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CONSUMERS' WILLINGNESS TO PAY FOR CERTIFIED HIGH IRON BEANS

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Abstract

This study surveyed household decision makers to determine the willingness to pay (WTP) a premium price for certified high-iron common beans and the underlying determinants in the urban areas of West Pokot County, Kenya. The data were collected from 384 respondents selected through a stratified multistage sampling technique using a pretested semi structured questionnaire. A one-and-one-half bounded contingent valuation method was utilized to assess WTP. The data were analyzed in R Software. Household decision makers were willing to pay an average price premium of Kenya Shillings 281 per kilogram. WTP was significantly influenced by age, the proportion of monthly income allocated to food items, access to nutrition information, relative trust in nutritional claims, relative trust in certification agencies and awareness of food certification. Interventions for implementing lower pricing and enhancing the trust and awareness levels of public certification agencies could be appropriate. Prices may gradually be raised once trust and familiarity with high iron common beans, have diffused among consumer segments.

Keywords: *Food certification; high-iron common beans; urban consumers; willingness to pay*
Jel Codes: *D12, D91, R20*

1. Introduction

The world is experiencing rapid urbanization. By 2050, the United Nations predicts that approximately two-thirds (68%) of the global population will reside in urban areas (UN DESA, 2018a). The majority of this increase, approximately 90%, will occur in small metropolitan areas in Africa and Asia (FAO, 2017). While this urban migration presents various opportunities, it also brings significant challenges concerning food security and access. Households residing in urban areas of low- and middle-income countries, such as Kenya, are expected to be vulnerable. This vulnerability stems from the fact that they allocate a substantial portion of their earnings to purchasing food, rendering them susceptible to changes in food prices (Brinkman *et al.*, 2010; Cohen & Garrett 2010). The volatility of food prices immediately impacts diet quality by compelling households to replace nutritious fresh foods

with less nutritious but more affordable staples (Bloem & De Pee, 2017).

Urban migration leads to a notable shift in individuals' dietary inclinations as they transition from traditional staple foods to more convenient alternatives such as rice, bread, and meals consumed outside the home (Cockx *et al*., 2017; Maruapula *et al.*, 2011; UN, 2020). Additionally, they tend to consume heavily processed foods (Steyn *et al*., 2012; Reardon *et al.*, 2021). The enduring consequences of the accessibility and cost-effectiveness of nutritious foods and balanced diets will disproportionately affect susceptible demographics, including those of women, children, and elderly people (Devine & Lawlis, 2019). Furthermore, disparities in child malnutrition and mortality within urban areas are becoming increasingly evident in comparison to disparities between rural and urban regions. This can be attributed to the expansion of impoverished communities (Fotso, 2006).

Urbanization, the commercialization of agri-food value chains, and dependence on purchased commodities all contribute to the deterioration of food and nutritional security in low-income neighborhoods (Raschke & Cheema, 2008). This calls for a need to find a sustainable method of supplying nutritious food (Nadeem *et al*., 2021). The nutrition and development community must assist the burgeoning food sector in manufacturing nutritious food that is of excellent quality and can be obtained at reasonable prices.

The CGIAR HarvestPlus Programme has spearheaded nutritional research on the biofortification of common beans with iron to alleviate iron deficiencies (HarvestPlus, 2022). It is of particular concern that consumers cannot differentiate a high-iron bean from a 'normal' bean based on their appearance alone (De Brauw & Bulte, 2021). De Brauw and Bulte (2021) contend that poor consumers are more inclined to choose the high-iron bean variant without the credence attribute. It is a legitimate concern that the high iron bean value chain may have a greater likelihood of excluding economically disadvantaged consumers, as they are reliant on purchasing beans from the market (Abate *et al*., 2021).

Food literacy is pivotal for enhancing food security because it addresses the limited understanding of food labeling, product characteristics, and food selection among households experiencing food insecurity (Butcher *et al*., 2019). In this context, certification systems are increasingly being utilized to regulate food chains (Veldstra *et al*., 2014) and to guide consumers in making purchases (Janssen & Hamm, 2011; Thøgersen *et al*., 2019). Abate *et al*. (2021) established a model that outlines four prerequisites for certifying grains in African agricultural markets. One of these prerequisites is that downstream participants in the value chain, such as consumers, must be willing to pay an additional amount for grains of higher quality. While there is empirical evidence available on the willingness of African consumers to pay for biofortified staple crops, limited research has been conducted on consumers' WTP for the certification of biofortified food products in urban areas of Kenya. To bridge the aforementioned knowledge gap, this study investigated consumers' WTP for certified high-iron beans in the urban areas of West Pokot County.

2. Materials and Methods

2.1. Study Area

This research was conducted in West Pokot County urban areas. The county spans an area of approximately 9,123.3 km^2, with a population of 184,446 people and a density of 68 persons per square kilometer (KNBS, 2019b). Kapenguria is the only municipality within the county. The Chepareria urban center is eligible to become a municipality, while the Kacheliba, Alale, Ortum, Kabichbich, Sigor, Lomut, and Konyao urban centers meet the requirements of being classified as towns according to Kenya's Urban Areas and Cities Amendment Act (2017). Majority of the urban population comprises of economically active people aged between 15 to

60 years (West Pokot County Government, 2019). Nearly a fifth (18.6%) of the West Pokot County residents live in Kapenguria and Chepareria towns.

The main economic activities in the County urban areas include retail and wholesale trading, fresh produce and cereals enterprises, and entertainment and hospitality businesses. The County also faces many challenges, including a high poverty level (69.4%), high stunting rates (34%), rampant insecurity along its borders with Turkana and Elgeyo Marakwet Counties, poor infrastructure, and adverse effects of climate change (West Pokot County Government, 2018). All these challenges have worsened drought shocks and hazards that exacerbate the nutritional status of the population.

2.2 Sample Size Determination and Distribution

Determination of the sample size was based on Kothari's (2004) approach, which is specified in equation 1:

$$n = \frac{z^2 \times p \times q}{e^2} \quad (1)$$

where *n* is the size of the sample, z is the confidence level (α=0.05), which is 1.96, *p* is the population proportion of interest (household decision makers), which is set to 0.5 since, statistically, a proportion of 0.5 results in a sufficient and reliable sample size when dealing with the population that is not known with certainty, *q* is the weighting variable computed as 1-*p*, and *e* is the precision rate, which is set to 5% to avoid 95% bias in sampling. This formula results in 384 respondents, as shown in equation 2:

$$n = \frac{1.96^{\,2} \times 0.5 \times 0.5}{0.05^2} = 384.16 = 384 \quad (2)$$

Table 1: Sample size distribution

Urban Centre	Urban Population	Proportion to size	Sample
Kapenguria	40,424	0.84	322
Chepareria	7,704	0.16	62
Total	48,128	1	384

Source: West Pokot County Integrated Development Plan (2022)

2.3 Sampling Procedure

This study employed a stratified multistage sampling approach for selecting respondents. In the first stage, West Pokot County was selected for its high malnutrition rate (KDHS, 2022). In the second stage, the Kapenguria urban center in West Pokot subcounty and the Chepareria urban center in Pokot South subcounty were purposely selected because they are major urban centers with more developed markets. The third stage involved stratification of the market outlets into supermarkets, open-air markets, and cereal shops for the two urban centers. This enables data collection from household decision makers buying household goods at market outlets. Consumers who shop at different market outlets have varying socioeconomic characteristics. As a result, stratified random samples are highly representative of the population. A mixed sampling technique was adopted in the fourth stage and split into two levels. The first level used nonprobability/judgment sampling (Kothari, 2004) because the population of household decision makers is infinite, and their distribution across the study area is unknown. The second level used proportionate random sampling to achieve equal representation of respondents in the urban centers from each market outlet (Kothari, 2004). To maintain data accuracy, respondents were asked to instruct their household members to avoid

participating in the interview if they came across any enumerators in the marketplace. This approach enhanced the data reliability by preventing duplicate interviews with the same household.

2.2. Data

To simplify data collection and enhance effective communication. Enumerators with a minimum of bachelor's degree and a higher diploma and those who could understand the local language were selected and trained to collect primary cross-sectional data using semi structured questionnaires. To conduct this study, the requisite research permits from Egerton University's ethics committee license number (EUISERC/APP/285/2023) and the National Commission for Science, Technology and Innovation license number (NACOSTI/P/24/32337) were sought. Pilot testing of the data collection instruments was conducted in the Iten urban center, which shares similar characteristics with the Kapenguria and Chepareria urban centers. A total of 38 questionnaires were distributed, constituting approximately 10% of the required sample size for the study. Respondents were interviewed at market outlets to obtain information on age, gender, education level, household size, household income, access to nutrition information, access to market information, trust regarding nutritional claims on high iron common beans, as well as trust in certification agencies. The coded data were analyzed using the DC choice package and marginal effects package in the R computer program (Aizaki *et al*., 2022; Arel-Bundock 2022; Team, 2010).

2.3. Modeling Consumers' WTP for Certified High-Iron Common Beans

From the one and one half bound contingent valuation questions. The following responses were obtained: ('yes' 'yes,' 'yes' 'no,' and 'no'). A 'yes' 'yes' indicate acceptance of the first and second bids, respectively. This bid was increased to premium bids of 10% 20%, 30%, 40% or more than 50% above the average price. A ('yes' 'no') indicates a household decision maker's intermediate WTP. This means acceptance of the first bid and rejection of the second bid. A ('no') indicated refusal to pay for the first bid.

Dichotomous choice estimation models are typically used to analyze these responses. The most common models are the probit and logit models (Bishop & Heberlein, 1990; Champ, 2017). The analysis could also use the spike model (Kriström, 1997). This model is ideal for cases in which the WTP distribution is asymmetric and when there is a high number of zero responses (Bengochea-Morancho *et al*., 2005; Geta *et al.,* 2015). Nevertheless, there were only a small number of zero responses in this study; hence, this model was abandoned. The single bounded logit model could also be used in the analysis. However, Hanemann *et al*. (1991) proved that this approach is statistically less efficient. The double-bounded dichotomous choice model could have been used in the analysis because it captures more information on respondents' WTP amounts than single-bounded dichotomous choice models (Lusk & Hudson, 2004). On the other hand, there are more efficiency gains in moving from a single bound to one- and one-half bound than in moving from a single bound to a double bound dichotomous choice model (Cooper *et al*., 2002). Hence, this study adopted a one-and one-half-bound dichotomous choice to estimate the WTP.

The semidouble-bounded logit model is used to model one and one half-bounded dichotomous choice responses. In the model specification, the first bid (B^1) was assumed to be equivalent to zero to indicate price equality between certified high-iron common beans and uncertified Nyota beans, a high-iron bean variant, which reduces the starting point bias. The second bid (B^2), or the premium bid, was contingent on the first bid and was to be assigned to the household decision maker only if he would be willing to buy at a price higher than the

initial bid amount. The second bid (B^2) and the initial bid (B^1) allow for setting the lower and upper bounds constraints on the unobservable household decision maker's true WTP. The probabilities of these occurrences ('yes', 'yes', 'yes', 'no', and 'no') are indicated as π^{yy}, π^{yn}, and π^{n}, respectively, and are a function of the initial bid B^1 and a higher premium bid after the initial "yes" response, B^2. This can be represented as follows:

$$\begin{gathered}\pi^{yy}(B_i^1, B_i^2) = P(B_i^1 \leq maxWTP \leq B_i^2) = P(B_i^2 \leq maxWTP) = 1 - G(B_i^2\ i;\theta) \\ \pi^{yn}(B_i^1, B_i^2) = P(B_i^1 \geq maxWTP \leq B_i^2) = G(B_i^2\ i;\theta) - G(B_i^1\ i;\theta); and \\ \pi^{n}B_i^1 = P(B_i^1 \geq maxWTP) = G(B_i^1\ i;\theta)\end{gathered} \quad (3)$$

where G (B; θ) represents the cumulative distribution function, assumed to be a logistic of the individuals' true maximum *WTP* with parameter vector θ to be estimated (Hanemann *et al*., 1991). Equation (3) is estimated using a log likelihood function as follows:

$$lnL(\theta) = \sum_{i=1}^{N}(d_i^n\ ln\mu^n(B_i^1) + d_i^{yn}\ ln\mu^{yn}(B_i^1\ B_i^2) + d_i^{yy}\ ln\mu^{yy}(B_i^2) \quad (4)$$

where d_i^n, d_i^{yn}, and $d_i^{yn}d_n$ are binary-valued indicator variables. It takes a value of one if the respective responses are chosen and zero otherwise. A logit model was adopted to determine the effects of the factors influencing WTP. Overall probabilities were calculated at the mean values using the estimated intercept (β_0), coefficients (β_i), and the explanatory variables (x_i), as follows:

$$P(B < maxWTP) = 1 - \frac{1}{1+\exp(\beta_0+\beta_i x_i)} \quad (5)$$

The socioeconomic, institutional and product characteristics used as independent variables to analyze the factors influencing WTP for certified high-iron common beans were derived from previous studies (Aseete *et al*., 2018; Banerji *et al*., 2016; Bett *et al*., 2013; Chelang'a *et al*., 2013; De Groote & Kimenju, 2011; Jada *et al*., 2023; Nuani *et al*., 2022; Oparinde *et al*., 2019; Phiri *et al*., 2017; Rizwan *et al*., 2022).

3. Results

3.1. Descriptive Results

Table 2 displays the descriptive statistics of the variables utilized in the study. A t test was used to analyze continuous variables, while a chi-square test was used for categorical variables to determine significant differences between males and females.

Male household decision makers were significantly more educated at 1% level. On average, male and female decision makers had approximately (13) and (12) years of schooling, respectively. This suggests that there is still a gender gap in educational attainment for this population, with males achieving higher levels of schooling. Additionally, female household decision-makers had a significantly greater proportion of children under five years of age, with a mean of (0.15) compared to (0.11) among male household decision makers. This gender gap could be attributed to culture in many sub-Saharan countries, where women are traditionally expected to take on a more prominent role in child-rearing. The t test results also revealed a significant difference in trust in nutritional claims between male and female decision makers. Female household decision makers had greater relative trust (0.80) than male household

decision makers (0.59) significant at 5% level. One reason for this finding is that women tend to be more health conscious and pay closer attention to nutrition labels and claims than men.

Table 2. Definition of Variables Used in The Descriptive Statistics and Econometric Results

Variable	Definition of variables and their measurements	Male	Female	t-value
Continuous variables		**Mean**		
Age	Age of the household decision maker in years	40.51	41.90	1.50
Education	Years of schooling of the household decision maker	13.27	12.43	-2.64***
Income	Proportion of monthly income allocated to food items in KES	0.36	0.38	1.03
Household proportion below 5 years	Proportion of household members below 5 years	0.11	0.15	2.67***
Relative trust nutritional claims	Trust on nutritional claims of high iron beans over trust on nutritional claims normal beans measured on a five-point ordinal Likert scale	0.59	0.80	2.38**
Relative trust on certification bodies	Trust on public certification over trust on participatory guarantee systems measured on a five-point ordinal Likert scale	1.81	1.85	0.33
Categorical variables		**Percentage**		**χ2 Value**
Sex	% of household decision makers	36.45	63.55	384***
Access to Market information	% of respondents with access to market information	20.71	17.21	0.72
Access to nutrition information	% of respondents with access to nutrition information	34.29	57.79	19.66***
Awareness of food certification	% of respondents who were aware of food certification	73.57	59.01	8.21***
Aware of anemia	% of respondents who were aware of anemia	92.14	90.16	0.42
Aware of stunting	% of respondents who were aware of stunting	96.43	96.72	0.02
Aware of high iron common beans	% of respondents who were aware of high iron common beans	22.86	38.11	9.43***

Notes: Household decision-maker household member responsible for making key decisions on matters concerning food consumption. KES refers to Kenyan shilling (Official Kenyan currency) Exchange rate was 1 $US = KES 158.45 at the time of survey. ****, ***** denote significant level at, 5% and 1% level, respectively

Approximately (63%) of household decision makers being female, and males making up (36%), it is clear that women play a significant role in making important purchase decisions for their households. Access to nutrition information was significantly greater for female

household decision makers than for male household decision makers, with approximately 57% of female decision makers having access to nutrition information compared to approximately 34% of male decision makers. This is attributed to women's traditional roles as family food planners, which motivate greater attention to nutritional information from various sources. Additionally, awareness of food certification was significantly greater among male household decision makers (73%) than among female household decision makers (approximately 59%). One plausible explanation for this finding could be higher levels of education among male decision makers, as indicated in Table 2. Higher levels of education have been associated with greater awareness of food certifications. Awareness of high-iron common beans is also essential. Compared with male household decision makers, female household decision makers had a significantly greater awareness (38%) of the existence of high iron beans than male household decision makers (22%). High awareness among females reflects their stronger orientation to nutritious and health-enhancing foods.

3.2 Krinsky and Robb Confidence Intervals of the Mean WTP

Table 3 shows summary statistics on the WTP amounts. The overall mean WTP was 282 KES per kilogram. When the influencing variables are factored in, the truncated mean is estimated to be approximately KES 281 per kilogram. This represents an approximately 27% price premium based on Nyota bean (a high iron bean variety) prices of KES 220 per kilogram. Finally, an adjusted truncated mean, which accounts for the impact of outliers on the mean, is approximately KES 295 per kilogram. The minor differences between the overall, truncated, and adjusted truncated means suggest that zero responses do not heavily skew the distribution (Duffield & Patterson, 1991).

Table 3. Krinsky and Robb simulated confidence intervals in KES

Estimates	Estimate	Lower Bound	Upper Bound
Mean	282.44	276.30	289.70
Truncated Mean	281.56	275.88	287.78
Adjusted Truncated Mean	295.27	283.03	316.83
Median	281.14	275.22	288.08

Notes: KES refers to Kenyan shilling (Official Kenyan currency) Exchange rate was 1 $US = KES 158.45 at the time of survey

3.3 Econometric Results

A semidouble-bounded logit model was estimated to determine the factors likely to influence consumers' WTP for high-iron common beans among West Pokot subcounty urban households. The estimated marginal effects and their corresponding standard errors and p-levels of significance are presented in Table 4. The model fit results show that the likelihood ratio statistic of 350.91 with 10 degrees of freedom is statistically significant at the 1% level. This implies that the semidouble-bounded logit model captures additional information on the observed data compared to the constrained model. The pseudo-R squared was 0.39. This suggests that the independent variables of the model adequately explained the variability in the WTP.

Table 4. Semidouble-Bound Logit Model Results on Factors Influencing WTP

Variable	dy/dx	Coefficient	Standard Errors	P values
Age of the household decision-maker in years	0.0066	0.0763	0.0016	0.0000***
Gender of the household decision-maker	0.0304	0.3581	0.0227	0.1860
Education	0.0058	0.0677	0.0042	0.1620
Household proportion under five years	0.1133	1.2486	0.0734	0.1439
Aware of anemia	-0.0310	-0.3922	0.0335	0.3457
Aware of stunting	0.0077	0.0880	0.0518	0.8820
Proportion of monthly income allocated to food items in KES	-0.3718	-5.4087	0.0962	0.0000***
Access to market information	0.0098	0.1150	0.0276	0.7244
Access to nutrition information	0.0531	0.6120	0.0227	0.0225**
Relative trust in certification bodies	0.1263	1.3844	0.0151	0.0000***
Relative trust on nutritional claims	0.1288	1.4103	0.0307	0.0000***
Awareness of food certification	0.1062	1.1009	0.0251	0.0000***
Awareness of high iron common beans	0.0293	0.3478	0.0243	0.2336

Notes: **, *** denote significant level at 5%, and 1% level, respectively

4. Discussion

The age of the household decision maker positively influenced WTP at the 1% significance level. Older individuals are more likely to pay higher prices for certified high-iron beans than younger individuals. This inclination could be attributed to the fact that as people age, they become more health conscious, thus demonstrating a greater willingness to allocate their food budget to products that support their health and their families. These results are consistent with the findings of Zhang *et al*. (2012) and Muhammad *et al*. (2015), who observed that elderly consumers had greater WTP for certified organic and safe fresh products, respectively. However, it contradicts with the findings of Hossain *et al*. (2021), who reported that age had a negative effect on WTP for certified chicken. This could be because some elderly people may have perceived certified chicken as less healthy and nutritious.

The proportion of monthly income allocated to food items was significant and negatively affected consumers' WTP, with a probability of decreasing WTP by up to 37.18%. This finding aligns with Engel's law, which asserts that the percentage of income spent on food decreases as income increases (Houthakker, 2008). Food comprises approximately 50% of the entire household budget in lower middle-income nations such as Kenya (Kumar *et al*., 2009). Low-income consumers have less discretionary income for nonfood items due to the need to devote more of their limited income to sustenance. This effect is pronounced in West Pokot, where the monetary poverty rate is 57.3%, and the multidimensional poverty rate is 82%. This statistic is higher than the national rates of 35.7% and 57.3%, respectively (KNBS, 2020). The high poverty levels in West Pokot may explain the observed negative effect on WTP for certified high-iron common beans.

Access to nutrition information positively influenced household decision-makers' WTP, with a marginal effect of 5.3%. Access to nutritional information reduces uncertainty about a product's nutritional qualities and allows consumers to assess its value in light of personal health motivations or broader dietary trends. Oparinde *et al*. (2019) confirmed these findings and reported that nutritional information positively affected the WTP for high-iron bean varieties. The fact that nutritional information is readily available in conventional markets increases consumers' intentions to buy (Boyle & Bishop, 1985). These results also mirror those of De Groote *et al*. (2018), who found that consumers who had access to nutritional information were (WTP) a price premium for instant fortified pearl millet products.

Relative trust in certification agencies had an asymmetrically positive effect on WTP for the public compared to the participatory guarantee system (PGS). Trust in public agencies significantly increases WTP by 12.63%. The possible cause of this discrepancy is likely due to the low trust in PGS and limited awareness of participatory guarantee systems demonstrated by some respondents, primarily due to their limited presence in West Pokot County. Banerji *et al*. (2016) reported a comparable finding, where trust in national agencies (public) increased the WTP for high-iron pearl millet. These findings are consistent with research by Truong *et al*. (2022), who revealed that people who distrust food certification choose not to buy certified food. This decision stems from their skepticism toward food certification organizations, as they believe that certification does not ensure compliance with food standards.

Relative trust in nutritional claims was significant at the 1% level. Trust in nutritional claims of high iron common beans increases WTP by 12.88%. In this context, high-iron common beans can be considered credence good, unlike conventional beans, as quality or nutrient content cannot be sufficiently confirmed and evaluated even after they have been bought and consumed, as described by Perez *et al*. (2019). This finding is consistent with research by Ha *et al*. (2019), who found a link between higher WTP and greater trust in foods with credence characteristics, such as organic food. Additionally, Angulo and Tamburo (2005) found that consumers' trust in food labeling positively correlates with their WTP for certified food. As a result, the establishment of a market for such products necessitates building consumer trust, as emphasized by Janssen and Hamm (2012).

In addition, awareness of various local and third-party certification authorities was positive and significant at the 5% level, with a probability of decreasing WTP by up to 10.62%. This could be attributed to the fact that awareness of certification likely enhances consumers' perception of certified high-iron common beans. This finding corroborates that of Banerji *et al*. (2016), who found that awareness of food certification agencies increases the valuation, certification and branding of high-iron pearl millet. Additionally, Janssen and Hamm (2012) found that higher awareness levels of organic certification increase consumers' WTP.

4. Conclusion and Recommendations

This study utilized a semidouble bound logit model to assess the factors that influence the WTP for certified high-iron beans. The findings indicated a mean WTP of KES 281 per kilogram. The findings from this study reveal that household decision makers allocate a significant portion of their monthly income to food items, which has a negative effect on WTP. In contrast, access to nutritional information by the household decision maker and relative trust in nutritional claims on high-iron common beans increased WTP. These results underscore the importance of accessing nutritional information and building trust mechanisms for certified high-iron common beans.

If certification becomes the preferred means for consumers to access high-iron common beans, then their knowledge of nutrition and trust could be increased. The aforementioned objective could be accomplished by disseminating information through various channels, such as community educational programs, social media platforms, mass media outlets, and print media advertisements. The study also suggests that marketers may need to consider implementing lower market penetration pricing or subsidy programs to enable low-income consumers to afford certified high-iron common beans. Prices may gradually be raised once trust and familiarity diffused among these consumer segments. In this way, they can reach low-income groups.

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