Tropical Small Island Agriculture Management (TSIAM)

Journal Homepage: https://ojs3.unpatti.ac.id/index.php/tsiam

Volume 5	Issue 2	Desember (2025)	DOI: 10.30598/tsiam.2025.5.2.135	Page: 135 - 147

Hedonic Price Analysis for Consumer Preference on Rice Quality Attributes in Some Selected State of North-Western Nigeria.

Bello Bunza ABUBAKAR[1*], Abubakar Ngaski ABDULLAH[2] and Muhammad Sani Muhammad JABO[3]

[1,2,3)]Department of Agricultural Economics, Usmanu Danfodiyo University, P.M.B. 2346, Sokoto, Nigeria

*Corresponding Author e-mail: abubakar.bbunza@udusok.edu.ng

Keywords: *Hedonic Price, Consumer Demand, Market Location, Rice Types, Rice Brand*

ABSTRACT

Rice consumption in Nigeria has grown tremendously over a few decades, particularly among urban dwellers. The country also ranks first as a producer and consumer of rice in the West African sub-region. Consumption is expected to increase with population growth, urbanization, and changes in consumption habits. This study investigated the influence of rice attributes on price. A total of 156 rice samples were collected from 15 markets within a radius of 400 km from the site of the Middle Rima River Valley Irrigation Scheme in Nigeria, which was analysed for grain physical and chemical quality characteristics, which were subjected to the hedonic price analysis of different rice types sold in the markets. Results show that some markets had a significant discount effect on the price of rice while consumers pay a premium price for imported rice. These findings suggest that the consumers preferred rice with more appealing physical attributes such as low percent broken, high length to width ratio, low varietal mix, and low impurities; despite the nutritional ascendancy, domestic rice's high amylose and protein contents over the imported. The wide price differentials between domestic and imported rice could be a bridge with improvement in the physical attributes of domestic varieties and better post-harvest handling techniques to reduce the brokenness and impurities of the domestic rice. There is also a need for nutrition advocacy to narrow the gap in consumers' preference for domestic rice.

INTRODUCTION

Rice is a significant food crop consumed as healthy and staple food across the globe. Rice is consumed by more than 4.8 billion people in 176 countries and is the most important food crop for over 2.89 billion people in Asia, over 40 million people in Africa, and over 150.3 million people in America (FAOSTAT, 2018). Rice consumption in Nigeria is growing, particularly among urban dwellers. The country ranks first as a producer and consumer of rice in the West African sub-region (AfricaRice, 2018).

In Nigeria, rice represents an important basic commodity contributing a significant proportion of the food requirements for its population, cultivated in almost all the agro-ecological zone of the country (Adeola, Adebayo & Oyelere, 2008). Rice consumption in Nigeria is growing, particularly among urban dwellers. The country also ranks first as a producer and consumer of rice in the West African sub-region (AfricaRice, 2018). However, recent estimates indicated that rice is the third major cereal crop after millet and maize in the country's output and cultivated land area (FAOSTAT, 2020). In addition, rice is the most important food source for humans, as world demand is expected to hit 1,533 million tonnes by 2030 compared to 747.3 million tonnes in 2015 (FAO, 2018). Rice is now the third most consumed cereal and the fourth most consumed crop in terms of calories intake (Cadoni & Angelucci, 2013). According to the Federal Ministry of Agriculture and Rural Development (FMARD, 2011), Nigeria is the second-largest rice importer globally, spending more than 356 billion Naira annually on rice imports. This substantial reliance on rice importation can be attributed to the poor performance of the Nigerian agricultural sector (FMAWR, 2011) and especially the perceived low quality of the rice grown in Nigeria by consumers. Limited access to credit remains a bottleneck strangulating the development of the rice value chain in Nigeria. Contract farming through the interlinked credit-output transaction (ICOT) has been shown to improve farmers' output, income, and poverty reduction in developing economies (Key & Runsten, 1999; Shuaibu & Nchake, 2020; Chen & Chen, 2021).

Rice consumption is expected to increase annually by about 15% per annum occasioned to changing preferences by consumers (Chidiebere, 2017). Rice consumers are susceptible to quality and are ready to pay higher prices for better quality (Akoa-Ecoa et al., 2016). Price differences between rice samples of different quality classes indicate that grain quality attributes must be contributing to the price of rice. However, preference for quality attributes and how they influence consumer purchase prices is region-specific (Calingacion et al., 2014).

Grain physical characteristics such as color, rate of breakage, shape, and length of grain, percent of chalkiness in the grain and purity on the one hand, and chemical characteristics including percent amylose and protein content, and gel consistency that measure softness of rice (Unnevehr, 1986; Brorsen, Grant & Rister, 1984; Cuevas et al., 2016) are expected to influence consumers decision in determining the price for rice. This is based on the Lancaster (1966) model of consumer behaviour, which postulated that products are consumed for the characteristics they possess, which are associated with consumer preference. Hedonic price means the implicit prices based on the commodity's characteristics or attributes. The term 'hedonic' often refers to one deriving satisfaction through consuming the good at hand (Triplett, 2004). Selim (2009) stated that the theory of the hedonic pricing model is based on regression analysis, which could be in the form of simple regression or multiple regression. Hedonic pricing models have received wide applicability in the scientific world and were used in measuring utility using the characteristics possessed by good in several studies of some agricultural commodities: Rice (Bonifacio & Duff 1992; Kaosa-ard & Juliano 1991; Abansi, Duff, Lantican, & Juliano, 1992; Kawamura, 1999; Hara, 2000; Untong & Kaosa-ard

2010; Gurung, Bhandari, Paris & Mohanty, 2013; Anang et al. 2011; Bailey, Lawton & Alvaro, 2020)), fruit juice (Weemaes & Reithmuller 2001), eggs (Kim et al., 2003). Isriya & Prapinwadee (2018) studied the Consumer's behaviour and rice attributes. Their study shows that the main idea of hedonic price theory is based on the quality or attributes of the products the consumer's preference derived from product characteristics.

This study estimated the relationship between rice prices, location, and quality characteristics. The price paid by the consumers is an aggregation of the value placed on the quantity and quality of rice (Isriya & Prapinwadee, 2018). Physico-chemical in these studies, only physicochemical characteristics were considered. The findings suggest that the consumers preferred rice with more appealing physical attributes such as low percent broken, high length to width ratio, low varietal mix, and low impurities.

Materials and Method

Study Area

This study was conducted in three states of Sokoto, Kebbi, and Zamfara, Northwestern part of Nigeria. Sokoto state lies between latitude 5° 13' 36.0012" E and longitude 12° 56' 14.7336" N with a landmass of 27,825 Km^2, with an estimated population of about 5,307,154 people in 2016 (NPC, 2006). Kebbi state lies between latitudes 10^{0}8'N and 13^{0}15'N and longitudes 3^{0}30'E and 6°^{0}02'E with an estimated population of approximately 4,724,046 people. Zamfara lies between Latitude: 12° 10' 12.86"N and Latitude: 12° 10' 12.86"E, with a landmass of 37,931 Km^2 and an estimated population of about 5,307,154 people (NPC, 2020).

The area falls within the dry Sudano-Sahelian Savanna agro-ecological zone of Nigeria, with an average annual rainfall of between 300mm and 700mm, with distinct wet (May- October) and dry (November-April,) seasons (NiMeT, 2019). Farming constitutes the major occupation of the rural people. Major food crops grown are rice, millet, maize, sorghum, cowpea, groundnut, sesame, and tree crops grown in the area: mango, cashew, etc.

Rice sample collection

A total of 15 markets (5 urban and ten rural markets) were selected randomly within a 400 km radius of Goronyo. Two additional markets were purposively established in the Capital city of Nigeria; Abuja market (urban) and Gosa Market (rural). One hundred fifty-six samples were collected from the 15 markets for grain quality analysis (Table 1). At the time of rice samples collection, respondents also provided information on the type of rice traded (parboiled or white), trademark (if any), the origin of sample (domestic or imported), price per unit of measure in Naira, and price/Kg (in Naira). The milled rice samples purchased from the respondents were sent to the rice quality laboratory of the AfricaRice, Ivory, cost for physicochemical analyses.

Table 1: Distribution of rice samples based on type and origin collected from markets within a 400km radius of the MARVIS

Qualitative Variables.	Market Types	Frequency	Percentage
Market	Asera	7	5.072
	Bagega	8	5.797
	Bernin kebbi	10	7.246
	Gangara	8	5.797
	Godel	10	7.246
	Gorongo	8	5.797
	Gosa Market	12	8.696
	Gusau	10	7.246
	Jega	10	7.246
	Kamba	9	6.522
	Kasuwan	8	5.797
	Mommon	5	3.623
	Sanyinna	10	7.246
	Sokoto	10	7.246
	Tilli	5	3.623
	Tureta	8	5.797
Type of rice	White	17	12.319
	Parboiled	121	87.681
Origin	Domestic	98	71.014
	Imported	40	28.986

Source: field survey, 2021

Grain quality analysis

Grain quality parameters of the domestic and imported rice samples were analysed for moisture (%), amylose, and protein contents (%). The percentage moisture content was briefly determined using a Single Kernel Moisture Meter (PQ-510, Kett, Japan). Amylose and protein content was determined using Near-Infrared Spectroscopy using the AN820 Instant Rice Composition Analyzer (KettUS, CA, USA). Impurities that measure foreign material such as weed seeds, stones, sand, heat-damaged grains, and husk were manually sorted from 200g of each rice sample, weighed, and computed the percentage weight of the impurities.

Whole grains (head rice) were separated from broken grains using a laboratory rice grader (Satake, Hiroshima, Japan); grain dimensions, mixed varieties, color damage, and chalkiness were determined as described by Ndindeng et al.(2015) using the S21 Rice Statistic Analyzer (LKL Technologia, Brazil). A color meter (CR-400, Minolta Co., Ltd., Tokyo, Japan) was used to measure the color intensity of head rice based on the Lab uniform color space procedure (Zohoun et al. (2018).

Briefly, 50g of whole grains were put into the vibrator sample receiver following calibration with a chalky reference sample. The “long white” classification setup of the Classificador S21 software (Version 4.05) was checked in “capture” mode, and the vibrator was then switched on to singly release individual grains from the receiver through an inclined blue tile beneath the camera, capturing images of the grains. The captured images were processed by applying the “advanced filter – length distribution” command to determine grain dimensions.
Average values of grain length and width and calculated length/width ratio (LWR) were displayed and saved. The International Rice Research Institute (IRRI) has used grain LWR to classify grain

shape as round (LWR ≤ 1), bold (LWR 1.1–2.0), medium (LWR 2.1–3.0), and slender (LWR > 3.0). Mixed varieties were determined from the percentage of grains with a significant difference in width, while color damage was the percentage of grain with colored spots on the grain. To determine chalkiness, the "basic filter – chalky distribution" command was applied. The percentage of total chalky area for the grains was recorded and reported as the percentage chalkiness of the samples. IRRI classification of chalkiness of a sample is 1 ((<10%), 5 (10–20%), and 9 (>20%) Zohoun et al., 2018).

Statistical analysis

Hedonic price model specification

Economist has widely used the hedonic price valuation approach in their studies (Kaosa-ard & Juliano, 1991; Kawamura, 1999; Boyle and Bishop, 1998; Kawamura, 1999; Earnhart, 2001; Isriya and Prapinwadee,2018 The Hedonic price model was drawn from the model of consumer demand developed by Ladd and Suvannunt (1976). According to Unnevehr et al. (1986) and Bikram (2013) established that the consumer demand is based on consumer utility, which in turn is a function of product characteristics and is expressed as follows:

$$\text{one}P_r = \sum_{j=1}^{n} \beta_{rj} x_{rj} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: P_r = the market price of the r sample of rice; X_{rj} = the amount of characteristics j in the sample of rice; P_{rj} = the implicit value of characteristics j.

Adding the random error term to equation (1) and an intercept to allow the effects of quality attributes, the completed estimation equation is expressed as follows:

$$\text{two}P_r = \beta_0 \sum_{j=1}^{n} \beta_{rj} x_{rj} + u \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: P_r = the market price of the rice sample of rice; β_{rj} = the amount of characteristics j in the r sample of rice; P = the implicit value of characteristics j; β_0 = intercept term and u = random error.

$$P_r = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + u \ldots\ldots(3)$$

P_r = the market price of the rice sample of rice (₦/kg);

X_1 = Broken/head rice (%); X_2 = Length to width ratio; X_3 = Mixed variety (%); X_4 = Color damage (%); X_5 = Protein content (dry matter) (%); X_6 = Moisture content (%); X_7 = Amylose content (%); X_8 = Chalkiness (%); X_9 = Impurities (%); X_{10} = location (urban or rural); X_{11} = rice type (white or parboiled); α = constant term; u = Error term.

Mann –Whitney test was used to compare the Grain quality traits between domestic and imported rice. The Mann-Whitney U test is a non-parametric test used in place of an unpaired t-test. It is used to test the null hypothesis, stating that "there is no significant difference between the domestic and imported rice."

Result and discussion

Distribution of rice samples collected from

In markets within the study area, the majority (87.68%) of the rice type identified was parboiled rice (table 1). Similarly, local/domestic rice represents a large proportion (71.01%) of the product traded. In comparison, imported rice accounted for 28.99% of available rice in the rural and urban markets within the study area. It implied that parboiled rice in the selected markets is more abundant than white rice, which may be due to its cooking quality characteristics and higher head rice recovery when processed. Similarly, parboiled rice was reported to be more abundant in markets in Ghana than white rice. In contrast, Unnevehr et al. (1986) reported the availability of white rice more than parboiled rice in the Kandy market, Sri Lanka.

Characteristics of the rice samples

Characteristics of the rice samples, price and aggregate features, their extreme values, and the standard deviation of their mean values are listed in Table 2.

Table 2: Mean and variability of the rice samples' price and grain quality characteristics.

Grain Characteristics	Minimum	Maximum	Mean Value	Standard Deviation
rice (Naira/kg)	178.570	347.830	252.405	27.953
Broken (%)	0.160	40.490	8.531	8.370
Length to width ratio	2.289	3.828	2.974	0.376
Mixed variety (%)	0.780	49.780	14.089	13.708
Color damage (%)	2.900	97.120	64.173	25.278
Protein content (dry matter) (%)	7.100	16.200	10.283	1.973
Moisture content (%)	9.900	12.150	11.141	0.524
Amylose content (%)	11.950	20.600	17.447	1.828
Impurities (%)	0.000	7.050	1.074	1.256

Source: field survey, 2021

In this study, Ignoring rice type, the mean price of a Kg of rice was N 252.405 (SD=27.953). Broken percentage of rice sold in the market range from 0.160% to 40.490% (SD=8.370), while the length to width ratio ranges from 2.289 to 3.828 (SD=0.376). This corroborates with Cuevas et al. (2016) and Isriya and Prapinwadee (2018), who reported that the consumers prefer rice with fewer broken grains. A higher mean value was recorded for the color damage, 64.173% (SD=25.278), with a wide range between the minimum (2.9) and maximum value (97.12). It could be due to higher variability in color of the domestic rice and improper usage of processing techniques. A high percent protein content average above 10% was recorded for all samples, from 7.1% to 16.2 %. It could be said that the protein content of the rice samples traded in the markets within the study location is far above the average of 7% reported in several studies conducted in the Americas, Asia, and African continents (Julio & Villareal, 1993; Omari et al., 2018). The average percent impurities of all rice types was1.07%; some samples had no impurities while others had as high as 7%.

Hedonic price model for grain quality traits, market, and type of rice and its origin.

Table 3: impact of grain quality traits, market, and type of rice and its origin in the study area.

Source	Price (Naira/kg)	Standard error
Intercept	244.360*	102.303
Broken (%)	-0.179	0.466
Length to width ratio	-1.433	16.347
Mixed variety (%)	-0.193	0.304
Color damage (%)	-0.156	0.142
Protein content (dry matter) (%)	-0.210	1.939
Moisture content (%)	4.263	7.218
Amylose content (%)	0.588	1.285
Impurities (%)	-2.227	2.234
Market-Asera	-2.994	8.052
Market-Bagega	-11.826	10.317
Market-Bernin Kebbi	1.643	10.451
Market-Gangara	-4.126	9.234
Market-Godel	-6.576	8.545
Market-Goronyo	-30.409**	9.244
Market-Gosa Market	-27.448**	9.230
Market-Gusau	-2.330	8.131
Market-Jega	13.339	9.753
Market-Kamba	-20.410*	8.738
Market-Kasuwan	3.029	9.502
Market-Mommon	9.205	7.820
Market-Sanyinna	18.463	13.193
Market-Sokoto	-12.325	11.128
Market-Tilli	0.383	12.796
Type of rice	0.243	8.775
Origin	-30.263*	7.705
R^2 of model	**56%**	
P-value of model	**<0.0001**	

Note: Single and double asterisks (* and **) denote statistical significance at the 5% and 1% levels, respectively.
Source: field survey, 2021

All people regularly consume Rice irrespective of their socio-economic class (Lançon, Erenstein, Touré & Akpokodje, 2004). However, preference and willingness to pay for the premium price for the rice varies among different categories of consumers, based on whether or not they live in urban areas, economic prosperity (Damardjati & Oka, 1992), and a host of other factors. The linear regression model for the hedonic price equation in table 2, used in this study, revealed that the model was significant at a 1% level, based on the P-value, and explained 56% of the variability observed in the price of rice. The standardize rice price coefficients for variables included in the model are presented in Figure 1.

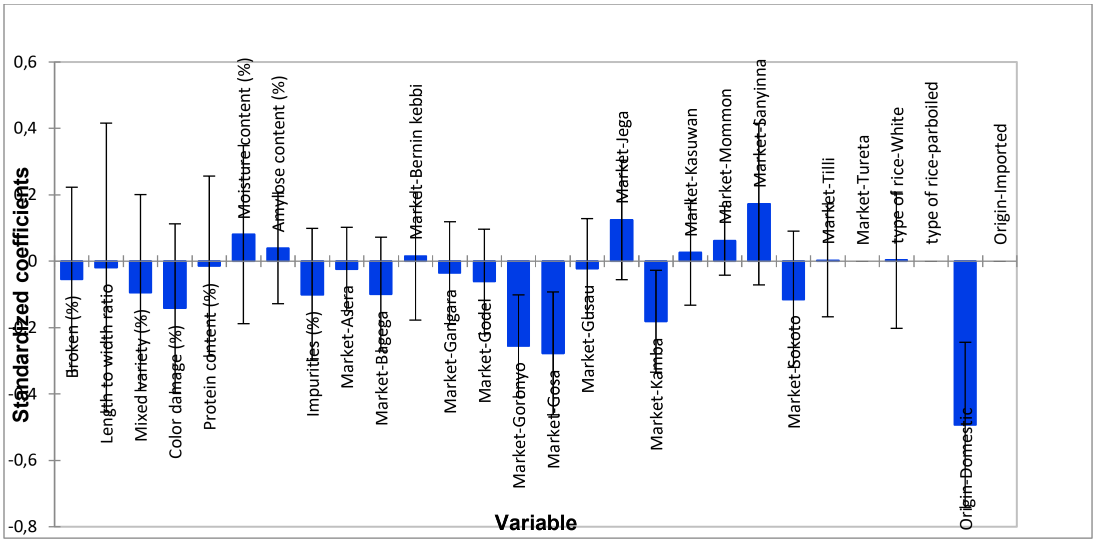

Figure 1: Standardize rice price coefficients for quantitative and qualitative variables in markets in and around Goronyo, Nigeria.

Based on this model, grain quality traits and rice type did not significantly affect price, perhaps because chemical quality characteristics are credence attributes that consumers cannot evaluate or verify themselves (Rutsaert, Demont, & Verbeke, 2013). Nonetheless, even physical attributes such as head rice percentage, shape, and grain length do not seem to affect price significantly, as revealed by our result. This may be linked to the fact that characteristics of the rice were within the normal range and are usually classified under the same group. Sirisupluxana & Bunyasiri (2014) reported that Thai rice consumers prioritize physical quality such as purity and percent of broken rice over cooking quality.

The market influenced the price with significant discount effects in Goronyo (30.4 Naira per kg), Gosa (27.4 Naira per kg), and Kamba (20.4 Naira per kg) (Table 3). This might be because these markets are primarily rural and have a high domestic rice supply. The highest price premium effect was recorded in the Sanyinna market (rural market), while the highest discount effect was recorded for domestic rice. Further analysis showed that the rice prices observed between Goronyo and Sanyinna, both rural markets (Figure 2), was not due to differences in grain qualities but rather due to unobserved heterogeneity in those markets proximity to the rice irrigation scheme which affect supply. Thus, improving grain quality traits for domestic rice so that this rice mimics imported brands will improve the price and reduce quality loss in domestic rice.

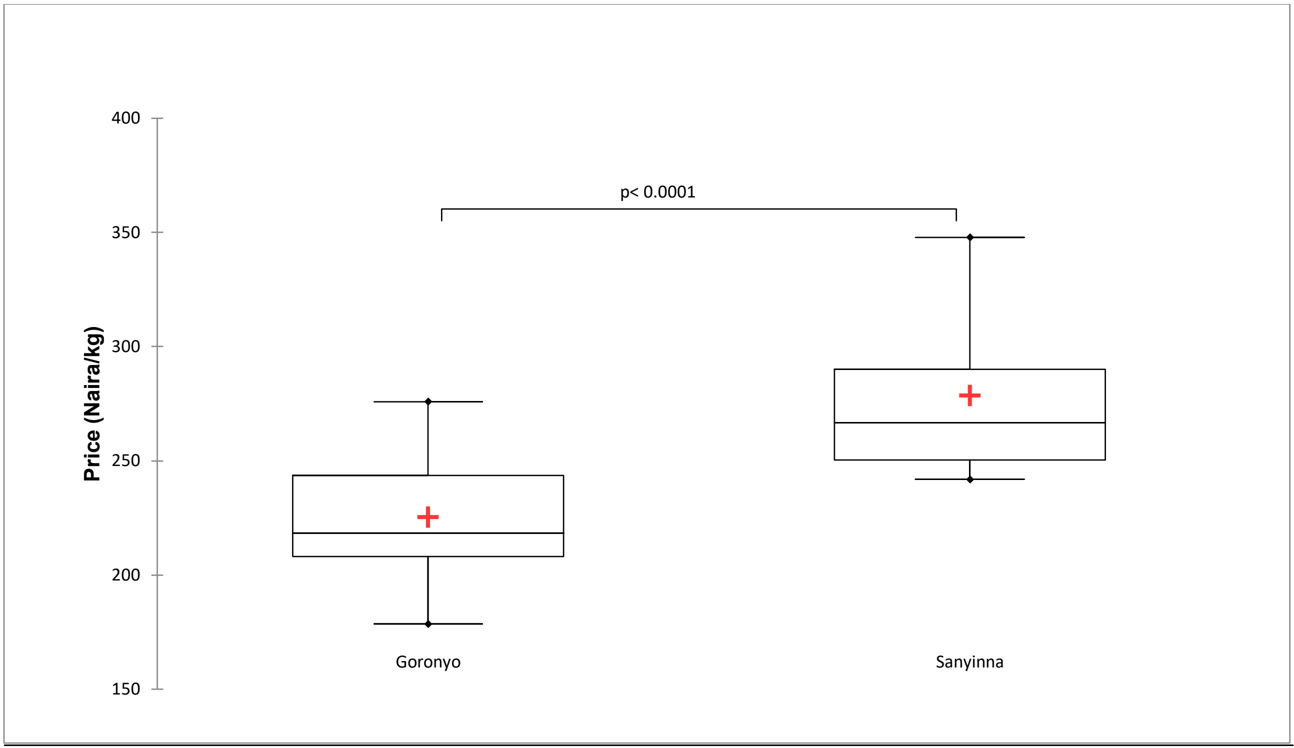

Figure2: Comparison of rice prices between Goronyo and Sanyinna, both rural markets in Sokoto state, Nigeria.

Origin of rice also showed a significant inverse relationship with price, and domestic rice recorded a significant discount effect (30.2 Naira per kg) to imported rice. This implies that both urban and rural consumers preferred imported rice over domestic rice; a related study conducted in some provinces of Benin republic, a neighbouring country to Nigeria, reported a similar preference for imported and parboiled rice over domestic and raw rice (Naseem et al., 2013). However, Naseem et al. (2013) concluded that the implicit prices paid by rice consumers in Benin for domestic and imported rice were based solely on quality attributes, in stark contrast to our current study's evidence. Further, our result contrasted with the report of Untong & Kasosa-ard (2010), who concluded that consumers emphasize value for physical, cooking, and eating quality.

Grain quality traits between domestic and imported rice
Table 4: Descriptive characteristics of domestic and imported rice collected in the Study Area.

Variable	Sample size	Minimum	Maximum	Mean Value	Std. deviation	Mann - Whitney Test (p-value)
Price (Naira/kg) Domestic	98	178.570	347.830	242.322	24.063	P<0.0001
Price (Naira/kg) Imported	40	235.290	333.330	277.108	20.574	
Percent Broken Domestic	98	0.520	40.490	11.061	8.300	P<0.0001
Percent Broken Imported	40	0.160	19.520	2.331	4.387	
Length to width ratio Domestic	98	2.289	3.422	2.787	0.242	P<0.0001
Length to width ratio Imported	40	2.440	3.828	3.431	0.218	
Mixed variety (%) S21 Domestic	98	1.720	49.780	18.684	13.455	P<0.0001
Mixed variety (%) S21 Imported	40	0.780	33.660	2.830	5.166	
Color damage (%) Domestic	98	2.900	91.700	59.586	22.717	P<0.0001
Color damage (%) Imported	40	6.980	97.120	75.413	27.904	
Chalkiness (%) Domestic	98	0.000	50.040	2.469	7.425	P=0.492
Chalkiness (%) Imported	40	0.000	16.510	1.405	3.906	
Color intensity Domestic	98	7.404	12.429	9.804	1.052	P=0.606
Color intensity Imported	40	7.654	14.382	10.078	1.489	
Protein (%) A820 Domestic	98	8.450	16.200	11.064	1.768	P<0.0001
Protein (%) A820 Imported	40	7.100	10.900	8.370	0.781	
Moisture (%) A820 Domestic	98	9.900	12.150	10.976	0.508	P<0.0001
Moisture (%) A820 Imported	40	11.000	12.100	11.545	0.297	
Amylose (%) A820 Domestic	98	11.950	20.600	18.040	1.728	P<0.0001
Amylose (%) A820 Imported	40	14.450	18.950	15.994	1.120	
Impurity (%) Domestic	98	0.000	7.050	1.410	1.287	P<0.0001
Impurity (%) Imported	40	0.000	2.900	0.251	0.669	

Source: field survey, 2021

The grain quality traits between domestic and imported samples were further compared using the Mann-Whitney test. Significant differences were observed for all studied parameters except chalkiness and color intensity, and in most instances, imported samples recorded better values (Table 4). Consumers preferred rice with low percent broken (2.3 ± 4.3%), high length to width ratio (3.4 ± 0.2), low varietal purity (2.8 ± 5.1%) and low impurities (0.25 ± 0.6%).

Domestic rice recorded higher mean values for color damage 59.586% (SD=22.713) and better protein 11.064% (SD=1.768) and amylose 18.04% (SD=1.728) contents. Since physical attributes such as grain shape, length, head rice percentage, and impurities were linked to premium prices and more preferred, there is a need for improvement in some grain quality characteristics and methods of milling domestic rice to resemble imported brands. Based on the length to width of domestic samples ratio of 2.787% (SD=0.242), they are classified as medium-grained while the imported samples were slender at 3.431% (SD=0.218) by international standard (Cruz and Kush, 2000). Chalkiness of domestic samples recorded at 2.469% (SD=7.425) while the imported samples also recorded 1.405% (SD=3.906), both the domestic samples and imported samples fall within the same grade 1 (<10%) according recent classification (Zohoun et al., 2018). Interestingly, domestic rice is more nutritious, with high amylose (>18%) and protein (>11%) content as well as lower moisture (10.9%) than imported rice. This may not be unconnected to the prolonged storage and handling period the imported rice might have suffered or the inherent genetic make-up of the domestic varieties. This implies that grain quality improvement will also increase the price of domestic rice to meet up with imported rice. These findings corroborate Calingacion et al. (2014), who reported that preference for quality attributes and how they influence consumer purchase prices is region-specific.

Conclusion and Recommendation

The result of this study is only the location and origin of rice exert significant discounts in Goronyo, Kamba, and Gosa for price. Curiously, consumers were willing to pay a premium price for better physical attributes of the imported rice (shape, length, head rice percentage) over the nutritional superiority (lower moisture content and higher protein content) of the domestic rice. Interestingly, amylose content (a surrogate feature of the eating quality of rice) also places domestic rice above imported. Therefore, the study recommends that efforts to boost rice production in the Middle Rima Valley Irrigation Scheme aim to improve the physical attributes of the domestic varieties and postharvest handling, especially parboiling operations and milling operations to scale-down impurities as to make domestic rice attractive to consumers across Nigerian markets. There is also a need for farmers and authorities to promote domestic rice due to its nutritional prepotency.

Acknowledgment
I highly appreciated and acknowledged the assistance given by the TRIMING (Transforming Irrigation Management in Nigeria) Project financed by the World Bank through the Africa Rice Center (AfricaRice) and the supervisory team from the faculty of Agriculture Usmanu Danfodiyo University Sokoto.

References

Abansi, C. L., Duff, B., Lantican, F. A. & Juliano, B. O. (1992). Consumer demand for rice grain quality in selected rural and urban markets in the Philippines. In: *Consumer demand for rice grain quality*. Edited by (Unnevehr, L. J., Duff, B. and Juliano, B. O.). International Rice Research Institute, Manila, Philippines. pp. 37-57.

Abidoye, R. B., & Chan, A. P. C. (2018). Hedonic Valuation of Real Estate Properties in Nigeria. *Journal of African Real Estate Research*, 1(1), 122-140. DOI:10.15641/jarer.v1i1.452

Adeola, R. G., Adebayo O. O. & Oyelere G. O. (2008). Effects of the Federal Government special rice programme on rice yield and farmers income in Oyo State. *International Journal of Agricultural Economics and Rural Development,* 1 (1): 1-6.

Africa Rice Center (AfricaRice) (2018). Annual Report for 2016: Towards rice self-sufficiency in Africa. Abidjan, Côte d'Ivoire: pp 36.

Akoa-Etoa, J. M., Ndindeng, S. A., Owusu, E. S., Woin, N., Bindzi, B. & Demont, M. (2016). Consumer valuation of an improved parboiled technology: experimental evidence from Cameroon. *African Journal of Agricultural Resource Economics*. 11(1): 8-21.

Anang, B. T., Zulkarnain, Z. A., & Yusif, S. (2013). Production constraints and measures to enhance the competitiveness of the tomato industry in Wenchi Municipal District of Ghana. *American Journal of Experimental Agriculture*, *3*(4), 824.

Bailey, P., Lawton, L. & Alvaro, D. (2020). Pricing Open Bagged Rice in Nigeria: A Hedonic price model approach. *Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2020 AAEA Annual Meeting, Kansas City, Missouri, July 26-28th.*Working Paper

Bikram, G. (2013). A Hedonic Pricing Model of Rice for Bhutan. *International Journal of Humanities and Management Sciences* (IJHMS) Volume 1, Issue 2 ISSN 2320–4044 (Online)

Bonifacio, E. P., & Duff, B. (1992). The impact of postharvest operations on rough rice and milled rice quality in the Philippines. *Consumer demand for rice grain quality. International Rice Research Institute, PO Box*, *933*, 149-157.

Boyle, K., & R. Bishop. (1998). Welfare measurements using contingent valuation: a comparison of techniques. American Journal of Agricultural Economics 70: 20-28.

Brorsen, B.W, Grant, W.R, & Rister, M.E. (1984). A Hedonic Price Model for Rough Rice Bid/Acceptance Markets. *American Journal of Agricultural Economics*. 66: 156. doi: 10.2307/1241032

Cadoni, P. & Angelucci, F. (2013). Analysis of incentives and disincentives for rice in Nigeria. Monitoring African Food and Agricultural Policies. Food and Agriculture Organization. Retrieved from http://www.fao.org/mafap

Calingacion M, Laborte A, Nelson A, Resurreccion A, Concepcion J.C & Daygon V.D. (2014). Diversity of global rice markets and the science required for consumer-targeted rice breeding *PloS One*. 9: e85106. Available: https://doiorg/101371/journal.pone.0085106.

Chen, J. & Chen, Y. J. (2021). The impact of contract farming on agricultural product supply in developing economies. *Production and Operations Management*, 30(8), 2395-2419.

Chidiebere, M. (2017). Analysis of Value Chain in Rice Production System in Ebonyi State, Nigeria. *A thesis submitted to the post graduate school Federal University of Technology, Owerri.* Accessed online; http://futospace.futo.edu.ng on 24/03/2019, 05:30 pm.

Cruz, N. D., & Khush, G. S. (2000). Rice grain quality evaluation procedures. In: Singh, R. K., Singh, U. K and Kush, G. S. *Aromatic rices*, *3*, 15-28.

Cuevas, R.P, Pede, V.O, McKinley J, Velarde, O, & Demont, M. (2016). Rice Grain Quality and Consumer Preferences: A Case Study of Two Rural Towns in the Philippines. PLoS ONE 11(3):1-17 e0150345. doi:10.1371/journal.pone.0150345

Damardjati, D. S. & Oka, M. (1992). Evaluation of urban consumer preferences for rice quality characteristics in Indonesia. *Consumer demand for rice grain quality.* International Rice Research Institute*, 933*, 59-73.

Earnhart, D. (2001). Combining revealed and stated preference methods to value environmental amenities at residential locations. *Land economics*, *77*(1), 12-29.

FAOSTAT (2018). Food and agricultural organization statistical data base.

FAOSTAT (2020). Food and agricultural organization statistical data base. Retrieved on 12th February, 2022. https://www.fao.org/faostat/en/#data.

Federal Ministry of Agriculture and Rural Development (FMARD) (2011). Agricultural transformation agenda: We will grow Nigeria's agricultural sector. Draft report of the FMARD, Abuja, Nigeria.

Food and Agriculture Organization (FAO) (2018). Sustainable rice based production and people's livelihood. *International Rice Commission Newsletter (Special Edition)* 52, pp 24-36, Rome, Italy.

Gurung, K., Bhandari, H., Paris, T. & Mohanty, S. (2013). Gender Dynamics in Changing Rice-Based Agricultural Systems in Bangladesh. *Policy Breifs, Los Banos, Laguna, Philippines: International Rice Research Institute (IRRI)*.

Hara, M. (2000). Measuring positive externalities in Japanese rice production: A hedonic price analysis. In: *Ecological Economics*. New York, Rensselaer Polytechnic Institute. D Phil. https://doi.org/10.1002/fsn3.242

Isriya N. B & Prapinwadee S. (2018). Consumer's behavior and rice attributes for Thai HomMali Rice in Sichuan Province of China Journal of Business and Retail Management Research (JBRMR), 12 (2): 242-252

Julio. P. G. & Villarea, A. T. (1993). Genetic diversity analysis of Cuban traditional rice (*Oryza sativa* L.) varieties based on microsatellite markers. Genome 39:373-378. http://dx.doi.org/10.1590/S1415-47572007000600014

Kaosa-ard, M. & Juliano, B.O (1991). Assessing Rice Quality Characteristics and Prices in Selected International Markets. *Rice Grain Marketing and Quality Issues*, International Rice Research Institutes, Philippines, 23-25.

Kawamura, T. (1999). *Hedonic Price Analysis and its Application to Package Design: Packaged Cooked Rice in Japan,* World Food and Agribusiness Congress*,* 13-14.

Key, N. & Runsten, D. (1999). Contract farming, smallholders, and rural development in Latin America: the organization of agro-processing firms and the scale of out-grower production. *World Development*, 27(2): 381-401.

Ladd, G.W. & Suvannunt, V. (1976). A Model of consumer Goods Characteristics*. American Agricultural Economics Association*, 58: 504-10.

Lancaster, K. (1966). A New Approach to Consumer Theory. *Journal of Political Economics*, 74: 132-157.

Lançon, F., Erenstein, O., Touré, A., & Akpokodje, G. (2004). *Quality and competitiveness of local and imported rice on West African urban markets* (No. REP-11507. CIMMYT.).

Naseem, A., Mhlanga, S., Diagne, A., Adegbola, P. Y., and Midingoyi, G. S. K. (2013). Economic analysis of consumer choices based on rice attributes in the food markets of West Africa—the case of Benin. *Food security*, *5*(4), 575-589.

National Population Commission (NPC) (2006). Population projection report for Goronyo and Gada Local Government Areas of Sokoto State, Nigeria. *Accessed online at https//www.npc.gov.ng on 10/11/2018, by 10:35:00 Am.*

Ndindeng, S. A., Manful, J. T., Futakuchi, K., Mapiemfu, D. L., Akoa-Etoa, J. M., Bigoga, J., Tang, E. N., Graham-Acquaah, S. & Moreira, J. (2015). A novel artisanal parboiling technology for rice processors in sub-Saharan Africa. Food Sci. Nutr. 3(6): 557-568. https://doi.org/10.1002/fsn3.242

NiMeT (2019). Nigerian Meteorological Agency: Seasonal Rainfall Prediction

Omari, R., Ampadu-Ameyaw, R. & Owusu, E. G. (2018). Marketing and promotional plan for local Rice based on drivers of traders and consumers preferences. *FARA Research Report*, 3(3):56

Rutsaert, P., Demont, M., & Verbeke, W. (2013). 23 Consumer Preferences for Rice in Africa. In *Realizing Africa's rice promise* (pp. 294-302). CABI.

Selim, H. (2009). Determinants of house prices in Turkey: Hedonic regression versus artificial neural network. *Expert Systems with Applications, 36*(2), 2843-2852.

Shuaibu, M. & Nchake, M. (2020). Credit market conditions and agricultural performance in Sub-Saharan Africa. *The Journal of Developing Areas*, 54(4): 41-53.

Sirisupluxana, P. and Bunyasiri, I. N. (2014). *Demand for Thai Rice Project*, TDRI (in Thai).

Triplett, J. (2004). Handbook on hedonic indexes and quality adjustments in price indexes: Special application to information technology products, pp.1815-1965. OECD Publishing, Paris. DOI: https://doi.org/10.1787/9789264028159-en

Triplett, J. E. (1986). Automobiles and hedonic quality measurement. *Journal of Political Economy*, *77*(3), 408-417.

Unnevehr, L. J. (1986). Consumer demand for rice grain quality and returns to research for quality Improvement in Southeast Asia. *American Agricultural Economics Association*. 68, 634–641.

Untong, A. D. & M. Kaosa-ard, M. (2010). Import Demand for Thai Rice and Factors Determining price and rice in Modern Trading Market in China. *Journal of Applied Economics*, 17(2)

Weemaes, H. & Riethmuller P (2001) What Australian consumers like about fruit juice: results from a hedonic analysis. Paper selected for presentation at the World Food and Agribusiness Symposium, International Food and Agribusiness Management Association, Sydney 27-28 June 2001

Zohoun, E.V., Ndindeng, S.A., Soumanou, M.M., Tang, E.N., Bigoga, J., Manful, J., Sanyang, S., Akissoe, N.H. & Futakuchi, K., (2018). Appropriate parboiling steaming time at atmospheric pressure and variety to produce rice with weak digestive properties. *Food Science & Nutrition*, 6(4), pp.757-764.