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ANALYSIS OF CONSUMER WILLINGNESS TO PAY FOR GENETICALLY MODIFIED MAIZE FOOD IN SWAZILAND

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ABSTRACT

Genetic modification has been regarded as the new techno-economic standard of the 21st century. There are a number of promised benefits that come with the technology, including that of increase in crop yield, drought tolerance, environmental friendly farming, low food prices, better taste and nutrition among others. However, the use of biotechnology in food production is one of the most controversial subjects in modern agriculture with some scientists and consumer organizations citing possibilities of GM food causing allergies and cancer in human beings among other negative environmental and ethical concerns. This study was an assessment of consumer willingness to pay for GM food in Swaziland. Data were collected across the four regions of the country, sampling 100 respondents in each region making a total sample size of 400 respondents. The respondents were primary or secondary shoppers in their households, who were above the age of 18 and have heard about GMOs. Data were analysed using SPSS version 20. The results show that there were few respondents (32%) who had objective knowledge about GMOs. However, 70% of the respondents believe that GMOs are already being sold in the local markets. A binary logistic regression model was used to analyse willingness to pay for GM maize meal. The variable that were found to be affect consumers' willingness to pay for GMO maize food were age, knowledge level, health perception, ethical perception and environmental perception about GMOs.

Keywords: Consumer's perceptions, contingent evaluation, GMO, Maize, Swaziland, Willingness to pay.

Contribution/ Originality

This study contributes in the existing literature of consumers' perceptions on genetically modified food. This is the only study in conducted in Swaziland that focused on consumers, while other studies focused on farmers.

1. INTRODUCTION

Genetic modification is a general term for a number of specific techniques that alter the genetic material (DNA) of organisms. By altering the DNA, geneticists are able to change an organism's physical characteristics. Genetically modification means the manipulation of the DNA of crops or animals in a way that could not occur naturally. Groote *et al.* (2011) state that if insect resistance maize is adopted in Africa, economic analyses show that the returns are likely to be very high: under standard assumptions the economic surplus is calculated at US $208 million over 25 years, compared to a cost of US $6.76 million. Most of the benefits go to the maize consumers, which mean this technology could make a substantial impact in poverty reduction.The argument was that by developing pesticide-and-

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herbicide-resistant crops, farmers would be able to increase their yields and decrease their costs. GMO crops were not only made to yield more, but also to withstand drought and salty soils and would be pest and disease resistant and also more nutritious and tasty.

Even though GM technology has been flagged as a solution to issues of food security and other benefits, there are also some perceived negatives about it. These include concern that the gene from GM crops might escape to the environment and contaminates other crops. There is a concern that if a gene from an herbicide tolerant crop escape to the environment, it might result in herbicide resistant weeds. Consumer organizations and other non-governmental organizations (NGOs) have as well expressed worries regarding antibiotic-resistant marker genes, potential allergic reactions, ethical and religious concerns, and the lack of consumer choice due to inadequate labelling (Frank, 1999). The use of biotechnology in food production has since then become one of the most controversial subjects in modern agriculture. A majority of studies analysing consumer acceptance of GMO have been done in developed countries and Asia with very little done in Africa (Muchopa *et al.*, 2006; Kimenju *et al.*, 2008; Bailey *et al.*, 2014). This means that consumer acceptance of GM products in Africa is not well known irrespective of the fact that the technology continues being developed for Africa. Swaziland has recently approved a biosafety bill, which is meant to control the handling of GMOs in the country. One of its stipulations is that all products made of genetically modified organisms must be clearly labelled so. The problem at the moment in the country is that the demand for GM food is not known and as consumers become able to identify GM products from the labels it is assumed that their willingness to pay might change affecting the returns of GM food distributors. It is then important for companies who are already interested in distributing GM seeds or products in the country to know if these products will be successful before major investments are being made. This can be achieved through analysing the consumer willingness to pay for GMO which is a result of consumer risk/benefit perception, price and attitude towards GM products. This paper aimed at getting more information about the perceived success of GMOs at local marketing level by assessing consumers' willingness to pay for GM food, focusing on maize products consumed by human beings.

2. LITERATURE REVIEW

2.1. Status of GMOs Products in Swaziland

Genetically modified crops are still not grown in Swaziland awaiting legislation permitting it. However, GM maize is imported and first get milled (to prevent it from being planted) before being distributed for animal and human consumption. A study by Matsebula (2012) found that of the 10 maize products sampled randomly in areas around Matsapha, more than 99% of it had GM traits in it and were not labelled. This shows that in Swaziland GMOs are highly consumed. The presence of GMOs in the markets in Swaziland is also echoed by Africa Centre for Biosafety (2012) in that Swaziland, Somalia and Mozambique have continually received GM maize (and soybeans in the case of Mozambique) imports which had accumulated to 285 000 tonnes by end of 2011 from South Africa only. The report also shows that in 2010 Swaziland imported 39 200 tonnes and 44 100 tonnes in 2011. The Times of Swaziland dated 21May 2012 report that the Swaziland Environment Authority (SEA) recognises that over 100 000 tonnes of genetically modified food products enter the country from South Africa. Most of the imports include yellow maize for animal feed and white maize meal.

Swaziland has great regards for the potential benefits of modern biotechnology in agriculture, environmental management and human health. The minister of Tourism and Environmental Affairs was recorded in the Swazi Observer, dated 29 August 2014 stating that the Swazi Nation should not shy away from modern biotechnology, but should embrace and learn more about GMOs and apply the technology. In the same article it was recorded that farmers in Swaziland want to grow GM cotton. The Swaziland Cotton Board has already filed an application with the Swaziland Environmental Authority as the competent authority mandated to handle these issues, to bring the genetically modified cotton seeds into the country. However, this new technology comes with some uncertainties as the long term effects of such on the environment and human health has not been fully investigated.

In a study by Dlamini *et al.* (2008) the agriculture stakeholders suspected that products of biotechnology are already found in Swaziland. This could be due to the fact that most of the seeds planted in Swaziland and food aid are imported from countries who are known to be producers of GMOs. It was also found that the agriculture sector has a high level of tolerance towards acceptance of GMOs. The country has passed a biosafety bill and it is anticipated that when the bill has been passed into a law, biosafety regulatory committees and risk assessment procedures and methods of notification will be developed.

2.2. Consumer Acceptance and Willingness to Pay for GM Food

Kimenju *et al.* (2008) in a study to find the willingness to pay for genetically modified foods in Kenya using CVM with dichotomous choice framework and a double bounded logistic model found that 68% would be willing to buy GM maize meal if it were offered at the same price as their favourite maize meal brand. Nairobi consumers were found to be willing to pay KShs 58 for 2kg packet for GM maize meal, which is a 13.7% premium over average of the then (2003) maize meal price (KShs 51), confirming acceptance of the use of GM technology. Chern *et al.* (2002) found that despite the low awareness of biotechnology, more than 80% of US students were at least "somewhat willing" to consume GM foods. By comparison, 56% of Norwegian students were not very willing or would avoid consuming GM foods, despite their high awareness of GM technology. The difference in the attitude on the willingness to consume GM foods was very dramatic between Japan and Taiwan. Although there were only 17% of Japanese students who were "somewhat" or "very willing" to consume GM foods, the figure was 79% for Taiwanese students. These results suggest that American and Taiwanese students were more willing to consume GM foods than Norwegian and Japanese students.

Onyango and Govindasamy (2005) estimated willingness to pay for GM benefits by evaluating the ratio of the attribute coefficient (benefit or technology) to the coefficient of the monetary variable. It was found that genetic modification involving animal genes, Bacterium, and plant genes has a negative effect on choice (i.e., reduces the probability of the GM alternative being selected). The results show that more compensation is required to induce acceptance of processes involving animal, bacterium, and plant genes (22%, 9%, and 5%, respectively). Huffman *et al.* (2001) in examining the importance of different food products by conducting auctions with soybean oil, corn tortilla chips, and raw potatoes, found that consumers did not react differently to GM food depending on whether the product was highly refined, cooked, or raw. Boccaletti and Nardella (2000) in their empirical analysis supports the idea that one of the main reasons for the low acceptance of GM food products is the “scarce knowledge” that individuals have about this topic; those with a higher knowledge are more likely to buy these products. This was proven by that whenever consumers were given correct information they were more willing to pay higher prices in order to benefit from quality improvements, which may indicate that, regarding the acceptance of GM foods, practical reasons often prevail over ethical considerations. This may be particularly true whenever the use of biotechnology reduces health risks, such as those caused by the use of pesticides.

3. METHODOLOGY

3.1. Sampling Design

The study was targeting maize products buyers in Swaziland. Data were collected in the four regions of the country; in the city of each region. From the list of all supermarkets (from the Ministry of Commerce) in each of the regions, cities, 4 supermarkets were randomly selected. The total number of supermarkets in the four cities was 29; 6 supermarkets in Shiselweni, 5 in Lubombo, 7 in Hhohho and 11 in Manzini. A total of 25 consumers were interviewed from each of the selected supermarkets by targeting every third consumer that came along to the supermarket for possible interview. This amounted to a total sample size of 400 respondents.

3.2. Data Collection Procedure

Data were collected by well-trained enumerators. It was collected using questionnaires which were designed to gather primary information such as demographics, attitude and consumer willingness to pay for GM maize product. The questionnaire consisted of structured questions that were divided into two forms; dichotomous choice and multiple categories questions. Generally the questionnaire was divided into five categories: (a) Identification and demographic background, (b) Awareness and knowledge about GMOs, (c) Trust in institutions to ensure quality, (d) Perception on GMOs food, and (e) Consumer willingness to pay for GM maize (including bid prices presented). First the respondents were asked if they were aware of GMOs. If 'yes' the questionnaire was administered, but if 'no' it was not be administered to that person.

3.3. Data Analysis

The contingent valuation method (CVM) was used to analyse consumer willingness to pay for GM food. In this method, each of the respondents was asked whether or not they were willing to pay a certain price for maize meal (which is widely used as staple food in Swaziland) in a hypothetical market. The prices of the maize meal were close as possible to the real market in order to reveal peoples' true preferences in an actual market. To guarantee this, the respondent was first asked to state the price of a 2.5kg maize meal (package used in this study) and that price would be used as the basic price. Efficiency would be improved by offering the respondent a second bid, higher or lower depending on the first response, in an approach known as the double-bounded Contingent Valuation Method. A logistic regression model was used to estimate the consumer willingness to pay.

3.4. Analytical Framework

To estimate the consumer willingness to pay for GM maize product, a logistic regression model was used to assess willingness to pay for GM maize food products and the effect of each explanatory variable on the consumer willingness to pay more for the products. The binary logistic regression model is often used to model the event probability of a categorical response variable with two outcomes. This model is preferred because the dependent variable is dichotomous; consumers would provide a 'yes' or 'no' answer to the question on whether or not they would be willing to pay for GMO maize.

The logistic regression model estimates the parameters using maximum likelihood, which implies that the resultant estimated probabilities of success are the maximum likelihoods estimates of the conditional probabilities of success given the observed value of the predictors (Gujarati, 2009). It generates an S-shaped curve in the normal distribution and its advantage over the other functions is that the parameters estimated under the logistic regression are fully efficient and statistical tests on the parameters are better behaved even with small samples (Gujarati, 2009).

WTP has a particular density function around a mean, in function of the price. The logistic distribution is commonly used in applied research and the price is entered indirectly in an argument called the index function. The logistic function also has an advantage of a closed form cumulative distribution function, which presents the proportion of the population whose WTP falls below a certain value B, which can be presented as;

$$G(B) = P(WTP<B) = \pi^{n}(B) = 1/(1+\exp(v)) \quad \ldots\ldots (2)$$

For respondents whom their WTP is higher than the offer B, the expression is;

$$1-G(B) = P(WTP>B) = \pi^{y}(B) = 1-1/(1+\exp(v)) \quad \ldots\ldots (3)$$

Using the above equations the likelihood function for a simple dichotomous choice model can be derived;

$$\text{InL}(v)=\sum_{i=1}^{N}\{d^{y}\ln\pi^{y}(B_i) + d^{n}\ln\pi^{n}(B_i)\} = \sum_{i=0}^{n}\{d^{y}\ln(1-G(B_i)+d^{n}\ln G(B_i)\} \quad \ldots\ldots(4)$$

Where d^y is 1 if the *i*th response is "yes" and 0 otherwise, while d^n is 1 if the *i*th response is "no" and 0 otherwise.

A double bounded contingent valuation method was used in this study where the consumer was presented with two bids; the other being contingent on the first bid. If the individual responds "yes" to the first bid, the second bid, B^u was some amount greater than the first bid ($B_i>B^u$); if the individual responds "no" to the first bid, the second bid, B^d was some amount smaller than the first bid ($B_i<B^d$). Thus there are four possible outcomes to the questions: a

"yes" to the first bid followed by a "yes" to the second bid (probability denoted by π^{yy}), a "yes" followed by a "no" (π^{yn}), a "no" followed by a "yes" (π^{ny}), and both answers are "no" (π^{nn}). To receive information on a wider range of values, the bids differ between respondents *i*.

The probability to receive a "yes" answer to both questions equals the probability that the respondent's WTP is higher than the highest bid:

$$\pi^{yy}(B_i,B_u)=Pr(B_1\leq \max WTP_i)=1\text{-}G(B^u) \quad (5)$$

Similarly, the probability of receiving first a "yes" followed by a "no" answer equals the probability that the WTP of respondent *i* falls between the initial bid and the second, higher bid:

$$\pi^{yn}(B_i,B^u)=Pr(B_i\leq \max WTP_i\leq B^u)=G(B^u)\text{-}G(B_i) \quad (6)$$

The probability of receiving a "no" followed by a "yes" is again the probability that WTP falls between the initial and the second, now lower bid:

$$\pi^{ny}(B_i,B^d)=Pr(B^d\leq \max WTP_i\leq B_i)=G(B_i)\text{-}G(B^d) \quad (7)$$

Finally, the probability of receiving two "no" answer is equal to the probability that WTP falls below the second, lower bid:

$$\pi^{nn}(B_i,B^d)=Pr(B_i>\max WTP_i \text{ and } B^d>WTP_i)=G(B^d) \quad (8)$$

Combining the four probability outcomes, the log-likelihood functions become;

$$\ln LD(\theta)=\sum_{i=0}^{n}\{d^{yy}\ln\pi^{yy}(B_i,B_u)+d^{nn}\ln\pi^{nn}(B_i,B^d)+d^{yn}\ln\pi^{yn}(B_i,B^u)+d^{ny}\ln\pi^{ny}(B_i,B^d)\} \quad (9)$$

Where d^{yy}, d^{nn}, d^{yn} and d^{ny} are binary variables with 1 denoting the occurrence of the outcome and 0 otherwise. The estimation of the parameters are obtained by maximum likelihood function and mean WTP is calculated as α/ρ.

To measure the effects of the explanatory variables the model assumes that the probability of willingness to pay a higher price for GMO food, π_i=probability (WTP=1) is related to X_i by

$$\text{Log}\left(\frac{\pi i}{1-\pi i}\right)=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6 \quad (10)$$

Where $\left(\frac{\eth i}{1-\eth i}\right)$ = the odds ratio in favour of paying more for GM maize product, meaning it is the odd ratio of the probability of being willing to pay more to the probability of not being willing to pay more.

X_1= income

X_2= knowledge about GM products

X_3= age

X_4= education level

X_5= Perception on GMOs

X_6= Trust in institutions to ensure food quality

The respondents were classified into five categories of income levels. Knowledge about GMOs was determined through statements from which the respondent had to state if there are true or false. Age was expressed in categories (18 to 24, 25 to 34, 35 to 44, 45 to 60 and above 60) and education level was classified into five categories according to the highest education level attained. On the perception, each of the questions was scored on a quantitative scale (1=totally disagree, 2=disagree, 3=don't know (neutral), 4=agree and 5= strongly agree. It was measured in four categories; a health perspective, a benefit perception, ethical perception and environmental perception. From the four categories a perception index was found to show a general consumer perception towards GM food.

To elicit trust in institution to ensure food quality, the variable was scored with each question scored in a quantitative scale (1=no trust, 2= partially not trust, 3= Neutral, 4=partially trust and 5= high degree of trust. To measure trust respondents were required to state their level of trust for each of four institutions (government, consumer and environmental groups, food and agribusiness companies and scientists and academicians) to execute the responsibility stated in the statement. A trust index was done to come up with a general trust in institutions of consumers. Consumer perceptions were measured in four categories; health perception, benefit perception, ethical

perception and environmental perception. Questions were asked from each of the categories and respondents were presented with options of; totally agree, partially agree, don't know, partially disagree and totally disagree. An index of each perception category was achieved and later all the perceptions were combined to form one general consumer perception. In the index 0.1 to 0.4 meant that the consumer has a negative perception on GMOs, while 0.6 to 1 meant the consumer has a positive perception on GMOs and 0.5 means the respondent has neither a positive nor a negative perception about GMOs. Consumer perceptions wwere further analysed using descriptive statistics.

Consumer knowledge level on GMOs was achieved by giving statements to the respondents from which they had to indicate if the statement if true, false or they do not know. As shown in literature that there is a high debate about GMO adoption in the world, Swaziland inclusive, elicitation of the level of knowledge was meant to describe if the respondents have objective knowledge (proven facts) about GMOs or they only have subjective knowledge (personal believes which might not be true) or they do not possess much knowledge on the subject. Descriptive statistics were used to analyse consumer level of knowledge about GMOs.

4. RESULTS AND DISCUSSION

4.1. Characteristics of Respondents

The results on the characteristics of respondents are presented in Table 1. Respondents from the rural areas made about 54% of the respondents, while 20% and 26% came from the urban areas and semi urban areas respectively. There were as well many female respondents (59%) compared to 41% men. About 51% of the respondents were single, while 45% were married, 1.5% divorced and 1.8% widowed. The respondents were grouped according to their age whereby 19% were those between age of 18 and 24, 40% between age of 25 and 34 while the group between 35 and 44 made 26%, about 16% were between 45 and 60 while only 2% were above the age of 60 years.

Table-1. Frequency distribution of the demographic characteristics of survey respondents

Characteristics (n=40)		Frequencies	Percentages
Geographical region	Hhohho	100	25
	Manzini	100	25
	Shiselweni	100	25
	Lubombo	100	25
Residency	Rural area	216	54
	Urban Area	80	20
	Sub-urban area	104	26
Gender	Female	235	58.8
	Male	165	41.2
Marital Status	Single	204	51
	Married	183	45.6
	Divorced	6	1.5
	Widowed	7	1.8
Age	18-24	71	17.8
	25-34	162	40.1
	35-44	97	24.5
	45-60	63	15.8
	>60	7	1.8
Education Level	Primary School	18	4.5
	Secondary School	24	6
	High School	90	22.5
	Tertiary	268	67
Family Monthly Income	<E1,000	44	11
	≥E1,000≤E2,000	59	14.8
	≥E2,000≤E5,000	95	23.7
	≥E5,000≤E10,000	115	28.7
	>E10,000	87	21.8
Shopper Ranking	Primary Shopper	232	58
	Secondary Shopper	168	42

The education level of the respondents was dominated by those who have tertiary education (67%) followed by 22% of respondents with high school certificates, 6% with secondary school education and 5% with primary school education as a high education level.

Grouping the respondents according to their income shows that 11% earn less than E1,000 while 15% earn more or equal to E1,000 but less than E2,000, 24% earn E2,000 or more but less than E5,000, 29% earn E5,000 or more but less than E10,000 and 22% earn more than E10,000.

4.2. Awareness and Knowledge of GMOs

About 70% of the respondents believed that GM maize are being sold in Swaziland while 30% did not believe so. The level of knowledge about GMOs was deduced through objective questions that required the respondents to choose between true, false and don't know options from which it could be generalised that 32% of consumers of the respondents had objective knowledge about GMOs, while a majority (68%) did not have much knowledge on GMOs.

4.3. Consumer Perceptions on GM Food

Consumer perceptions about GMOs were measured using four categories which were the risk perceptions, benefit perceptions, ethical perceptions and environmental perceptions. In each of the questions asked in all the categories, respondents were presented with five options to choose from; totally agree, partially agree, don't know, partially disagree and totally disagree. The results showed that a majority (45%) of consumers in Swaziland perceive GM food to be risky to human health. About 26% perceive that GMOs are not a health hazard to human beings. The results showed that a substantial percentage (31%) of consumers do not know if GMOs are a health hazard or not to human health. About 44% consumers in Swaziland perceive that GMOs have benefits and 26% do not realise any benefits from GM food. Even under the benefit perception a substantial number of respondents (30%) were not aware if GM food has got benefits or not.

A majority (45%) of the respondents perceived GM food not being ethically right while 29% do not see a problem with GM food ethically. A section of 27% consumers did not know if GMOs are ethically right or wrong. On environmental risk perception the results showed that, 41% of the respondents perceived a risk factor while 27% did not and 33% were neutral.

Generally the results show that consumers in Swaziland have a negative perception on GMOs. The percentage of those that are negative is 40% against 30% who had a positive perception and 30% had neutral perception about GMOs. Respondents were also required to score their discernment in as far as food labelling is concerned. A majority (81%) found labelling GM products as important. This was made of 69% respondents who found it very important and 11% who found labelling GM products as partially important. There was 7% who was neutral and 13% who perceive labelling GM product as not important (5% partially not important and 8% totally not important). Testing of all GM food for possible allergies was found important by 71% of the respondents with 66% finding it very important and 13% finding it partially important. About 8% were uncertain, while 8% found it not important. There was an expected positive correlation between labelling of GM products and testing them for possible allergies. This implies that consumers who found it important to label products also found it important to test every product for possible allergies.

4.4. Consumers' Willingness to Pay

Contingent valuation method was used to measure consumer willingness to pay. Consumers were first asked if they would be willing to buy GM maize meal at the same price as their regular maize meal. Most of the respondents were not willing to buy GM maize at the same price as their regular maize meal. Only 37% were willing and 63% respondents were not willing. The average price was set at E24 for a 2.5kg maize meal. The respondents who would not buy GMOs at the same price as non-GM maize meal were given a price option contingent and lower than the first price. As shown in Table 2, 10% of the consumers who would not buy GM maize meal at the same price as the

regular meal were willing to buy it at a discount of E2 (8%) from the E24/2.5kg of a regular maize meal. About 11% were willing to buy genetically modified maize if discounted by E5 which is 21% from the regular maize meal. When the GM maize meal was discounted by E10 (42%), 13% of consumers were then willing to buy it. There was 28% of consumers who mentioned that they could never buy GM maize meal regardless of any discount.

Table-2. Consumer willingness to pay for GM maize meal contingent from the price of usual maize meal (at average of E2 per 2.5kg maize meal)

Level of willingness to pay	Percentage
Plus E10	3
Plus E5	7
Plus E2	9
Same price	18
Minus E2	10
Minus E5	11
Minus E10	15
Can never buy GM food	29

US$1 is equal to 12.41 Emalangeni (E)

The respondents who were willing to buy genetically modified maize at the same price as the regular maize meal were given a higher price option from which 9% indicated that they cannot buy GMOs at any price above that of the usual maize meal. About 18% of the responden'8ts would buy GMOs even when E2 (8%) expensive than their usual maize meal, while 7% would buy them even when E5 (21%) expensive. There was only 3% consumers who would buy GM food even when it was E10 (42%) more than their common meal. The average willingness to pay mean was calculated and found to be 1.63 with a standard deviation of 0.483. This means that generally consumers in Swaziland would be willing to buy GMO if they are discounted by E2 from the normal maize meal. These results mean that we reject the null hypothesis which assumed that consumers in Swaziland are willing to pay more for GM food.

4.5. Factors Affecting Willingness to Pay

A binary logistic regression model was used to measure willingness to pay where, age, education level and income level were measured in a scale of 1 to 5, while gender was male or female. Household size was measured by the exact number of members in the household and an index was found for knowledge, trust in institutions to safe-guide quality, health perception, and benefit perception, ethical perception and environmental perception. Table 3 shows the result of the logistic regression model used to analyse factors affecting willingness to pay for GM food.

The results show that five out of the eleven variables significantly affect willingness to pay for GMOs in Swaziland at 1% level and 10% level. Age was one of the variables that were significant at ($p<0.10$) and has a negative sign. The coefficient for age was -0.216 and the odd ratio was 0.806. This means holding all factors constant the likelihood of being willing to buy GMOs is 0.806 times less than not willing to buy them. This also implies that with one unit increase in age, the odds of willingness to buy GMOs decreases by 19%. The results show that as consumers grow older they became reluctant to adopt or consume food made of new technologies like genetic modification.

Knowledge was significant ($p < 0.01$) and positively related to willingness to pay for GMOs and having a standard error of 0.058. The coefficient for knowledge was 0.11 and the odd ratio was 1.117 implying that with one unit increase in knowledge, the odd of being willing to pay for GMOs increases by 1.117 times the odd of not being willing to pay for GMOs. The results also show that with one unit increase in knowledge about GMOs, willingness to pay increases by 110%. This means the more a consumer gets knowledge about GMOs is the more that consumer will be willing to buy GMOs.

Table-3. Regression result of logistic model

Variable	Coefficient	Std error	Wald	Sig	Exp (B)
constant	-2.744	1.303	4.431	0.035	0.064
gender	0.275	0.234	1.387	0.239	1.317
age	-0.216*	0.130	2.751	0.097	0.806
education	0.054	0.180	1.090	0.764	1.056
house h memb.	0.40	0.041	0.946	0.331	1.041
income	-0.098	0.111	0.779	0.377	0.906
knowledge	0.110*	0.058	3.668	0.055	1.117
trust	-0.18	0.014	1.835	0.176	0.982
health perc	0.68**	0.036	22.267	0.000	1.183
benefit perc	0.007	0.004	1.463	0.960	1.007
ethical perc	0.127**	0.036	12.207	0.000	1.135
environ perc	-0.103**	0.37	7.932	0.005	0.902

**, * indicate statistically significant at the 0.01 level and 0.10 confidence levels, respectively.

The health and ethical perception were both found to be significantly at 0.01 significant level and their standard errors were the same at 0.036. However the positive sign was not expected from both these variables since they were posed to measure the consumers' risk factors. It was expected that if consumers perceive high health and ethical risk they will avoid GMOs the most. The coefficient for health was 0.068 and the odd ratio was 118%. This implies that with one unit increase in health perception the odd of being willing to buy GMOs increases by 0.068 times the odd of not willing to buy GMOs. Also it shows that with one unit increase in health perception there is an odd of 118% increase in willingness to buy GMOs. The coefficient for ethical perception was 0.127 meaning that with one unit increase in ethical perception the odd of being willing to pay for GMOs increases by 0.127 times the odd of not willing to pay for GMOs. It also shows that with one unit increase in ethical perception about GMOs consumer willingness to pay increases by 114%.

Environmental perception was found to be significant at 0.01 significant level and had a negative sign. The logic coefficient was -0.103 and the standard error was 0.37. These results show that as environmental perception increases by the odd of being willing to buy GMOs decreases by -0.103 times the odds of willingness to pay for GMOs. It also shows that with one unit increase in environmental perception on GMOs the likelihood for being willing to buy GMOs decreases by 10%.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

It can be concluded form the results of the study that consumers in the study sample recognise the benefits that come with GM food but their concerns outweigh them. The consumers in Swaziland are not willing to pay more for GMOs or same price as non-GM food. They are however generally willing to pay for GM meals at an 8% discount. This means we accept the null hypothesis which states that consumers in Swaziland are not willing to pay more for GM food. With food distributors it can be concluded that even when all GM products are labelled the demand will still be high if the price is reduced by at least 8%.

5.2. Recommendations

Due to the low level of consumers' knowledge about GMOs in Swaziland it is recommended that the government (welfare policy makers), environmental entities, media, agribusiness dealers and NGOs should provide training about GMOs. It is believed that if consumers have been equipped with unbiased knowledge about GMOs they can be in a position to make informed decision regarding consumption of GMO foods.

REFERENCES

Africa Centre for Biosafety, 2012. Resist corporate attachs on your food sovereirgnty. MA Status Report.

Bailey, R., R.E. Wilonghby and D. Grzywacz, 2014. On trial agricultural biotechnology in Africa, energy, environment and resources., Research paper. Available from https://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20140716BiotechAfrica.pdf?dm_i=1TY5,2N30J,BHZLN4,9NERT,1.

Boccaletti, S. and M. Nardella, 2000. Consumer willingness to pay for pesticide free fresh fruit and vegetables in Italy. International Food and Agribusiness Management Review, 3(2000): 297-310.

Chern, W., K. Rickertsen, N. Tsuboi and T. Fu, 2002. Consumer accaptance and willingness to pay for genetically modifies vegetable oil and salmon: A multiple- country assesment. AgBioForum, 5(3): 105-112.

Dlamini, A.M., M.A. Dube and N. Nkambule, 2008. Stakeholder perception and application of biotechnology in agricultural industries in Swaziland. Scientific Research and Essays, 3(10): 477-487.

Frank, H., 1999. Food safety and GM food. Ireland: Food Safety Authority. Available from: https://www.fsai.ie/.

Groote, H., W. Overholt, J. Ouma and J. Wanyama, 2011. Assesing the potential economic impact of bacillus thuringiensis (BT) maize in Kenya. Africal Journal of Biotechnology, 10(23): 4741-4751.

Gujarati, D.N., 2009. Basic econometrics. 2nd Edn., New York: McGraw-Hill Book Company.

Huffman, W., K. Brown and D. Kuester, 2001. Consumer willingness to pay for healthier genetically modified food: ISU study. Available from http://www.news.iastate.edu/news/2011/sep/huffmanGMO.

Kimenju, S., H. Groote, J. Karugla, S. Mbogoh and D. Poland, 2008. Consumer awareness and attitudes towards GM foods in Kenya. Africa Journal of Biotechnology, 4(10): 1066-1075.

Matsebula, Z., 2012. Detection of gnetically modified organisms in maize food production in Matsapha: Implications for GM labelling. Kwaluseni: University of Swaziland.

Muchopa, S., Munyuki-Hungwe and Matondi, 2006. Biotechnology food security, trade and economists, a sythesis of issues impacting on wconomic right in Africa. Available from www.consumersinternational.org.

Onyango, B. and B. Govindasamy, 2005. Consumer willingness to pay for GM food benefits: Pay off or empty promises? Implication for the Food Industry Choice, 20(4): 223-226.