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Research Article

WHO CONSUMES MORE BROKEN RICE GRAIN? EVIDENCE FROM RURAL AND URBAN CONSUMERS

Rashed Saeed*[1], Irfan Mahmood[1]

[1] *Senior Scientific Officer, (PARC) Social Sciences Research Institute, Faisalabad*

Corresponding author: **rashedkasuri@gmail.com*

Abstract

The present study, in response to rising food prices, was conceived to find quantitative differences, particularly in broken rice consumption concerning the consumers' geographic (urban/rural) location. Four districts, namely Faisalabad, Sheikhupura, Kasur, and Toba Tek Singh were selected as a case study from central Punjab. Cross-sectional data collected randomly from 250 consumers of broken rice (100 from Faisalabad and 50 from each of the remaining districts with equal proportion of rural and urban households) was used to run a descriptive and non-parametric test of Mann-Whitney U-Test, an alternative test to student t-test. Descriptive statistics show that the average monthly income of the households was Rs. 73251, with an average monthly income of Rs. 63911 and Rs. 82667 for rural and urban households, respectively. The overall total rice consumption per household (11.2 Kg/month) comprised almost half (51%) of broken rice (5.71 Kg/month). Total rice consumption was comparatively more in urban households despite a non-significant difference. The Mann-Whitney U-test finds a highly significant difference in the consumption of broken rice for rural and urban households. The test further clarifies that rural consumers consumed more broken rice (6.38 Kg/month) than urban households (5.04 Kg/month). Comparatively, more consumption of whole rice in urban settings and broken rice in rural areas seem in line with their respective higher and lower income levels. As these research findings have important policy implications for ensuring household food security, there is a need to further validate findings for appropriate national-level policy using large country-level data sets. Keeping in view the role of rice similar to wheat flour in reducing food insecurity, studies finding the relationships between household income and consumption of rice, including locally called pona, adware, tota, or mix type categories of broken rice, are suggested to deeply understand the consumer preferences for broken rice market in the country.

Keywords: Broken rice consumers, Mann-Whitney U-test, cross-sectional data, geographic location.
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1. INTRODUCTION

Rice is a staple food globally, particularly in Asian countries. On average, the annual rice consumption in Asia is around 85 kg, and globally, the figure stands at about 65 kg per person (Nemati-Mansour et al. 2022). Bashir et al. (2018) while quoting the report of the International Grain Council, 2018 highlighted that rice is one of the major crops grown and consumed by more than half of the world population in the world. Major rice-producing countries are China, India, and Indonesia, while significant exporters are India, Thailand, Vietnam, Pakistan, and the United States with major competitors such as Thailand, India, Myanmar, and Vietnam, Pakistan exports IRRI, basmati, and broken rice to the world after meeting its domestic needs. Ali (2020) reported that among significant exporters of rice, Pakistan is also one based on good quality milled rice, brown rice, and broken rice (a by-product of the milling process that is highly demanded due to its lower price) and the most significant markets for Pakistani broken rice are Afghanistan, Senegal, and China. Almost 40 to 45 percent of the rice crop is used for

local consumption, with the remaining exported. Pakistani consumers mainly prefer basmati rice for consumption and during the year 2020/21, approximately 200,000 tons of 40-100% broken kernel went to poultry and animal feeds (Raza, 2020). Pakistan exported broken rice worth USD 251 million against exported world broken rice value of USD 2.6 billion by capturing 10% world market share in 2021 (Ilyas et al., 2022).

So, rice plays a vital role in ensuring the food security of many developing nations. In many Asian countries, rice is the leading staple food in both rural and urban settings. For Pakistan, rice is the second most important staple after wheat and the second major exportable commodity after cotton. Pakistan enjoys a comparative advantage in cultivating superior quality basmati rice in the Kallar tract of Punjab Province of Pakistan, comprising eight adjoining districts with suitable climate and soil characteristics for its cultivation. The country over the last 40 years has been exporting various surplus basmati rice products like single and double polish rice, brown rice, par-boiled/saila and steamed rice to harness premium prices of rice types to the world markets on account of unmatchable aroma, superfine grain, unique taste and extreme grain elongation after cooking. The consumers in Pakistan eat both kinds of rice, i.e., whole and broken rice, depending upon their income levels, prices of entire and relative prices of broken rice based on other cooking attributes such as taste, aroma, length of rice, and nature of cooked dishes, etc. The preferences for whole and broken rice may differ significantly depending upon factors such as prices and the income level of the consumers.

Important questions arise: “Is there any difference in rice consumption, particularly broken rice consumption, among rural and urban households in the wake of rising food inflation in the country? More specifically, is there a case of intra-rice type substitution, in which consumers eat more broken grain rice (ordinary rice) by shifting away from whole grain rice (fine rice) as their disposable incomes decline? Research on this issue is of prime importance as consumers widely believe that whole grain and broken rice grains have the same taste/quality but that broken rice significantly brings discounted prices compared to whole kernels (Richardson, 2021). Therefore, the countries relying on staples for their food security may witness disturbances in their food consumption behaviours if prices of such commodities become highly volatile in the market. Pakistan is no exception to this issue despite bumper production of certain staple foods in the country. According to Suleman et al. (2022), CPI in urban markets increased by 7.7% annually during the year 2020 compared to 8.4% during the year 2019 and CPI in rural areas also increased to 12.75% in 2020 compared to 8.1% during the year 2019. The literature further highlights that despite the country's continuous bumper production of food commodities, the current historically recorded inflation is crossing 30 percent because of rising food prices in the country, which is badly hitting the purchasing power of local consumers. Similar to wheat flour, rice grain is also confronting food price inflation in Pakistan where households’ income elasticity for rice is becoming smaller and smaller over time. This has led to a decline in per capita rice consumption in several high and middle-income countries (Pingali, 2007).

As rice is a basic staple food in Pakistan, it is less enriched in food value. The consumers who once used to eat whole grain rice have now been seen switching towards broken rice and sometimes towards locally known inferior broker rice grades such as pona, adhwaar, tota or nakku type products of rice. To the best knowledge of the authors, the issues of household rice consumption including consumption of broken rice after price volatilities in the market are being widely researched in the international literature, but little focus is observed in the case of Pakistan where rice

is considered a whole grain (instead of broken grain) is studied enough from farm level production to consumer level consumption. Internationally, Faye et al. (2022) studied household rice consumption behavior in terms of local and imported as well as whole and broken aspects amid rising food prices and changes in income levels across geographic locations in Senegal. Similarly, Mgendi (2014) researched consumers' preferences for rice attributes in Dar-es-Salaam city of Tanzania. Mottaleb and Mishra (2016) conducted research on rice consumption and grain-type preference of households for long-and-slender (whole) grain and short-and-bold-grain (broken) rice in Bangladesh by applying the mauza-level fixed effect estimation method. Pavilus (2018) assessed rice consumers' preferences and willingness to pay for selected rice quality characteristics covering local and imported broken rice in Haiti by applying a hypothetical choice experiment. Sisang (2019) performed research on factors influencing consumer preference for rice in the Northwest Region of Cameroon by applying multinomial logit, linear regression model, and factor analysis to assess factors influencing consumer decisions for local and imported rice types. Richardson et al. (2021) worked on the optimization of broken rice consumption by understanding the confluence of sensory and economic preferences among Haitians in response to price hikes in the market. Similarly, work by Richarson et al. (2022) suggests that the government should enhance the import of broken rice as the cheaper broken rice on the plates of the poor across Haiti is a better option than putting broken rice before the pets. Zhang et al. (2021) focused on energy derived from broken rice and rice bran for broiler chickens in Hunan, China.

Despite the reality that the export market only accepts top-quality basmati with limited broken kernels (0-5% broken kernels), empirical evidence on the consumption of any broken kernels is lacking in Pakistan. For example, a comprehensive work by Bashir et al. (2018) under ADB funded project on the basmati rice value chain in Punjab lacks the aspect of broken rice along the rice value chain study. Another recent work by Saeed et al. (2020) also focused only on basmati rice cluster feasibility and transformation study in Pakistan. Therefore, once again recalling that with economic progress and growth in the disposable incomes of consumers, they may shift towards superior quality items or even switch to the items' available alternative products following their incomes and vice versa. For example, households at relatively lower ends of income consume more rice than high-value foods such as meat, poultry, and vegetables by shifting away from rice (Kearney, 2010). The literature further suggests that the volatility in rice prices (especially in high-quality rice) and possible interruptions in supplies of whole and broken kernels (being strong substitutes for the same quality and taste) could result in rice food insecurity internationally and nationally. In this background, Saha et al. (2021) are of the view that a good understanding of rice attributes, particularly of broken rice, can help attract different market buyers via consumption behaviour and price options, hence potentially boosting the use of rice for food instead of feed for animals.

Keeping in view the economic forces affecting the consumption of commodities, the present study was conceived by believing the study would be the first to provide a basis for an exploratory examination of rice consumption across the geographic location of households in the country for the years to come. However, the study was narrowed down to find quantitative differences, particularly in broken rice consumption concerning the geographic (urban/rural) location of the consumers in Punjab where more than 90% of basmati has been shared in national output since times immemorial (Giraud, 2008). Keeping in view the aim of the study, the following allied objectives were

1) to study the demographics of households segregated by geographic location of consumers, 2) to explore the extent of consumer likeness for broken kernel in the study area, 3) to find quantitative differences in rice consumption patterns to rural and urban households and 4) to provide recommendations/way forward towards rice food security.

2. Materials and Methods

The study was carried out in 4 adjacent districts, namely Faisalabad, Toba Tek Singh, Sheikhupura, and Kasur, located in Punjab Province. Each district has its climate and agronomic variations that distinguish them from each other in matters of income level, prices of the commodity based on production of rice crop etc. District Sheikhupura has a comparative advantage over district Faisalabad in all types of paddy production due to its distinct climate and sandy loam to loamy soil characteristics while District Faisalabad known as Manchester city of Pakistan has relatively more job opportunities than Sheikhupura, Toba Tek Singh and Kasur. So similar and many contrasting situations present in these study districts made it a fit study area for conducting empirical research on rice consumption behaviour by their residents. The study used a cross-sectional research design whereby primary data were collected through well-designed and pre-tested questionnaires containing all relevant variables to attend to the specific objectives of the study. A special section of the questionnaires was allotted to collect data on the demographic profile of the rice consumers and about the rice quantities themselves to segregate the information as per rural and urban categories. A random sampling technique was followed to collect data from survey respondents. A sample size of 250 respondents for conducting face-to-face interviews was managed by randomly selecting 100 households from Faisalabad (relatively being a big city) and 50 households from each of the three remaining small districts. The sample size so formed comprised an equal number of households from rural and urban locations of four districts to capture the proper geographic impact on rice consumption during the fiscal year 2023-24. Every effort was made to ensure consumers of broken rice. Descriptive statistical analyses, such as frequency, average, and percentage, were conducted to study the demographic profile of households. Depending upon the properties and symmetric behaviour of the variable of interest (rice consumption data), the statistical technique of the Mann-Whitney U-test (a non-parametric alternative to independent samples t-test) was applied to test whether there are any group differences between rural and urban households regarding rice consumption or not? The use of the Mann-Whitney U-test in the case of non-symmetrical behaviour of variables has been made in various research such as in the work of Batra (2008), Cuevas et al. (2016), Chamorro-Koc et al. (2021), Mustapa et al. (2023), Ahmed et al. (2023) and Deb et al. (2023).

In other words, the null and alternative hypotheses were set as below to test the presence of differences in broken rice use among rural and urban households:

Ho: There is no significant difference in the consumption of broken rice for rural and urban households.

H1: There is a significant difference in consumption of broken rice for rural and urban households.

One of the set objectives (likeness for broken rice) was studied using a 4-point Likert scale by assigning likeness categories for broken rice as very much liked, much liked, less liked and not liked. Statistically significant differences were declared where the probability value was less than 5% level of significance ($P<0.05$) following Shamim et al. (2016). The analysis of data was conducted in SPSS (Statistical Package for Social Sciences).

3. Results and Discussion

3.1. Socio-Economic Status of Respondents

Socio-economic characteristics are important variables to study as these factors

may affect the purchase decisions of households for commodities. Table 1 presents the status of the rice consumers in terms of descriptive statistics of residence status, family living system, family size, age, education, domestic income earners, monthly income, and total and broken rice quantities in the study area. The demographics are elaborated on in percentages, ranges, and average values.

Table 1: Socio-Economic Characteristics of Respondents

Characteristics	**Rural**		**Urban**		**Overall**	
Residence (%)	50		50		100	
Family living (%)	Nuclear	Joint	Nuclear	Joint	Nuclear	Joint
	72	28	67.2	32.8	69.6	30.4
Characteristics	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**
Age (year)	18 – 75	38.26	17 – 75	34.83	17 – 75	36.54
Education (year)	0 – 18	9.85	0- 20	10.07	0 – 20	9.96
Family size (No.)	2 - 17	7.09	2 - 35	7.94	2 - 35	7.52
Income earners (No.)	1 - 4	1.66	1 - 6	1.94	1 - 6	1.8
Income (Rs/month)	18000-350000	63911	20000-260000	82667	18000-350000	73251
Total rice consumption (Kg/month)	2 – 65	11.2	2 – 60	11.23	2 – 65	11.22
Broken rice consumption (Kg/month)	1 – 65	6.38	1 – 30	5.04	1 – 65	5.71

Source: Field Survey, 2023-24

The survey respondents in rural and urban settings were almost equal according to the defined methodology. The overall family living system, even from the geographic perspective of respondents, reveals that the nuclear system was a dominant living system with a 69 percent majority in the study area (see Table 1). The average age of the overall sample respondents was 36 years with a range of 17-75. However, the rural respondents were comparatively older than their urban counterparts with respective average ages of 38 years and 35 years respectively. The overall average education level was nearly matriculation (9.96 years) that ranged from illiterate class to highly qualified class of PhD level studies. The education level was almost matriculation both among rural and urban households. Overall family size was 7.52 persons with a minimum number of 2 to a maximum number of 35 persons. The family size was slightly larger in urban households (7.94 persons) than in rural settings (7.09 persons). Anyhow, the size of the household was moderate in line with the study of Ajayi and Ajiboye (2020). On average, 1.8 persons were income earners, ranging from 1 to 6 persons per household in the study area. Urban households had a higher number of income earners than rural households, which endorsed more job opportunities in urban settings. The earners were earning, on average, approximately 73251 rupees per month per household. Urban dwellers were earning almost 20% more than rural dwellers. The implication is that both the rural and urban households had moderate income according to Ajayi and Ajiboye (2020). The overall mean total rice consumption per household was 11.22 Kg/month, ranging from 2 to 65 Kg/month. The total monthly rice consumed seems equal among rural and urban households. Broken rice consumption on an average basis was estimated at 5.71 kg/month, which is around 51% of the total rice quantity per household. The survey results

further depict that the consumption quantity of broken rice was higher in rural areas (6.38 Kg/month) as compared to urban households (5.04 Kg/month). The consumption of broken kernels ranged from a minimum quantity of 1 Kg/month to a maximum of 65 Kg/month. Although Senegalese households consume relatively more broken rice than Pakistani consumers while the consumption shares of broken rice for rural (57%) and urban consumers (45%) matches with Senegalese households where the rural share of broken rice is higher than urban at 62% and 52% respectively (Faye et al., 2022). Anyway, the implication of reasonable broken rice use in the study area is that it has a huge potential in international trade as well as in the food basket of local consumers, particularly those belonging to rural households despite the fact that slender, long, and fine grain rice is mainly preferred in Pakistan (Giraud, 2013).

3.2. The extent of Consumers' Preference for Broken Rice

Considering the country's huge consumption of broken rice, the respondents were asked to show their likeness to or dislike of it. The Chi-Square results presented in Table 2 show that most of the overall consumers (sum = 90%) expressed their likeness for broken rice as a staple food from very much to less liked rice (Ali, 2020) and yielding almost the same taste. In this way, only 10% of respondents expressed their dislike for broken rice, perhaps mainly because of the available handsome income for purchasing whole rice grain instead of broken rice. Another way of looking at Table 2 reveals that the households showing a greater dislike for broken rice were relatively rural households, although the overall differences across Likert scale categories were insignificant according to the Chi-Square test.

3.3. Rice Consumption Differences by Residence Status of Households

According to Mann-Whitney U-test results given in Table 3, the mean ranks of rural and urban households in the case of total rice consumption quantity are 124.43 and 126.57 respectively. The difference in these ranks is not significant as the p-value of 0.814 is not less than 5%. This implies that there is no significant difference regarding total rice consumption as perceived by rural and urban households. Similarly, the mean ranks of households in the case of broken rice consumption are 133.89 for rural households and 117.11 for urban households. The difference in these ranks is proved significant as the Mann-Whitney U-test test statistic has a p-value of 0.064, which is less than 10%. The authors had to reject Ho. (null hypothesis) for supporting

Table 2: A Chi-Square Analysis of Likert Scale Responses

Rice	Likeness	Residence Status		Overall	Sig.
		Rural	Urban		
Broken rice consumption	Very much liked	30 (24.0)	25 (20.0)	55 (22.0)	0.724
	Much liked	45 (36.0)	47 (37.6)	92 (36.8)	
	Less liked	36 (28.8)	42 (33.6)	78 (31.2)	
	Not liked	14 (11.2)	11 (8.8)	25 (10.0)	
Overall		125 (100)	125 (100)	250 (100)	

N.B: The figures in parenthesis represent percentages

Source: Field Survey, 2023-24

levels. Even the households showing less likeness were higher in percentage than the households showing total dis-likeness for broken rice. This finding implies that the respondents had a higher preference for broken rice in the study area than disliking it because it has a lower price than whole the alternative of H1. By manipulating the Z-value provided in the U-test and the number of sampled respondents, the effect size "r" was estimated to be 0.22 which according to Cohen's (1988) criteria depicts that the effect size is small (although there exists the difference over broken rice use,

but that difference is not that big between the rural and urban households). The finding that the location of households matters regarding household broken rice consumption is in line with the findings of Faye et al. (2022) in Senegalese households. Less preference for broken rice in urban areas is also reported in Bangladesh where the whole fine-grain type is mainly preferred by the affluent and urbanized class (Mottaleb, 2016). Anyhow, the presence of a highly significant difference in monthly income for both the rural and urban households, as per Table 3 below, also supports the enhanced consumption of broken rice in rural areas due to poor purchasing power/lower income of the rural inhabitants (read Table 3 with Table 1).

which half (51%) of the rice was broken rice type (5.71 Kg/month). Although overall rice consumption was comparatively higher in urban households, the difference estimated was insignificant. On the other hand, a highly significant difference was found in the consumption quantity of broken rice among rural and urban households. Rural consumers, as compared to urban consumers, consumed significantly more broken rice due to the widely held belief that whole and broken rice types taste the same. However, the consumption behavior of respondents for both rice types of prima facie seemed in line with the respective lower and higher income levels/purchasing powers of rural and urban consumers. Moreover, using huge data sets, the preference for broken

Table 3: Results of Mann-Whitney U-Test

	Residence	N	Mean Rank	Sum of Ranks
Monthly Income	Rural	124	110.32	13679.50
	Urban	123	137.79	16948.50
	Total	247		
Total rice use	Rural	125	124.43	15553.50
	Urban	125	126.57	15821.50
	Total	250		
Broken rice use	Rural	125	133.89	16736.50
	Urban	125	117.11	14638.50
	Total	250		
	Test Statistics*			
		Monthly Income	Total rice use	Broken rice use
	Mann-Whitney U	5929.500	7678.500	6763.50
	Z	-3.027	-.236	-1.849
	Asymp. Sig. (2-tailed)	.002	.814	.064

a. Grouping variable: Residence Status Rural or Urban

Source: Field Survey, 2023-24

4. Conclusion and Way Forward

The study, in the wake of rising food inflation in the country, particularly analyzed households' quantitative differences present in broken rice consumption by geographic (urban/rural) location of the consumers in four districts, namely Faisalabad, Toba Tek Singh, Kasur, and Sheikhupura in central Punjab. It was revealed that the total rice consumed per household was 11.2 Kg/month, out of rice among households in the study area justifies further deeper analysis to validate findings for appropriate provincial/national level rice policy. Also, keeping in view the role of rice similar to wheat flour in reducing food insecurity, studies finding the relationships between household income and consumption of broken rice categories locally called pona (75% broken), adhwaar (50% broken), tota (25%) or mix type categories should be included

in future demand and supply analyses to ensure sustained food security in the country.

5. Competing Interests

Both authors declared no competing interests in the publication of this research manuscript.

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