketers is because they sometimes mix and re-bag different rice brands, thereby misleading consumers. The low trust for the government-owned research institutes could be a function of the general distrust of the government which is prevalent in the nation (Omotoso, 2014; Africa Center for Strategic Studies, 2019; Poushter, 2015).

Table 4. Rice Consumption Variables

Daily rice meals consumed (%)		Amount of rice consumed weekly (%)	
One	41.3	<5kg	61.3
Two	42.7	5kg-10kg	25.3
Three	16	10kg-20kg	10.7
None	0	>20kg	2.7
Rice purchasing location (%)		Pay attention to labels of food? (%)	
Markets	70	Not at all	11.3
Neighborhood stores	24.7	Yes, sometimes	50
Supermarkets	5.3	Yes, most times	38.7
Pay attention to labels of rice? (%)		Humans cause global warming (%)	
Not at all	18.7	Agree	63
Yes, sometimes	15.3	Not agree	17.4
Yes, most times	66	Don't know	19.5
Effects of global warming (0 = not bad; 5 = very bad)		Preference for imported or domestic rice (%)	
Average	3.6	Imported	59.3
Average trust rating (0=no trust, 5=most trust)		Domestic	30.7
Rice farmers	3.1	Indifferent	10
Rice marketers	2.2		
Government research institutes	2.2		
Private research institutes	3.1		
Non-profit research institutes	2.9		

Model Estimates

The MNL and correlated RPL model estimates for each attribute are shown in Table 5. The estimates are relative to the reference attribute grain yield. The correlated RPL was the best model based on the Log-likelihood, AIC and BIC estimates. The results from the RPL model indicate that eight of the specified attributes are statistically significant at the 5% level. The efficiency in the use of nitrogen, phosphorus, and pesticide use, health and safety, and women empowerment, are significant at the 1% level, and labor productivity, food safety, and water use efficiency are significant at the 5% level. Both the MNL and RPL models indicate no significance for farm profitability and greenhouse gas emissions. The standard deviation of the coefficients are all significant except for labor productivity, which indicates the presence of substantial heterogeneity in the consumer preferences that justifies the use of the RPL model.

Preference Shares

We estimated the preference share for each attribute (grain yield included) using the RPL coefficients from Table 5 and rank the attributes in order of importance (shown in Table 6). The preference shares all sum to 1 (or 100 percent). Food safety has the largest share, 39% and ranks as the most important attribute. Health and safety ranks as the 2nd most important with 25% of the preference shares. As stated earlier, food safety refers to rice that is safe to eat, while health and safety refers to the safety of the rice industry workers. The magnitude of the preference shares of these two attributes are much larger than the preference shares of the other attributes; for instance, women empowerment ranks third with a share of 5.7%.

Table 5. MNL and RPL estimates.

Attributes	MNL	RPL
Farm Profitability	0.134	0.075
	(0.084)	(0.127)
SD		1.296***
Labor Productivity	0.183*	0.277**
	(0.085)	(0.103)
SD		0.041
Food Safety	1.717***	2.788**
	(0.093)	(0.175)
SD		1.873***
Water Use Efficiency	0.195*	0.391**
	(0.085)	(0.129)
SD		1.202***
Nutrient-Use Efficiency; Nitrogen	0.285***	0.659***
	(0.084)	(0.124)
SD		1.095***
Nutrient-Use Efficiency; Phosphorus	0.252**	0.566***
	(0.086)	(0.124)
SD		1.039***
Pesticide Use Efficiency	0.200*	0.467***
	(0.084)	(0.141)
SD		1.434***
Greenhouse Gas Emissions	0.024	0.249
	(0.085)	(0.150)
SD		1.650***
Health & Safety	1.547***	2.360***
	(0.092)	(0.154)
SD		1.278***
Child Labor	0.185*	0.078
	(0.085)	(0.169)
SD		2.830***
Women Empowerment	0.528***	0.874***
	(0.085)	(0.175)
SD		2.119***
Log-likelihood	-4013.5	-3545.3
AIC	8048.947	7244.635
BIC	8109.398	7667.791

* 10% significance level. ** 5% significance level. *** 1% significance level

The confidence intervals of food safety and health and safety show that they are each significantly different from each other and the rest of the attributes. From the above we can infer that food safety is paramount for consumers, which is not misplaced given the country's poor track record of food safety incidents (Osagbemi, Abdullahi, & Aderibigbe, 2010; Oni, Oni, &

Esumeh, 2009; Fatiregun, Oyebade, & Oladokun, 2010; Adedoyin, Ojuawo, Adesiyun, Mark, & Anigilaje, 2008; Omojokun, 2013). Many of these food safety incidents have resulted from the misuse of agrochemicals used on farms and/or in storage. Studies have been conducted on rice samples in Nigeria which show the presence of lead and other metals, which are major components of agrochemicals in concentrations that could be dangerous to the human health (Otitoju, Otitoju, Iyeghe, & Onwurah, 2014; Emumejaye, 2014; Alani, 2015). The high level of concern for health and safety may have been influenced mostly by reports of the current conflict situations being faced by farmers in the main food producing areas of the country. For example, terrorist attacks mostly in the Northeast parts of the country, and the farmer-herder conflict in the Middle belt and Southern region are affecting many farming communities, resulting in deaths and displacements. These conflicts are disrupting food supplies, leading to increases in food prices and predictions of an impending food crisis (Ilo, Jonathan-Ichaver, & Adamolekun, 2019; Martin, 2016; Pugliese, 2014). However, the health and safety SRP indicator refers to labor conditions (within the control of the industry) that lead to improved worker health and safety. Some of these include other factors that currently influence the health and safety of Nigeria's rice production workers such as; the lack of use of safety techniques during the application of agrochemicals, protective equipment aren't available to the farmers thereby exposing to the health risks of these agrochemicals (Abubakar, Mala, Mumin, Zainab, & Fatima, 2015; Okafoagu, Oche, & Lawal, 2017; Apeh, 2018; Bassi, et al., 2016). Also, the traditional rice parboiling methods still used in many of the rice producing areas exposes the women (who are usually in charge of parboiling) to smoke for extended periods of time leading to serious health issues such as vision loss and 100% exposure to tuberculosis (Tinsley, 2012). Lastly, a lack of access to protective equipment for workers is prevalent in Nigerian rice mills, making them vulnerable to health issues such as respiratory problems, physical injuries and other health issues (Oginyi, Mbam, Abojei, & James, 2017).

Women Empowerment ranks as the 3rd most important attribute with a preference share of 5.7%. Women empowerment is considered a prerequisite to achieving global food security (Akter, et al., 2017), not only because of their contribution to agricultural production (women produce over 50 percent of the world's food (FAO, 2011) and contribute about 43 percent of the agricultural labor force (Doss, 2014) but also their leadership in the household (with some cultural exceptions, women tend to be the primary caregivers, and evidence shows that women empowerment is associated with better household nutritional status and higher quality care for children (Duflo, 2012; Smith, et al., 2003)). In Nigeria, despite the vital position of women in Nigeria's agricultural industry, they are currently still marginalized. Although this isn't limited to rice farming, studies of rice farmers in Nigeria have found that female rice farmers face constraints that make them less productive than their male counterparts (Chete, 2018; Omiunu, 2014; Coker, et al., 2017). The efficiency in the use of pesticides, nitrogen fertilizers, and phosphorus fertilizers complete the top 6 ranked attributes. The relatively high ranking of the agro-chemicals is most likely a result of the general perception consumers have about the effects of these chemicals on health and the environment. Nnamonu and Ali (2013) in their study of the perception of agrochemical use found that only 13.9% of the consumers had a positive perception of agrochemical use. Other studies have also found a low rate and/or knowledge of the proper use of agrochemicals among farmers in Nigeria (Apeh, 2018; Olowogbon, Fakayode, Jolaiya, & Oke, 2013). However, the shares of the 3 agro-chemicals are very small, denoting a relatively low perception of their importance to the respondents. The overlapping in the confidence intervals of the attributes ranked 3 to 12 show that there is no statistically significant difference between them.

Various reasons could account for the positions of the bottom six attributes. The relatively low concern among consumers for the water use of rice farmers could be because the respondents feel far removed from any effects of the water usage of the farmers (since Lagos state is a metropolitan city). Studies and reports have shown that the concern for GHG emissions is generally low in the country, probably a result of non-enlightenment about GHG or the fact that it isn’t seen as a big problem since Nigeria’s GHG contribution is low compared to countries such as the U.S or China (Daggash, 2018; Olaniyan, Sulaimon, & Adekunle, 2018). It is interesting that child labor carries such a low preference in our study, given that it has been an issue that generated a lot of controversy and concern among consumers especially in developed countries. Child labor is part of the issues that the Fair Trade movement advocates against (FairTrade America, 2018), and studies show that consumers are willing to pay premiums for Fair Trade certified foods (Yang, Hu, Mupandawana, & Liu, 2012; Otieno, 2018; Loureiro & Lotade, 2005; Rousu & Corrigan, 2008)

Table 6. Preference shares for each SRP performance indicator.

Attribute	Preference share	Rank	95% Confidence Interval
Food Safety	0.389	1	0.323-0.453
Health & Safety	0.254	2	0.209-0.297
Women Empowerment	0.057	3	0.042-0.076
Nutrient Use Efficiency; Nitrogen	0.046	4	0.038-0.056
Nutrient Use Efficiency; Phosphorus	0.042	5	0.034-0.051
Pesticide Use Efficiency	0.038	6	0.031-0.048
Water Use Efficiency	0.035	7	0.027-0.045
Labor Productivity	0.032	8	0.025-0.039
Greenhouse Gas Emissions	0.031	9	0.023-0.040
Child Labor	0.026	10	0.019-0.035
Farm Profitability	0.026	11	0.019-0.034
Grain Yield	0.024	12	0.019-0.030

Preference Shares by Socio-economic Groups

The results by sub-groups are displayed in Tables 7-9 in the main text and Tables 11-13 in the appendix.

Preferences for sustainability attributes across education groups (low education (< secondary school) and high education (> secondary school)), show that health and safety and food safety carry the largest weight, but there is a change in the order consumers value them. Health and safety is the most important attribute for the low education group, while food safety is most important for the high education group, actually accounting for almost 50% of their preferences. These results suggest that educated consumers may be more aware of the food safety risks of rice production than less educated ones, and therefore willing to attach a much larger weights. However, one quite striking and unexpected difference is that water use efficiency is considerably more important to the respondents in the 1st group (low education). It was expected that highly educated people would better understand the importance of water resources. Statistical significance (at the 5% level) was also found in the difference between the shares of this attribute in the 2 groups.

Table 7. Preference shares for SRP performance indicators by education†.

	Low Education group, n=37			High Education group, n=113		
Rank	Attribute‡	Preference Share	95% Confidence Interval	Attribute‡	Preference Share	95% Confidence Interval
1	HS	0.351	0.228-0.479	FS	0.496	0.414-0.575
2	FS	0.268	0.182-0.364	HS	0.244	0.190-0.302
3	WP	0.088*	0.053-0.139	NEN	0.037	0.028-0.047
4	WE	0.046*	0.029-0.069	WP	0.035*	0.022-0.053
5	LP	0.044*	0.028-0.065	NEP	0.031	0.024-0.041
6	NEN	0.040	0.026-0.060	PE	0.030	0.022-0.040
7	NEP	0.039	0.024-0.059	LP	0.025*	0.019-0.034
8	PE	0.033	0.021-0.050	GY	0.025	0.018-0.033
9	FP	0.033	0.020-0.052	FP	0.023	0.016-0.031
10	GY	0.023	0.015-0.035	WE	0.022*	0.016-0.030
11	CL	0.019	0.010-0.036	GHG	0.020	0.015-0.028
12	GHG	0.016	0.009-0.025	CL	0.011	0.007-0.018

†. The low education group represents those with < secondary school and the high education represents those with > secondary school education.

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

Tables 8-9 show the preference shares for two variables that relate to rice purchasing habits and global warming opinions.

In Table 8, we examine the preference shares between those who agree that humans cause global warming and those who don't. There are similarities and also interesting differences between them. One similarity is that the food safety and health and safety rank the same across both, although the food safety share for the 1st group (those who agree) is larger than the second and the difference in the food safety shares is significant between the two groups. Also, the shares for these two attributes in the 1st group are statistically significantly different from the rest of the attributes. Another similarity is that both groups rank women empowerment the same. Two striking differences are that child labor as well as greenhouse gas emissions are more important to the 1st group (those who agree) relative to the second. Another interesting difference is that water use efficiency is more important by a large extent to those in the 2nd group (those who don’t agree).

In Table 9, food safety has a high preference share of 67% in the group of respondents who don’t purchase their rice from the markets. In fact, this share is the largest share of all the preference shares estimated. Given the nature of Nigerian markets where food tend to be exposed to the open air and not always sold in labelled packages, as opposed to supermarkets and neighborhood stores in Nigeria, this result is not surprising (Ehiri, et al., 2001; Pepple, 2017). Women empowerment is also more important by a large extent to those who purchase their rice from the markets. This could be because most of the sellers in these markets are usually women and most of the respondents in this study are women too. The results of this table display more differences than the others. Another difference is that farm profitability is a lot more important to those who don’t purchase their rice from the markets.

Table 8. Preference shares for SRP performance indicators by perception that humans cause global warming.

	Agree, n = 94			Not agree, n = 55		
Rank	**Attribute‡**	**Preference Share**	**95% Confidence Interval**	**Attribute‡**	**Preference Share**	**95% Confidence Interval**
1	FS	0.438*	0.352-0.526	FS	0.269*	0.203-0.341
2	HS	0.254	0.196-0.320	HS	0.256	0.196-0.320
3	CL	0.062	0.040-0.097	WE	0.070	0.050-0.097
4	WP	0.056	0.039-0.078	WP	0.059	0.038-0.088
5	GHG	0.030	0.021-0.040	NEP	0.058	0.044-0.076
6	NEN	0.026	0.018-0.037	FP	0.054	0.037-0.077
7	LP	0.024	0.017-0.031	LP	0.050	0.037-0.066
8	FP	0.024	0.017-0.033	NEN	0.045	0.033-0.058
9	GY	0.023	0.016-0.031	PE	0.044	0.032-0.060
10	PE	0.022	0.016-0.030	CL	0.042	0.028-0.064
11	NEP	0.021	0.015-0.030	GY	0.027	0.020-0.037
12	WE	0.020	0.014-0.028	GHG	0.025	0.017-0.038

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

Table 9. Preference shares by rice purchase location

	Markets, n=105			Non-markets, n=45		
Rank	**Attribute‡**	**Preference Share**	**95% Confidence Interval**	**Attribute‡**	**Preference Share**	**95% Confidence Interval**
1	FS	0.300	0.240-0.370	FS	0.671	0.536-0.777
2	HS	0.285*	0.234-0.343	HS	0.171*	0.105-0.269
3	WP	0.071*	0.052-0.093	LP	0.032	0.019-0.051
4	NEP	0.050*	0.039-0.062	FP	0.026	0.015-0.042
5	NEN	0.047*	0.037-0.059	WE	0.022	0.013-0.037
6	CL	0.039*	0.026-0.054	GY	0.016*	0.009-0.025
7	LP	0.038	0.029-0.049	NEN	0.012*	0.007-0.022
8	PE	0.037*	0.029-0.047	NEP	0.012*	0.006-0.020
9	WE	0.036	0.027-0.046	PE	0.012*	0.006-0.021
10	FP	0.033	0.025-0.044	CL	0.010*	0.005-0.018
11	GY	0.033	0.025-0.042	WP	0.009	0.005-0.018
12	GHG	0.030*	0.022-0.039	GHG	0.009*	0.005-0.016

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

Implications

Our findings show that food safety and health and safety are the most preferred sustainability attributes by Nigerian rice consumers, and that these are robust across different dimensions such as education level, markets, and attitudes toward the environment.

Since food safety generates the most concern among the respondents, agents within the rice supply chain should prioritize producing the rice in the safest way possible and communicating this to consumers. Public and private stakeholders have a responsibility to educate producers about food safety protocols such as proper use of agrochemicals, which will require renovating efforts on agricultural extension and the use of technology to deliver information. To illustrate, AfricaRice is deploying its android app called RiceAdvice with the goal of providing rice farmers with management guidelines for production (AfricaRice, 2019). Vertical integration throughout the supply chain is another way to advance the adoption of food safety measures. Large commercial food companies are expanding their presence in Nigeria, and using integrative schemes to improve the reliability and quality of the food supply. To illustrate, Olam International is using out-grower schemes in Nigeria to guarantee the supply of quality paddy rice to operate their modern rice mills efficiently and deliver production services (e.g., extensions, credit) upstream. These vertically-integrated operations offer great opportunities to adopt production SRP measures throughout the supply chain and reach final consumers efficiently.

However, the Nigerian rice value chain is still highly disaggregated and fragmented, with many smallholder farmers, paddy traders, village and clustered parboilers and millers, and wholesale traders selling open-bag rice with little regard for quality and safety standards. The limited integration in the value chain also undermines the implementation of grades and standards for better rice quality. It is clear that the implementation of SRP in these fragmented chains is highly challenging, and efforts should be targeted at improving integration and traceability along the supply chain, for instance by strengthening the capacity of existing producers' cooperatives/clusters (Gyimah-Brempong, Johnson, & Takeshima, 2016), and promoting associative schemes with the help of the donor community and the public sector. An example of such an effort is the Competitive African Rice Initiative (CARI), through which participating rice farmers receive training and access to input markets to improve their production sustainability and livelihood.

The degree of concern showed for the health and safety of the workers in rice production shows that more attention needs to be given to this issue by both private and public stakeholders in the Nigerian rice industry. Again the role of the extension service has to be revamped to provide farm and mill operators the training they need to operate equipment and tools safely. Another policy alternative is to foster equipment sharing schemes to facilitate access to more modern and safe equipment and thus increase efficiency and safety. One example of this approach is Hello Tractor, a platform connects tractor owners to farmers through a digital app, facilitating machinery access to thousands of farmers at very competitive prices. In partnership with John Deere and the Nigerian Federal Ministry of Agriculture and Rural Development, Hello Tractor plans to deploy 10,000 tractors in Nigeria over the next five years (Forbes, 2018).

Our findings suggest that consumers put little weight on sustainability attributes associated with the resource use efficiency such as nitrogen, phosphorus, pesticides, water, and land (grain yield), and other pressing social issues such as women empowerment and child labor. These findings point to a potential conflict of interest between consumers and farmers, who stand to benefit greatly from a more efficient use of production resources (Johnson & Ajibola, 2016).

The implementation of the SRP standard in Nigeria depends on the ability to provide consumers with the adequate information on standards, quality assurance and traceability that will ultimately add value to consumers and the domestic rice sector. Marketers can rely on the use of labels to communicate their sustainability efforts since our results show that 81.3% of the respondents pay attention to rice labels. Since most rice in Nigeria is sold in open bags, it is important to sensitize rice sellers about the meaning of the SRP claims so that they can better serve consumers and become a vehicle of change. It is also important to train food inspectors on the meaning and importance of monitoring the market to ensure the proper use of the standard and avoid consumer deception.

There is ample evidence of the growing consumer awareness about rice quality attributes in West Africa (Rutsaert, Demont, & Verbeke, 2013; Demont & Ndour, 2015; Diagne, Demont, & Ndour, 2017). While the SRP standard gives producers the flexibility of choosing the requirements they will follow and use for their SRP claims, we believe the benefits can be maximized by considering consumers' preferences in the decision-making process.

Conclusions

The goal of this study is to investigate consumer preferences for sustainable rice production practices in Nigeria that can be used to improve the formulation of consumer-based sustainable policies. We employed the Best-Worst Scaling method and collected primary survey data from 150 consumers in Lagos to assess how consumers perceive each of the 12 performance indicators defined in the SRP standard.

Our findings identify food safety and health and safety as the most important sustainability attributes for Nigerian consumers, and these results are robust across a number of dimensions including consumers' education, income, and attitude towards climate change. Importantly, these two indicators are considered minimum essential requirements to be able to make SRP claims of working toward or producing rice sustainably. Performance indicators related more closely to the environmental impact of rice production and the working and power conditions of children and women carry significantly lower weights in consumers' preferences.

Our findings can help practitioners in Nigeria develop the best sustainability approaches taking into consideration not only producers' but also consumers' preferences, which can improve the odds of marketing sustainably-produced rice at a premium.

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Appendix

Table A 1. Effects coding of one of the choice sets†

Pairing	Best	Worst	FP	LP	GY	FS	WE	NEN	NEP	PE	GHG	HS	CL	WE	Choice
1	FP	GY	1	0	-1	0	0	0	0	0	0	0	0	0	0
2	FP	NEP	1	0	0	0	0	0	-1	0	0	0	0	0	0
3	FP	PE	1	0	0	0	0	0	0	-1	0	0	0	0	0
4	GY	FP	-1	0	1	0	0	0	0	0	0	0	0	0	0
5	GY	NEP	0	0	1	0	0	0	-1	0	0	0	0	0	0
6	GY	PE	0	0	1	0	0	0	0	-1	0	0	0	0	0
7	NEP	FP	-1	0	0	0	0	0	1	0	0	0	0	0	0
8	NEP	GY	0	0	-1	0	0	0	1	0	0	0	0	0	0
9	NEP	PE	0	0	0	0	0	0	1	-1	0	0	0	0	0
10	PE	FP	-1	0	0	0	0	0	0	1	0	0	0	0	0
11	PE	GY	0	0	-1	0	0	0	0	1	0	0	0	0	0
12	PE	NEP	0	0	0	0	0	0	-1	1	0	0	0	0	1

†. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

Table A 2. Shares of preferences by age[†]

	Young group n=122			Old group n=28		
Rank	**Attribute[‡]**	**Preference Share**	**95% Confidence Interval**	**Attribute[‡]**	**Preference Share**	**95% Confidence Interval**
1	FS	0.3888	0.3156-0.4616	HS	0.3868	0.2330-0.5531
2	HS	0.2488	0.2069-0.2959	FS	0.3590	0.2228-0.4909
3	WP	0.0531	0.0348-0.0762	WP	0.0982	0.0497-0.1852
4	NEN	0.0439*	0.0348-0.0547	LP	0.0316	0.0165-0.0549
5	NEP	0.0416	0.0313-0.0523	WE	0.0234	0.0116-0.0433
6	PE	0.0388*	0.0301-0.0490	NEN	0.0203*	0.0104-0.0352
7	WE	0.0348	0.0253-0.0454	FP	0.0202	0.0102-0.0346
8	LP	0.0326	0.0254-0.0407	NEP	0.0176	0.0083-0.0325
9	GHG	0.0313*	0.0230-0.0405	GY	0.0140	0.0070-0.0241
10	FP	0.0306	0.0215-0.0427	PE	0.0139*	0.0067-0.0259
11	CL	0.0294*	0.0207-0.0398	GHG	0.0083*	0.0039-0.0170
12	GY	0.0264	0.0196-0.0351	CL	0.0069*	0.0031-0.0147

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

†. The young group represents those < 45 years old and the old group represents those > 45 old.

Table A 3. Preference shares for SRP performance indicators by household income†

	Low income, n=70			High income, n=80		
Rank	**Attribute‡**	**Preference Share**	**95% Confidence Interval**	**Attribute‡**	**Preference Share**	**95% Confidence Interval**
1	HS	0.3576*	0.2677-0.4487	FS	0.4141	0.3398-0.4932
2	FS	0.3076	0.2223-0.3995	HS	0.2014*	0.1566-0.2503
3	WP	0.0427	0.0259-0.0694	WP	0.0660	0.0457-0.0910
4	CL	0.0420	0.0273-0.0628	NEN	0.0481	0.0356-0.0634
5	NEN	0.0412	0.0305-0.0544	NEP	0.0445	0.0330-0.0582
6	NEP	0.0396	0.0287-0.0527	WE	0.0381	0.0259-0.0521
7	PE	0.0349	0.0237-0.0490	LP	0.0370	0.0268-0.0491
8	WE	0.0345	0.0224-0.0488	PE	0.0347	0.0252-0.0471
9	LP	0.0314	0.0217-0.0444	GHG	0.0319	0.0229-0.0430
10	GHG	0.0257	0.0176-0.0366	FP	0.0307	0.0196-0.0450
11	GY	0.0232	0.0162-0.0323	CL	0.0288	0.0194-0.0419
12	FP	0.0198	0.0127-0.0304	GY	0.0245	0.0174-0.0328

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

†. The low income group represents those with average monthly household income of < N70, 000 and the high income group represents those with average monthly household income of > N70, 000.

Table A 4. Preference shares for SRP performance indicators by attention to rice labels

	Does not pay attention at all, n=28			Pay attention, n=122		
Rank	**Attribute‡**	**Preference Share**	**95% Confidence Interval**	**Attribute‡**	**Preference Share**	**95% Confidence Interval**
1	FS	0.5254*	0.3602-0.6678	FS	0.3635*	0.2880-0.4461
2	HS	0.3088	0.1781-0.4609	HS	0.2563	0.2139-0.3021
3	NEN	0.0321	0.0170-0.0597	WP	0.0589	0.0390-0.0848
4	LP	0.0226	0.0121-0.0410	NEP	0.0433	0.0347-0.0531
5	WP	0.0212	0.0096-0.0413	NEN	0.0407	0.0323-0.0499
6	WE	0.0181	0.0091-0.0332	CL	0.0407	0.0288-0.0549
7	GY	0.0166	0.0093-0.0294	PE	0.0368	0.0286-0.0462
8	PE	0.0138	0.0067-0.0263	LP	0.0361	0.0286-0.0453
9	FP	0.0120	0.0064-0.0216	WE	0.0338	0.0247-0.0443
10	NEP	0.0111	0.0056-0.0204	FP	0.0336	0.0231-0.0475
11	CL	0.0107	0.0051-0.0242	GHG	0.0292	0.0223-0.0375
12	GHG	0.0075	0.0034-0.0150	GY	0.0272	0.0211-0.0344

‡. FP: farm profitability; LP: labor productivity; GY: grain yield; FS: food safety; WE: water-use efficiency; NEN: nutrient-use-efficiency, nitrogen; NEP: nutrient-use-efficiency, phosphorus; PE: pesticide-use-efficiency; GHG: greenhouse gas emissions; HS: health and safety; CL: child labor; WP: women empowerment

*. The hypothesis that the share is not significantly different between the 2 groups is rejected at the 0.05 level according to the complete combinatorial test

UNIVERSITY OF ARKANSAS

To:	Glory Esohe Okpiaifo BELL 4188
From:	Douglas James Adams, Chair IRB Committee
Date:	12/13/2018
Action:	**Exemption Granted**
Action Date:	12/13/2018
Protocol #:	1811160774
Study Title:	Consumer Preferences for Sustainability Attributes in the Nigerian Rice Industry

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: Wei Yang, Investigator
Alvaro Durand-Morat, Investigator
Grant Howard West, Investigator

Page 1 of 1