One and one half bound dichotomous choice contingent valuation of consumers’ willingness-to-pay for pearl millet products: Evidence from Eastern Kenya

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Pearl millet is the fourth most important cereal after maize, rice and sorghum in terms of cultivation and production in the tropics, yet the least traded of all cereals in Kenya. New pearl millet varieties (KAT/PM1, KAT/PM2 and KAT/PM3) were introduced in response to low yield and birds’ menace that was wiping out the traditional pearl millet varieties in Kenya. Despite this, limited information exists on consumers’ willingness to pay and the determinants of willingness to pay estimates for these newly introduced varieties products. This study was undertaken to analyze consumers’ willingness to pay and the determinants of willingness to pay estimates for these pearl millet products. Results showed that most consumers (70%) were willing to pay a premium price with the mean willingness to pay off 42% over finger millet market price. Age, number of children below 12 years in a household, gender of household head, income and awareness levels were the important factors that positively influenced consumers’ willingness to pay premium prices.

Key words: Pearl millet, new varieties, willingness- to-pay, consumer, Kenya.

INTRODUCTION

Pearl millet (Pennisetum glaucum (L.) R. Br.) is the fourth most important cereal after rice, maize and sorghum in terms of cultivation and production in the tropics. It is estimated that over 11.36 million tons of pearl millet grains are produced in 17.4 ha globally (FAO, 2003). In Kenya, for instance, the areas under pearl millet have reduced from 100,143.9 ha (2011) to 93,310 ha in 2013. Areas that have experienced this drastic fall in hectares under pearl millet include: Eastern province (Tharaka, Mbeere, Mwingi, Kitui, Makueni districts) and Rift Valley province (Baringo, Elgeyo-Marakwet and West Pokot districts) (GoK, 2007; KARI, 2008; MoA, 2008). Pearl millet yields also have been declining since 1980 from 1,610 kg ha\(^{-1}\) to an estimated 200-800 kg ha\(^{-1}\) in 2008. The current yields per ha is low against the estimated global potential of 1,500 to 3,000 kg ha\(^{-1}\) (KARI, 2007; GoK, 2007; KARI, 2008; MoA, 2008). In terms of consumption, pearl millet has several merits in the rural household food baskets. It contains high level of protein (up to 12%), energy (3600 K cal kg\(^{-1}\)) and a
balanced amino acid profile making it a cheaper source of grain iron (Fe) and zinc (Zn) (Parthasarathy et al., 2006; ICRISAT, 1996). In addition, it is a staple diet for over 500 million households who are mainly small-scale farmers living in arid and semi-arid lands. However, in the past three decades, its consumption pattern has been declining partly due to the changing consumers taste and preference, diseases (leaf blight and rust) and birds' damage. Moreover, pearl millet industry has been facing numerous constraints which include: poorly developed and fragmented marketing channels with weak value chains, high assembly and processing costs, uncompetitive grain prices which collapse during harvesting season, lack of market information, limited processing facilities, in-adequate grain supply all year round and high cleaning costs among other several factors (FAO, 1996; Rohrbach, 2004). According to Gulia et al. (2007), in the USA market, pearl millet has no minimal set price; Eastern Kenya is not an exception to such marketing risks. These challenges have not only limited farmers' interest but have also threatened to wipe pearl millet out of farmer's fields despite local communities' interest. In fact, it is reported that most processing companies in Kenya (Kirinyaga Millers Limited, Kabansora Millers Limited, Proctor and Allan Limited) have lost contact with local farmers because of unreliable supply and poor quality grains. Data showed annual imports from Tanzania and Uganda for industrial processing as 1,560 metric tons (United States Agency for International Development, 2010). It is possible that pearl millet might be lost completely from farmers fields unless serious intervention is put in place.

As part of the intervention, the government of Kenya has put more emphasis on promoting pearl millet value addition to improve its competitiveness, acceptability and food security (GoK, 2003). In addition, from 1994 to 2007, the government of Kenya and International Fund for Agricultural Development (IFAD) initiated a US $ 15.5 million Eastern Province Horticulture and Traditional Food Crops Project to improve incomes and food security for small scale farmers' (Karanja et al., 2009). To further promote pearl millet, International Crops Research Institute for Semi-Arid and Tropics (ICRISAT), International Sorghum and Millets (INTSORMIL) and Bill and Melinda Gates Harnessing Opportunities for Productivity Enhancement (HOPE) project have developed interventions such as breeding, distribution of improved varieties and promotion of resource conservation and management to address productivity, profitability and marketing challenges of dry land cereals (Karanja et al., 2009). HOPE project is currently promoting high yielding, low soil fertility resistant and disease tolerant pearl millet varieties (KAT/PM 1, KAT/PM 2 and KAT/PM 3) in the market. It is expected that the small scale farmers will adopt these new varieties in order to improve their food security situation and income levels through sale of surplus. These efforts are in line with Kenya's vision 2030 of promoting economic development and food security amongst households residing in arid and semi-arid lands. However, a keen look at these past efforts in addition to a review of earlier research work reveals a strong focus on pearl millet production and value addition.

Therefore, studies on pearl millet products demand and consumption have received a slight or no research consideration which have resulted in inadequate knowledge on consumer attributes and willingness-to-pay (WTP); that may hamper production optimization and marketing of pearl millet products in Kenya. Therefore, knowledge of consumers' attributes and willingness to pay for products made out of these introduced pearl millet varieties are necessary for researchers to improve on the already produced pearl millet hybrids. Moreover, information on pearl millet products consumption may lead to the development of pearl millet products meeting specific demands of consumers. The objective of this study was to find out if consumers were willing to pay premium prices for these pearl millet products and which factors would influence their willingness to pay for the pearl millet products made out of these varieties. Understanding of consumers' willingness to pay is important to farmers as they will benefit from having a better understanding of the value of their products and are thus be in a position to determine how to maximize their profits. Companies, on the other hand, may benefit by being able to determine the economic gain or loss associated with investment they make in value addition.

MATERIALS AND METHODS

Study area

This study was undertaken in Mbeere district, Kenya due to its favourable climatic conditions (LM3 and LM4) necessary for pearl millet production, presence of numerous small scale pearl millet processing units and the long history of pearl millet production. The district covers a total area of 2,097 km² and lies between latitude 0°45'N and 0°32'N; longitude 37°55'E and 37°40'E with an altitude range of 500 to 1200 m above sea level on Tana River basin with a slope moderated by Kiambere, Kiang'ombe and Kianjiru Hills (Government of Kenya (GoK), 2005). The district experiences bimodal and unreliable rainfall averaging between 640 to 1110 mm with most parts receiving less than 750 mm annually. However, this unreliability of rainfall increases major crop failures especially for maize.

It has two main growing periods: long rains of April - June and short rains occurring between October-December with a growing length of between 90 to 119 days. The economic activity of the area is mixed farming with livestock production mainly composed of indigenous species of cattle, goats and chickens while crop production is limited to rain fed agriculture (GoK, 2005). The average temperature ranges between 20 to 30°C and sometimes rises above 30°C in March- the hottest month. The soils range from chromic Cambisols to rhodic Ferralsols and Luvisols with varying degree of stoniness, rockiness and soil depth (GoK, 2005). These soils are infertile and are highly sensitive to erosion as a result of surface sealing and hard pan setting.
Data description

This study was undertaken between August and September, 2012 – harvesting period to minimize variation in the consumption patterns. A two stage sampling technique was used to select 100 consumers for the study. In the first stage, purposive sampling technique was used to select Mbeere district due to its pearl millet history, presence of numerous small scale pearl millet processing units and the agro-ecological zones (LM3-LM4) necessary for pearl millet growing. In the second stage, a random sampling technique was used to select 100 consumers within the peri-urban areas of Siakago, Iishiara and Kiritire towns. To improve on questionnaire validity and content in tangent with study objectives, pretesting was done. Important data to the study included: the level of consumer awareness, socio-economic characteristics of pearl millet consumers, and the willingness to pay for new pearl millet products. Specifically, socio-economic factors considered important for the study included: income level of household head, number of children below 12 years, educational level of the household head, gender of household head/decision maker, employment status of household head, age of household head, level of awareness of household head of pearl millet and if a household have heard of the new pearl millet products before the study.

The model specification

In estimating consumers’ willingness to pay for novel goods in the absence of a real purchasing power, and in situations where primary data sources are available like in this study; contingent valuation methodologies are commonly applied (Stevens et al., 2000; McCluskey et al., 2001; Lusk and Hudson, 2004; Lin et al., 2005). In that regard, a Contingent Valuation (C.V.) methodology following a closed ended survey format was applied in this research. This survey will only provide meaningful results if it is grounded on consumer maximization theory. This theory holds that consumers maximize utility subject to budget constraints. It was assumed that the consumers would choose a bundle of pearl millet products giving him high satisfaction levels. The choice of C.V. methodology was also based on the assumption that it exactly mirrors the value of non market goods in the absence of a real purchasing power. This is because it constructs a hypothetical market which is not only structured but also realistic by ensuring respondents’ are faced with a well defined situation contingent on the event occurrence. Although, opponents of C.V. have punched holes on its reliability, the selection of an appropriate survey and elicitation methodology is capable of reducing or minimizing these preconceptions. In this study, a modified dichotomous elicitation technique - an extension of discrete choice with follow up approach was applied (McCluskey et al., 2001; Lin et al., 2005; Cooper et al., 2002).

In this technique, percentage bids were pegged on price differentials and the first bid (B1) was assumed to be equivalent to KES 100 to indicate price equality between pearl millet products and finger millet products to reduce starting point bias. The second bid (B2) or the premium bid was contingent to the first bid and was assigned to a consumer only if he was willing to buy at a price higher than initial bid amount. The second bid (B2) and the initial bid (B1) allows for setting of the lower and upper bounds on the unobservable consumers true willingness to pay for products. If the consumer responded to the first question with a ‘yes’, then he was willing to purchase pearl millet product at a premium price. From this, a follow up question with varying bid levels was given. From these iterations, three possible outcomes of a semi-double-bounded model was obtained: ‘yes’ ‘yes’; ‘yes’ ‘no’ and ‘no’. A ‘yes’ ‘yes’ indicated a consumers willing to purchase pearl millet product at a premium; ‘yes’ ‘no’ indicated a consumer as having intermediate willingness to pay while a ‘no’ indicated customers non willingness to purchase pearl millet products at a premium. Therefore, discrete outcomes (Dg) of the above bidding processes can be written as (Rodríguez et al., 2008; Lin et al., 2005; McCluskey et al., 2001):

\[
D_g = \begin{cases} 
\text{group 1 WTP} \leq B_1 \\
\text{group 2 } B_1 < \text{WTP} \leq B_2 \\
\text{group 3 } B_2 < \text{WTP}
\end{cases}
\]  (1)

From the discrete outcomes above, group 1 represented individuals not willing to purchase at any discount and are considered to have the lowest WTP; group 2 represent intermediate willingness to pay and finally, group 3 represented those who did not require any discount but accepted to pay the highest premium. Therefore, assuming a linear function of an individual i WTP for new pearl millet products can be summarized as:

\[
WTP_i = \alpha - \rho \beta_i + \lambda \xi_i + \epsilon_i \text{ for } i = 1, ... n
\]  (2)

Where \( \beta \) is the ultimate bid an individual i faces, \( \xi \) is a column vector of observable socio-demographic characteristics of an individual (age, income, employment status, gender of household head, and the number of children below 12 years in a household); \( \alpha, \rho \) and \( \lambda \) are the parameters to be estimated; \( \xi \) and \( \epsilon \) are assumed to be linear in parameters for all individuals, with the error term being independent and identically distributed with a mean zero and a variance \( \sigma^2 \). Under the above assumptions, the individual choice probability may be stated as in McCluskey et al. (2001):

\[
\text{Prob. (D=J)} = \begin{cases} 
\frac{\theta(\alpha - \rho \beta_2 + \lambda \xi_1)}{\theta(\alpha - \rho \beta_2 + \lambda \xi_2)} & \text{for } J = 1 \\
\frac{\theta(\alpha - \rho \beta_2 + \lambda \xi_2)}{\theta(\alpha - \rho \beta_2 + \lambda \xi_3)} & \text{for } J = 2
\end{cases}
\]  (3)

The likelihood function can therefore be stated as below:

\[
L = \prod_{i=1}^{n} \left( \frac{\theta(\alpha - \rho \beta_2 + \lambda \xi_1)}{\theta(\alpha - \rho \beta_2 + \lambda \xi_2)} I_{p1i} + \frac{\theta(\alpha - \rho \beta_2 + \lambda \xi_2)}{\theta(\alpha - \rho \beta_2 + \lambda \xi_3)} I_{p2i} \right)
\]  (4)

Where \( I_{pk} \) is the indicator function for even k and \( I_{pk} \) denoting the jth alternative occurrence. In the empirical implementation, G(\( 
\)) may be defined as a standard logistic distribution function with a mean of zero and standard deviation \( \sigma = \pi / \sqrt{3} \). The parameters of the function to be estimated using maximum likelihood function are \( \alpha \) and \( \rho \). The value of (rho) ranges between 0and 1 and should be positive to form downward sloping S-curve as a negative value would contradict economic theory. Finally, the mean WTP is derived as a ratio of \( \alpha / \rho \) through restricting variables coefficients to zero in parameter estimation with the exception of the random bid (Rodríguez et al., 2008; Lin et al., 2005; McCluskey et al., 2001). The final mean WTP is written as:

\[
E (\text{WTP}, \alpha, \rho, \beta, \xi) = \theta(\alpha + \lambda \xi) / \rho
\]  (5)
REGRESSION MODEL

In understanding the factors affecting consumer’s willingness to pay premium price, a logit model was adopted. The choice of this model was guided by the discrete structure of WTP questions used in this study. A logit model is initially set up in the form of a latent regression with Equation (6) as its starting point;

\[ y^* = x' \beta + \varepsilon_i \]  

(6)

In the Equation (6), \( y^* \) represent unobserved portion while the observed section is represented as (Green, 2006):

\[ y_i = \begin{cases} 0 & \text{if } y \leq \mu_1 \\ 1 & \text{if } \mu_1 < y \leq \mu_2 \\ 2 & \text{if } \mu_2 < y \leq \mu_3 \\ \vdots & \text{if } \mu_{j-1} < y \\ j & \text{if } y \geq \mu_j \end{cases} \]  

(7)

In the Equation (7) above, \( \mu_j \)'s are known parameters under estimation in conjunction with parameter \( \beta \) with an error term normally distributed across all observations. Therefore, restricting mean and the variance of the error term to 0 and 1, the below probabilities are attained (Pishbahar et al., 2013);

\[
\begin{align*}
\Pr(y = 0|x) & = F(-x'\beta) \\
\Pr(y = 1|x) & = F(\mu_1 - x'\beta) - F(-x'\beta) \\
\Pr(y = 2|x) & = F(\mu_2 - x'\beta) - F(\mu_1 - x'\beta) \\
\Pr(y = j|x) & = F(\mu_j - x'\beta) - F(\mu_{j-1} - x'\beta) \\
\Pr(y = j+1|x) & = 1 - F(\mu_j - x'\beta)
\end{align*}
\]  

(8)

For the above probabilities Equation (8) to be positive, the following conditions needs to be met;

\[ 0 < \mu_1 < \mu_2 < \cdots < \mu_j \]

In a logit model, coefficients and marginal effects of explanatory variables on the probabilities are usually different. By undertaking first order differentiation of Equation (8), the marginal effects of changes in the explanatory variables can be obtained as shown in Equation (9) (Pishbahar et al., 2013);

\[
\begin{align*}
\frac{\partial \Pr(y = 0|x)}{\partial x_i} & = -F(-x'\beta)\beta_i \\
\frac{\partial \Pr(y = 1|x)}{\partial x_i} & = F(-x'\beta) - F(\mu_1 - x'\beta)\beta_i \\
\frac{\partial \Pr(y = 2|x)}{\partial x_i} & = F(\mu_2 - x'\beta) - F(\mu_1 - x'\beta)\beta_i \\
\frac{\partial \Pr(y = j|x)}{\partial x_i} & = F(\mu_j - x'\beta) - F(\mu_{j-1} - x'\beta)\beta_i \\
\frac{\partial \Pr(y = j+1|x)}{\partial x_i} & = -F(\mu_j - x'\beta)\beta_i
\end{align*}
\]  

(9)

The empirical specification of the final model for estimating factors of WTP is shown below.

\[ \text{WTP} = \alpha + \beta_1 \text{HHhead} + \beta_2 \text{Income} + \beta_3 \text{Nochildren} + \beta_4 \text{Agelevel} + \beta_5 \text{Employstatus} + \beta_6 \text{Gender} + \beta_7 \text{AgeofHH} + \beta_8 \text{Awareness} + \beta_9 \text{Heardproduct} + \epsilon_i \]  

(10)

In estimating factors affecting consumers WTP premium prices and therefore included in the above logit model were obtained from review of relevant past researches. Although demand for a product is usually affected by its price, in this study, only socio-demographic factors (age, household head, employment status, income, gender of household head, education and presence of children below 12 years in a family), awareness and whether a consumer has ever heard of the pearl millet product or not were included. These socio-demographic characteristics were assumed to be similar to those affecting consumer expenditure and analysis for local products. The inclusion of awareness and whether a person has ever heard of pearl millet products were based on an assumption that not all consumers perceive quality in a uniform manner despite their objectivity in the measurement of utility. In fact, there exist possibilities that some product quality may yield negative or positive utility to consumers.

The presence of children below 12 years in a household was found a direct influence between consumers’ WTP and beef products (Loureiro and Umberger, 2003). Gao et al. (2011) also observed a positive linkage between WTP and presence of children below 12 years in a family for fresh citrus consumers. And because these products were considered high quality goods, we also hypothesized pearl millet to be in this group. Therefore, a positive relationship was expected (Table 1). Kimenju and De Groote (2005) observed a positive connection between WTP and maize consumers’ income levels. Also, Loureiro and Umberger (2003) found a positive link between income levels and WTP amongst beef consumers. In this study, a positive association was also expected.

Govindasamy et al. (2006) acknowledged a positive relationship between consumer level of awareness and WTP. In addition, Bate et al. (2007) observed a negative association amongst organic foods consumers and their WTP. These results offer divisive empirical evidence and as a result, we hypothesized that it could take either a positive or negative sign. Owusu and Onfori (2012) observed a direct relationship between level of education and WTP for organic product consumers. Budak et al. (2010) also observed a positive relationship between the level of education and Turkish livestock producers WTP. In this study, we believe that highly educated consumers consider pearl millet products as a poor man’s food and therefore would not associate with it. And as a result, a negative relationship between educational level and WTP was eminent.

Carpio and Isengildina-Massa (2009) found out that female headed households were more willing to pay premium prices than male counterparts to obtain animal products. Haghiri and McNamara (2007) noted that male headed households as willing to pay premium than female headed households for pesticide free products. Because of the inconclusiveness of discussion in this variable, a positive or negative relationship was hypothesized. Employment is a source of income and exposure to current information. Therefore, consumers who were in employment were expected to be well exposed and would buy pearl millet products due to its health benefits and so a positive relationship was anticipated.

The age of a household head affects his/her purchase decision making. We hypothesized that older household heads as less willing to pay premium prices due to their low income levels. Consumers are rational people and would want more out of less. In that sense, we hypothesized that whether a household have ever heard of pearl millet or not was positively related to his willingness...
to purchase it at higher prices. Finally, we believed that whether a consumer was a household head or not was positively related to his/her WTP premium prices. This was because if purchaser was a household, he was responsible for decision making exercise and therefore he would be more willing to pay a premium than if otherwise.

RESULTS AND DISCUSSION

Socio-economic characterization of pearl millet consumers

A socio-economic characterization of pearl millet consumers are shown in Table 2. Results showed that in terms of education, majority of the consumers (52%) were in primary school; 31% were with secondary education; only 3% had university education while 5% were of illiterate category. On average, therefore, there was low level of literacy amongst the consumers and this implies that consumers may not be in a position to capture the benefits associated with pearl millet marketing as they may be disadvantaged during bargaining process (Table 2).

The number of years a person takes in performing any marketing function directly influences his/her marketing experience and thus his profit levels. Therefore, the more experience a marketer is, the higher his understanding of a marketing system, conditions and prices trends. From the study, the average mean age of consumers was 45.42 years (Table 2) and this implies that majority of pearl millet consumers were dynamic youths within the economically active age bracket of 21 to 50 years and thus they were able to take risks associated with marketing. Therefore, these actors could make a meaningful impact in the consumption of new pearl millet products. Result further revealed that, 61% of pearl millet consumers were males or male headed households (Table 2). This might partly be attributed to the high prevalence of HIV/AIDS menace in the area. Moreover, statistics confirmed that 55% of pearl millet consumers were not in formal employment, 21% were employed on part time basis while 18% were on full time employment.

Consumers’ willingness to pay for pearl millet products

Contingent valuation methodology is normally criticized due to starting point bias and complication of the relevant estimates of willingness to pay. Therefore, to reduce these biases while simplifying consumer tasks in decision making, a starting point price of KES 100 (US $1.18) was proposed. This price (KES 100) was the operating market price for substitute products (finger millet) commonly available in the Eastern Kenya markets during the study period. Moreover, the choice of this substitute product was also informed by our baseline survey undertaken in 2011 in which producers reported that they had replaced pearl millet with finger millet in their farms. Indeed, this price was similar to a true Kenyan market situation where consumers are usually faced with a fixed price for a product and then required to make decision in its purchase. With this background, consumers were asked if they were willing to purchase pearl millet products at KES 100 for a two kilogram tin.

Those respondents who gave a positive response to the first question were further given the option of selecting a bid amongst the 5 point bids of 10, 20, 25, 50 and 75% and the result is presented in Table 3. Although all consumers were assumed to be rational in their purchase decisions, they exhibit varying WTP for given products. And as a result, 5 point bids (Table 3) were randomly chosen to bracket their expected maximum willingness to pay. These bids were assigned to a

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Table 1. Nature and a priori expected signs of Logit analysis of the factors determining consumers’ WTP.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Definition of variables</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP (Willingness to Pay)</td>
<td>If respondent is WTP a price premium for pearl millet products</td>
<td>1-Yes; 0- Otherwise</td>
</tr>
</tbody>
</table>

Independent variables

- Income (Income): The monthly income level of the household head
- Children (Nochildren): The number of children below 12 years in the household
- Education (EducLevel): Highest educational level of the respondent
- Gender (Gender): Gender of the household head
- Employment (Employstatus): Is the household head employed
- Age (AgeofHH): Age of the decision maker (years)
- Household head (HHhead): If the buyer is the head household
- Awareness (Awareness): The household head level of awareness of pearl millet product
- Heard (HeardProduct): If the household have heard of a pearl millet product

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1 Exchange rate – US $1 = KES 85
2 Bid – This the maximum amount of money a consumer would be willing to pay to get a pearl millet product in the market
Table 2. A summary of pearl millet consumers’ socio-demographic characteristics.

<table>
<thead>
<tr>
<th>Specific variables</th>
<th>Description</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>years</td>
<td>45.4 (11.7) 1</td>
</tr>
<tr>
<td>Educational level (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total (%)</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Total (%)</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Employment status (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full time</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Part time</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Housekeeper</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total (%)</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

1Standard deviation.

Table 3. Distribution of willingness-to-pay (WTP) responses.

<table>
<thead>
<tr>
<th>WTP category (%)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>23</td>
<td>32.86</td>
</tr>
<tr>
<td>20</td>
<td>19</td>
<td>27.14</td>
</tr>
<tr>
<td>25</td>
<td>14</td>
<td>20.00</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
<td>14.29</td>
</tr>
<tr>
<td>75</td>
<td>4</td>
<td>5.71</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.00</td>
</tr>
</tbody>
</table>

respondent, and they were only given one second chance to bid for these percentages. The random selection and distribution of WTP percentage bids was assumed to offer excellent market information for pearl millet market actors.

Distribution of willingness-to-pay responses

The percentage of the respondents who indicated positive WTP decreased with increase in premium offered implying that an increase in price decreases demand levels (Table 3). Out of the 70 positive respondents, 32.9% were willing to pay 10% while only 5.7% were willing to pay 75% price premium for the new pearl millet products. This implied that most consumers did not believe that these new pearl millet products could attract higher prices or be used as a raw material in making products described by the study instrument. Similar studies by Shukri and Awang-Noor (2012) in Malaysia reported 53.4% of their respondents as WTP RM 500 in comparison to 90.3% of respondents who were WTP RM 100 to acquire certified timber products. In addition, Kimenju and De Groote (2005) in Kenya found out that 50.3% of the respondents were willing to pay 5% while 39% were willing to pay a premium of 50% above the normal maize prices. Gunduz and Bayramoglu (2011), on the other hand, observed 81% of Turkish organic chicken consumers’ were willing to pay price premiums. Out of these, 28, 29 and 10% were WTP less than 5%, 6 to 10% and more than 10% price premium respectively above the regular chicken prices.

Estimate of consumers mean willingness-to-pay

Based on the result from contingent valuation method, the mean WTP was estimated and presented in Table 4. The result indicated that respondents were on average willing to pay Kshs.142 representing a premium of 42% over the normal price of Kshs 100 for similar finger millet product. In general, consumers showed a positive willingness to pay for new pearl millet products. These findings are similar to those of Padilla et al. (2007) who estimated a mean WTP for Chilean consumers at 39% for officially certified labels on traditional food products. On the other hand, Nepal consumers were willing to pay between 40 to 60% for labeled tomatoes (Bhatta et al., 2010). Loureiro and Umberger (2003) also observed that USA consumers were willing to pay 38 and 58% for certified steak and Hamburger above the initial given prices respectively. It is important to note that the true
position of the mean WTP might be lower than our mean WTP estimate partly due to the hypothetical nature of survey data used in the contingent valuation methodology. Such low levels of WTP (6-10 percent of regular price for equivalent products) have been observed by Boccaletti and Moro (2000) amongst Italian genetically modified consumers. Therefore, these results should be interpreted with caution.

Factors affecting consumer’s willingness-to-pay

A total of 100 respondents from Mbeere district were interviewed to support the analysis of the factors affecting consumers WTP. The main variables hypothesized to influence consumers WTP and used in logistic regression analysis included: a household head monthly income levels in Kshs (Income), level of respondents awareness of new pearl millet product (Awareness), if the respondents have ever heard of new pearl millet products (HeardProduct), total number of children below 12 years in a given household (NoChildren); Age of the buyer or household head (AgeofHH), the highest number of years a buyer/ household head have been in school (EducLevel) and the employment status of a household head/buyer (employment status). In addition, dummy variables like if the respondent was a household head or otherwise (HHhead) and whether the household head was male or female (Gender) were also included in the study (Table 5).

The findings of the maximum likelihood estimate for WTP a premium price is presented in Table 5. The model revealed a McFadden’s R² statistic of 0.40 which is a reasonable value considering the cross sectional nature of data and therefore correctly predicted the actual choice of WTP premium by consumers (Kennedy, 1994; Govindasamy and Italia, 1999). Moreover, the calculated Chi square statistic of 0.000 was statistically significant indicating the statistical significant of the model in explaining the result. In general, five out of nine hypothesized factors were significant at 1, 5 and 10%.

From empirical result, the coefficient of households with children below 12 years old is positive sign and significant at 5% level (Table 5). This means that households with children below 12 years old were 5.6% more WTP premium prices than those without these children. This is because, households with children are more concerned with the nutritional values of food they give to children and pearl millet is perceived as one such category of food. This empirical result mirror those of Gao et al. (2011) on USA fresh citrus consumers where he observed that households with children below 12 years tended to be in a pro quality cluster than perfectionist clusters. Because parents were more focused on fruit quality, they were willing to pay premium prices for quality fresh citrus fruits compared to those without children. In Turkey, Budak et al. (2010) observed those producers with larger herd sizes as more willing to pay premium prices than those with limited herd sizes to receive extension services due to their contribution to household

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**Table 4. Parameter estimates of mean WTP model.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient estimate</th>
<th>Standard error</th>
<th>P- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (α)</td>
<td>9.235</td>
<td>1.662</td>
<td>0.000</td>
</tr>
<tr>
<td>Bid (ρ)</td>
<td>0.065</td>
<td>0.013</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean WTP (α/ ρ)</td>
<td>142.077</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of observations = 100; Log likelihood = -63.862.

**Table 5. Empirical result from Logit model and their marginal effects.**

| Variable   | Coefficients | Standard error | z       | P>|z| | Marginal effects |
|------------|--------------|----------------|---------|-------|------------------|
| HHhead     | -0.555       | 0.716          | -0.78   | 0.438 | -0.056           |
| AgeofHH    | 0.080        | 0.029          | 2.76    | 0.006*| 0.008            |
| Gender     | 1.252        | 0.728          | 1.72    | 0.086***| 0.127           |
| EducLevel  | -0.102       | 0.348          | -0.29   | 0.769 | -0.010           |
| NoChildren | 0.558        | 0.244          | 2.29    | 0.022**| 0.057            |
| Employstatus| 0.238       | 0.277          | 0.86    | 0.390 | 0.024            |
| Income     | 1.029        | 0.388          | 2.65    | 0.008*| 0.105            |
| Awareness  | 1.351        | 0.420          | 3.22    | 0.001*| 0.138            |
| HeardProduct| 0.229       | 0.455          | 0.50    | 0.615 | 0.023            |
| Constant   | -10.540      | 3.136          | -3.36   | 0.001 | -                |

Statistics: Number of observations = 100; Prob.> chi square = 0.0000; Log likelihood = -33.660; Pseudo R-squared = 0.4014; Likelihood ratio test of zero slope coefficients= 45.15; * significant at 1%; ** significant at 5%; *** significant at 10%. 
Income. In USA, Loureiro and Umberger (2003) observed a contradicting result as households with children portrayed a negative correlation with willingness to pay for beef products. Bhatta et al. (2010) also noted a negative relationship between family size and willingness to pay for inorganic vegetables like tomatoes. This they attributed to the fact that a larger family size means more expenditure on foods and to cut down on these expenditures, they need to opt for cheaper food types.

Educational level attained by a given household directly affects a consumer’s willingness to pay levels. Access to better education enhances understanding of nutritional information; therefore, respondents with education should possess higher WTP. However, from empirical result (Table 5), the coefficient of the variable representing educational level was negative and had no significant role in influencing consumers’ willingness to pay premiums. Those with higher education were 1.0% less likely to pay premium prices compared to those with low education. This result is consistent with the priori assumption that as a person stays more in school; its willingness to pay for a premium price reduces. This is true because educated consumers can think and judge between good and healthy food and which is not. Secondly, they might expect that it is government duty to provide these products free of charge and thus their unwillingness to pay premium prices. In addition, educated consumers are more likely to be in off farm employments and therefore might over emphasize the need for produce safety standards. These findings are similar to Budak et al. (2010) who observed that highly learned Turkish producers’ unwillingness to pay premium prices for extension services. Bhatta et al. (2010) also observed a positive and significant result with Nepal inorganic vegetable consumers. However, they negate those of Owusu and Onfori (2012) findings that well educated Ghanaian organic food consumers’ willingness to pay higher premiums compared to less educated consumers. In addition, they contrast studies of Loureiro and Umberger (2003) findings that a unit increases in the level of education increases the level of US consumers WTP premium for certified Hamburger.

According to economic theory, as household income increases, the probability of household willingness to pay also increases. From our empirical result (Table 5), a household’s monthly income levels had a positive sign which was significant at 5% level with willingness to pay for new pearl millet products. A unit increase in a household monthly income increases its willingness to pay premium for new pearl millet products by 10.5%. This is consistent with our earlier expectation that an increase in a household income levels had a direct and a positive effect on premium payment. These results are consistent with Kimenju and De Groote (2005) observation that Kenyan maize consumers with higher income levels (greater than Kshs. 50,000) were willing to pay premium prices than those with low incomes levels. Similarly, Owusu and Onfori (2012) recorded that Ghanaian organic food consumers were willing to pay premium prices as monthly income levels increases. In addition, Govindasamy and Italia (2009) pointed out that USA households with earnings less than USA $ 30,000 were 16% less likely to pay premium compared to those earning over USA $ 70,000. Loureiro and Umberger (2003) on the other hand observed that as income levels of US households increases, their WTP premium prices decreases. They attributed this to the fact that, wealthy consumers in the USA considered their meat supply as safe and therefore no labeling was necessary. Boccaletti and Moro (2000) also observed a positive relationship between an individual’s income level and his willingness to pay. For instance, individuals with high income levels translated greater benefits accruing from genetically modified (GM) foods to money equivalent.

In terms of gender, our empirical results showed that the coefficient was positive and statistically significant at 10% level with consumers’ willingness to pay premium prices (Table 5). This indicates that male consumers were 12.7% more likely to pay premium prices for new pearl millet products compared to female consumers. Similar finding was also reported by Haghiri and McNamara (2007) pointed out in Canada that male consumers’ were more willing to pay premium prices than female counterpart for pesticide free produce. In addition, In China’s urban cities, Lin et al. (2005) found out that male Chinese consumers were more willing to purchase Soybean compared to female consumers. However, in USA, Govindasamy and Italia (1999) observed that male consumers were 12% less likely to pay 10% premium to acquire an organic produce. In South Carolina- USA, Carpio and Isengildina-Massa (2009) observed female consumers’ as 44% more willing to pay an additional price to obtain animal products compared to male consumers. Loureiro and Umberger (2003) also observed female USA households as more willing to pay a premium for mandatory country of origin labeling programs.

Household heads are decision makers in a family, and therefore their age levels are important in making a purchase decision. From the a priori assumption, it was hypothesized that older household heads might not be willing to pay premium prices as they are in their retirement ages with little income. However, from the empirical results (Table 5), the coefficient for the age of household head has a positive and significant sign at 1% level. This indicates that if a respondent was old, they were 0.8% more likely to pay higher price for the new pearl millet products compared to when the respondent was young. This implies that older consumers were more motivated in purchasing new pearl millet products than younger consumers. This might be attributed to the long history of pearl millet in Mbeere district and so they had excellent knowledge in its benefits and uses.

Access to information increases the level of consumers’
CONCLUSIONS AND POLICY RECOMMENDATIONS

Due to the importance pearl millet plays in rural households food baskets, this study examined whether consumers are willing-to-pay any additional amount if products of new pearl millet varieties were availed to them. Our results do recognize that 70% of Kenyan consumers were willing to show their appreciation for a pearl millet product through premium payment of 42%. Further analysis of data using a Logit model gave a consistent result with regard to signs and significance of coefficients. In terms of factors affecting consumers' WTP, results showed that households with a monthly income and children below 12 years and those with prior knowledge of pearl millet were most likely to pay price premium. Therefore, to boost profits from this potential niche and lucrative market sector, these households should be the prime target of marketers if they want to retrieve maximum returns.

In order to harness the existing opportunities in pearl millet market value chain, this study recommends the following. First, fast food marketers should be familiar with this price premium and adjust their marketing strategies to benefit from this niche market. Finally, empirical results also indicated that not all consumers were willing to pay equal price premium for pearl millet product. As empirical results showed that not all consumers were willing to pay equal price premiums for pearl millet products, marketers should classify consumers according to their willingness to pay percentage estimates and adopt matching marketing strategies to derive maximum benefit from these consumers.

Conflict of Interest

The authors have not declared any conflict of interest.

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