CAUSAL FACTORS FOR THE WILLINGNESS TO PURCHASE GM PRODUCTS: A PATH ANALYSIS

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ABSTRACT

Genetically modified products have been adopted at an extraordinary rate over the past decade, and this proliferation of transgenic science continues to arouse apprehension among many consumers around the globe. Hence, public policy regarding GM product apt to reflect consumer sentiments with strict regulation, tend to have constituents that are against the selection of such merchandise. The study was conducted to facilitate in solving this issue, evaluation on the consumers' awareness, ethnocentrism, acceptability and their willingness to purchase GM products has been proposed. The study used the adapted instruments from different respective articles and analyzed the path connected to the willingness to purchase GMO. The 300 respondents of the study were randomly chosen from the current list of families that was obtained from the Community Based Monitoring System. Based on the result, the calculation of reproduced correlation through path decompositions and subsequent comparison to the empirical correlation indicated that the path model fits the empirical data. The identified factors significantly influenced the willingness to purchase GM Products. Therefore, consumers' awareness, consumers' ethnocentrism, consumers' acceptability of GM Products have become vital factors on how thriving the market for GM foods will be in the forthcoming. Thus, it is recommended that policy-making bodies may consider the result of this study when implementing programs for GM products.

***Keywords**: Awareness, Ethnocentrism, Acceptability, Genetically Modified Organism, Path Analysis*

1.0 Introduction

Leading biotechnology in agricultural production is a standout amongst the most noticeable benchmarks ever of advancement. The utilization of genetic modification (GM) technology on yields and the subsequent genetically modified organisms (GMOs) are seen as a standout among the most essential yet questionable progressions in science and technology. Notwithstanding the impressive number of potentials and advantages proclaimed by numerous biotech companies and the governments, for example, decreased pesticide use, higher harvest yields, enhance nutritional values and many more, the controversy surrounding its adoption to food production persists in many countries (Chen and Chern, 2002).

In the Philippine setting, government agencies have approved a Joint Department Circular (JDC) that essentially allows the propagation of genetically modified crops in the country in compliance with a Supreme Court decision (Eñano, 2016). However, the safety of the GMO product is uncertain, and there is no long-term data on how genetically modified foods affect human health (Kannall, 2014). Henceforth, the consumers are hesitant to buy GM foods, primarily because of concerns about the general effects of GM foods on human health. Aside from which, consumers' ethnocentrism is also accountable for the valuation and purchasing purposes of buyers, even though may fluctuate within cultures and between various country-of-origin materials (Torres and Gutiérrez, 2007). The result on the analysis of the relative significance of different promoting mix strategies and purchaser ethnocentric propensities in the decision to buy imports indicates that ethnocentric tendencies can explain a much greater amount of variation in purchase behavior than marketing mix variables. Hence, the inclusion of ethnocentric tendencies into future studies on origin bias appears to be warranted given their substantial impact on import purchase behavior, particularly on Genetically Modified products (Herche, 1994). Consequently, consumers' awareness, ethnocentrism, and acceptance toward GM innovation and GM foods are critical for the worldwide market of GM products, agricultural trade, and the future improvement of agrarian biotechnology (Macer and Ng, 2000).

Despite the fact there is a developing body of literature concerning on GM food, slight devotion has so far been keen to examining and evaluating the factors that could affect directly and indirectly of the consumers' willingness to purchase these products. In this milieu, the present study is the first attempt to provide an overall picture of the consumers' decision process about GM products. In a sense that Bredahl's *et al*. (1998) work is mere addresses the issues of consumer attitudes and purchase intention. Moreover, a similar perspective to the meta-analysis did by Lusk *et al*. (2005), which then again, only focuses on the empirical literature meant to evoke the Willingness-to-pay a premium for a non-GM food, or the willingness-to-accept a return for a GM food product. Thus, the current study has been formulated.

The fundamental aims of the study were (1) to explore willingness-to-purchase GM products and (2) to identify the key determinants of its consumers' willingness such as consumers' awareness, ethnocentrism, and acceptability. The study generated the model through Path Analysis. Further, the created model was tested over diagnostic checking on the underlying assumptions for its robustness. Path Analysis is a correlation research method; therefore the measurement scale, restriction of range of the data values, missing data, outliers, nonlinearity, and non-normality of data affect the variance-covariance among variables and thus can impact the SEM analysis (Wittaker, 2011).

2.0 Conceptual Framework

Independent variables of the research were GM Products Awareness (X_1), Consumers' Ethnocentrism (X_2), and GM Products Acceptability (X_3). Meanwhile, Willingness to Purchase GM Products (Y) was identified as the dependent variable

for the research. The study had looked into the potentials of using these variables based on the following literature reviews:

According to Makanyeza (2015), consumers' awareness negatively influences consumers' ethnocentrism. The latter indicates that consumers' ethnocentrism indirectly sways the assessment and purchasing purpose of consumers, as influenced by cultures and between various information of the country-of-origin item (Torres and Gutierrez, 2007).

Li *et al*. (2002) observed that in spite of the fact that the more substantial part of Chinese consumers announced that they had practically little or no knowledge of biotechnology, their attitudes toward genetically modified products were generally positive, making to an ability to pay a premium for GM rice and soybean, and consequently their acknowledgment of these foods. Parallel to developed countries (UK and USA), Curtis *et al*. (2004) observed that generally, purchaser in developing countries (China and Columbia) have supplementary progressive discernments towards GM foods, in all probability coming from more earnest food needs, more positive media influence, higher trust in government, and a more positive attitude of science. Buyers who are better educated about GMOs will probably see the dangers of genetic alteration, yet they are likewise more prone to comprehend the advantages (Loader and Henson, 1998).

The triumph of any biotechnology program will be influenced on whether consumers accept its products. Springer *et al*. (2002) perceived that consumers would be the final judges of evolving technologies in agricultural production. Africa, where per capita food production scuffles to preserve pace with population growth and severe food shortages are the consistent manifestation, may not have the selection of rejecting food with GM content (De Groote *et al*., 2004). African policymakers confront an issue of whether to grasp the technology to sustain their people or whether to shield them from potential, as yet unproven, hazards. Since several developing nations have not framed authority positions on genetic modification, they may wind up embracing those from developed countries. The concerns among African farmers and consumers need to be known for their voices will be heard in the debate. Pinstrup-Andersen and Schioler (2001) argue that the agenda should be set by those people who have to live with the consequences of the action, in this case, African farmers and consumers. De Groote *et al*. (2003) observed that to help make decisions in this heated debate, it is essential that scientists contribute their objective analysis to the discussion.

Prior inquiries found that scores on the CETSCALE are associated conversely to the readiness to buy imports, the perspective of the idea of imported items, social openness, education, and income (Shimp and Sharma, 1987; Netemeyer *et al*., 1991). Outstandingly, consumers who hold strong ethnocentric convictions are bound to assess different items contrarily than are those individuals who don't keep such perspectives. The individuals who believe that it is not right to purchase foreign goods additionally tend to see those products as lower in quality than local products; ethnocentric consumers select local goods because of financial or moral convictions and in addition in light of the way that they are confident of their nation that conveys the best items (Klein *et al*., 1998: 99).

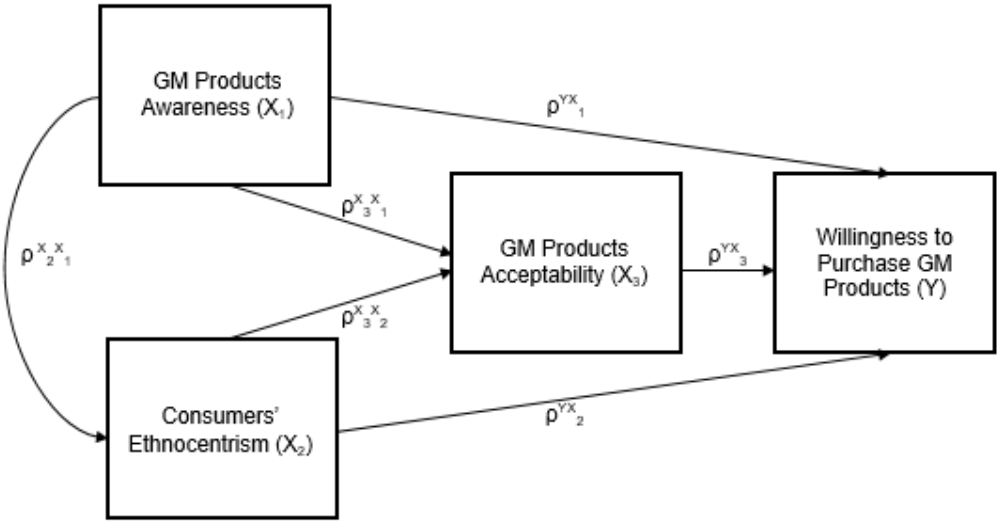

Figure 1. Input Path Diagram Representing a Proposed Causal Model

Legend: ρ^{YX}_1 – Path coefficient influence of Awareness towards Willingness to Purchase GMO
ρ^{YX}_2 – Path coefficient influence of Consumers' Ethnocentrism towards Willingness to Purchase GMO
ρ^{YX}_3 – Path coefficient influence of Acceptance towards Willingness to Purchase GMO
$\rho^{X_2X_1}$ – Path coefficient influence of Awareness towards Consumers' Ethnocentrism
$\rho^{X_3X_1}$ – Path coefficient influence of Awareness towards Acceptance
$\rho^{X_3X_2}$ – Path coefficient influence of Consumers' Ethnocentrism towards Acceptance

The causal model in Figure 1. proposed that the consumers' willingness to purchase GM Products results from the consumers' awareness, consumers' ethnocentrism, and acceptability of GM Products. Further, the path analysis was carried out through the multiple linear regression procedure. The causal model will be predicting the direct and indirect effect.

In this study, the model is specified by the following path equations:

$$Y = \rho^{YX}_1X_1 + \rho^{YX}_2X_2 + \rho^{YX}_3X_3 + e_1 \quad (1)$$

$$X_3 = \rho^{X_3X_1}X_1 + \rho^{YX_2}X_2 + e_2 \quad (2)$$

$$X_2 = \rho^{YX_1}X_1 + e_2 \quad (3)$$

where:

Y = Willingness to Purchase GM Products
X_1 = GM Products Awareness
X_2 = Consumers' Ethnocentrism
X_3 = GM Products Acceptability

3.0 METHODOLOGY

3.1. Participants and Data Collection

The respondents of the study were chosen from the current list of families obtained from the Community Based Monitoring System on the locality of Poblacion, Trento, Agusan del Sur. Slovin's formula was used in getting the appropriate number of sample size (n = 300) included in the study. Then, a simple random sampling technique was employed to determine the selected respondents.

The data were collected through a direct or interview method for the head of the household from January up to March 2017. The objectives of the study were adequately explained to the respondents to get their full cooperation in providing their honest response. The responses of the respondents were utilized solely for this research as per the recommendation of the Ethics Review Committee. After collecting the data from all of the samples, the data were checked for further analysis.

3.2. Measures

The study used adapted instruments from different respective articles. A modified 10-item questionnaire was utilized from the survey of Tanius and Seng (2015) regarding the level of consumers' awareness of GM products. While, in measuring the consumers' ethnocentrism, a questionnaire from the study of Guerrero, *et al*. (2014) was employed. This consumers' ethnocentrism is defined from the tendencies scale (CETSCALE) that was developed by Shimp and Sharma in 1987. It is the most commonly applied scales nowadays in the marketing literature. Moreover, an instrument from the study of Šorgo *et al*. (2011) in defining the dimension of GM product's acceptability was used. Also, for the level of willingness to purchase GM products among the consumers in Poblacion, Trento, Agusan del Sur, a questionnaire from the study of Yue, *et al*. (2015) was used. Further, an instrument was administered to the respondents and gathered their answers. The respondents indicated their responses using the 5 point rating scale and were interpreted using the Likert Scale shown below.

Table 1. Likert Scale of Descriptive Rating and its corresponding Interpretation of GM Products Awareness, Consumers' Ethnocentrism, GM Products Acceptability and Willingness to Purchase Genetically Modified Products

Rate	Interval	Descriptive Rating among each Research Variable			
		Awareness	Consumers' Ethnocentrism	Acceptability	Willingness to Purchase
5	4.20 – 5.00	Strongly Aware	Very high	Acceptable without any exception	Strongly Willing
4	3.40 – 4.19	Aware	High	Fair with some exceptions	Willing
3	2.60 – 3.39	Moderate	Average	Do not know/ do not have an opinion	Moderate
2	1.80 – 2.59	Unaware	Low	Unacceptable with some exceptions	Unwilling
1	1.00 – 1.79	Strongly Unaware	Very low	Unacceptable without any exception	Strongly Unwilling

4.0 Results and Discussion

4.1. Level of GM Products Awareness

The level of GM products awareness among public consumers is presented in Table 2. The consumers' awareness refers to the combination of the knowledge about the quality of GM products, education about the different forms of risks and problems associated with this product, knowledge about Consumer Rights, and the knowledge about consumers' responsibilities. Based on the table, it obtained an overall average of 3.41. The result means that public consumers are more or less aware regarding the GM products regarding the quality, hazards, consumer rights, and consumers' responsibilities.

Consumer awareness is vital so that buyers can take the right decision and make the right choice. This is the process of making the consumers of goods and services aware of their rights. It involves educating a consumer about safety, information and the redressed options available to them. Besides, the consumers have the right to voice their opinions about the food control procedures, standards, and activities that governments and industry use to ascertain that the food supply has these characteristics. The consumers have the right to expect that the foods they purchase and consume will be safe and of high quality. Thus, increasing the public consumers' awareness of the GM Products should be given priority.

Table 2. Level of GM Products Awareness among the Public Consumers

GM Products Awareness	Average	Descriptive Rating
1. I know what a Genetically Modified (GM) product is.	3.06	Moderate
2. I check the label to determine which product contains with or without GM components.	3.53	Aware
3. I know that the media have the responsibility to inform the public about GM products.	3.57	Aware
4. I know the Philippine government has a more stringent set of regulations to manage the propagation and sale of biotechnology seeds in the country.	3.44	Aware
5. I understand that some agricultural products contain GM components (e.g., rice, corns, soybeans, potatoes, and tomatoes)	3.42	Aware
6. I am aware that some varieties of crops and vegetables contain GM components to resist pests, diseases, and herbicides.	3.37	Moderate
7. Genetically Modified (GM) products are unnatural.	3.35	Moderate
8. The development of GM products has unexpected side effects.	3.45	Aware
9. I have the right to the full labeling of all GM products as a public consumer.	3.42	Aware
10. I have the right to know the ingredients used in GM food production.	3.45	Aware
Overall Average	**3.41**	**Aware**

Source: Adapted Questionnaire from Tanius and Seng (2015)

4.2. Consumers' Ethnocentrism Status

The level of consumers' ethnocentrism is presented in Table 3. The construct of consumers' ethnocentrism relies on the presumption that the consumers' patriotic emotions will have significant effects on attitudes and purchase intentions. Based on the table, it obtained an overall average of 2.30. The result means that public consumers have a low level of ethnocentrism. The consumers who tend to be considerably less ethnocentric are the individuals who have higher educational attainment, those who are young, who are with higher income levels, and those who are male (Balabanis *et al*., 2001; Good & Huddleston, 1995; Sharma *et al*., 1994).

Table 3. Level of Ethnocentrism among the Public Consumers

Consumers Ethnocentrism	Average	Descriptive Rating
1. Filipino consumers who purchase goods that were manufactured in other countries should be accountable for placing their fellow Filipinos out of work.	2.20	Low
2. Filipino consumers should acquire from foreign countries solely those merchandises that cannot be purchased inside the country.	2.24	Low
3. A real Filipino should continually buy country-made products.	2.22	Low
4. Foreign items must be taxed severely to cut back their access into the Philippines.	2.00	Low
5. Foreigners should not be permitted to place their products on the Philippine markets.	2.39	Low
6. Filipinos should not buy different items, because this discomforts Filipino business and causes unemployment.	2.40	Low
7. Filipino people should regularly purchase Philippine-made products instead of imports.	2.40	Low
8. There should be negligible trading or purchasing of goods from other countries except out of need.	2.45	Low
9. Curbs should be implemented on all imports.	2.42	Low
10. Filipino should purchase products made in the Philippines instead of allowing other countries to become rich off about it.	2.33	Low
11. It is permanently best to buy Philippine products.	2.29	Low
12. Philippine products should be selected first, last, and foremost.	2.29	Low
13. Purchasing Philippine-made products is a way to keep the country market system working well.	2.30	Low
14. It can also value me in the long-run, but I opt to aid Filipino products.	2.23	Low
15. It is not correct to purchase foreign products, because it puts Philippine out of jobs.	2.32	Low
16. Only those goods that are inaccessible in the Philippines should be imported.	2.42	Low
17. Patronizing foreign-made products is unbecoming a Philippine citizen.	2.23	Low
Overall Average	**2.30**	**Low**

Source: Adapted Questionnaire from Guerrero *et al*. (2014)

4.3. Acceptability Level of GM Products

The level of GM products acceptability is presented in Table 4. The studies in the developed countries have indicated that GM foods are accepted by the consumers only if these are offered at a significantly low price as compared to non-GM foods (Siegrist, 2008). The consumers in developed countries, particularly in Europe are usually concerned about the unknown risks associated with the GM products rather than being aware of the benefits (Christoph *et al*., 2008, Costa-Font, *et al*. 2008). Numbers of studies in Japan have shown that consumers have difficulty in accepting GM products (Macer and Ng, 2000). Similarly, studies in China indicated that consumers frequently lack awareness about GM foods, and only a few are willing to buy GM foods (Huang *et al*. 2002, Zhong *et al*., 2002). Based on the table, it obtained an overall average of 3.41. The result means that public consumers neither affirmative nor negative in accepting GM products regarding microorganisms, plants, and animals.

Table 4. Level of GM Products Acceptability among the Public Consumers

GM Products Acceptability	Average	Descriptive Rating
Microorganisms	3.49	Acceptable with some exceptions
1. Microorganisms used for natural synthesis in the food industry (e.g., bioethanol)	3.48	Acceptable with some exceptions
2. Microorganisms with the capability to synthesize medicinal substances (e.g., insulin)	3.47	Acceptable with some exceptions
3. Microorganisms with the ability to integrate applicable organic materials (e.g., various organic acids)	3.55	Acceptable with some exceptions
4. Microorganisms that can degrade poisonous or harmful substances before biologically non-degradable	3.46	Acceptable with some exceptions
5. Genetically modified viruses intended for the allocation of genes between organisms	3.50	Acceptable with some exceptions
Plants	3.68	Acceptable with some exceptions
1. Plants with the capability to synthesize medicinal affluence	3.72	Acceptable with some exceptions
2. Plants for animal sustenance that are resilient to pests and pathogens	3.71	Acceptable with some exceptions
3. Ornamental garden plants with new properties (e.g., blue carnations)	3.73	Acceptable with some exceptions
4. Crop plants with amplified tolerance to stress environments (e.g., drought, salinity, etc.)	3.65	Acceptable with some exceptions

5. Ornamental house plants with new properties (e.g., ornamental plants that glow in the dark)	3.60	Acceptable with some exceptions
6. Plants used for producing biofuel	3.82	Acceptable with some exceptions
7. Plants for human food with improved quality characteristics of a fruit (e.g., prolonged cold storage, more intense coloration, etc.)	3.50	Acceptable with some exceptions
8. Plants for human sustenance that are resilient to pests and pathogens	3.70	Acceptable with some exceptions
Animals	3.05	Do not have an opinion/do not know
1. Domesticated animals with new properties (e.g., cats with non-allergenic fur or fish that glow in the dark)	3.11	Do not have an opinion/do not know
2. Animals, for example, goats that produce milk containing medicinal substances (e.g., blood coagulation factor)	2.85	Do not have an opinion/do not know
3. Animals for food consumption having meat with improved characteristics (e.g., meat with low fat or with more intense color)	3.06	Do not have an opinion/do not know
4. Animals raised as contributors for GM organ transplants (repairing or replacing defective organs or tissue)	3.19	Do not have an opinion/do not know
Overall Average	**3.41**	**Do not have an opinion/do not know**

Source: Adapted Questionnaire from Šorgo *et al*. (2011)

4.4. Level of Willingness to Purchase GM Products

Table 5 presents the level of willingness to purchase GM products. Past literature suggested that in contrast to general resistance to GMO that is recognized to the risk roughly with its depletion overshadowing worth benefits (Huffman, Rousu, Shogren, & Tegene, 2004), consumers are inclined to purchase produce that offers improved advantages produced using biotechnology (Colson, Huffman, & Rousu, 2011; Uzogara, 2000). In studies wherein purchasers were requested to choose between a standard farming product and a GM product offering a particular advantage, (for example, enhanced nutritional value), consumers showed a proclivity to buy the GM item and pay a price premium (Colson & Huffman, 2011).

Table 5. Level of Willingness to Purchase GM Products among the Public Consumers

Willingness to Purchase GM Products	Average	Descriptive Rating
1. I am willing to buy food products containing GM ingredients.	1.91	Unwilling
2. I would buy If they were sold at the same prices as foods made without GM ingredients.	3.03	Moderate
3. I would buy If the preferable brand sold them and at the same rates as foods made without GM ingredients.	3.21	Moderate
4. I would buy If they were sold at the same prices by the most preferred brand, and were nutritionally enhanced (more nutrients, better absorption, etc.), compared to foods made without GM ingredients.	3.52	Willing
5. I would buy If they were sold at the same prices by the most preferred brand, and had an improved taste, compared to foods made without GM ingredients.	3.66	Willing
6. I would buy if they were sold at the same prices by the most preferred brand, and caused less pollution during their production, compared to foods made without GM ingredients.	3.80	Willing
7. I am not hesitant in buying GM foods.	4.28	Strongly Willing
8. I would be ready to purchase vegetable oil made of genetically modified soybeans.	3.45	Willing
9. I am prepared to buy GM tomato with enhanced nutritional value.	3.39	Moderate
10. I am ready to buy GM foods if they were less expensive.	3.83	Willing
Overall Average	**3.41**	**Willing**

Source: Adapted Questionnaire from Yue *et al*. (2015)

4.5. Path Analysis of the Willingness to Purchase GM Products

The aptness of the generated model for the said data was evaluated and was tested whether it satisfies the required assumptions for its appropriateness. The study examined the measurement scale of the variables into account that includes the basic statistics such as means, standard deviations, and correlations. The range of values obtained for variables was considered as a restricted range of one or more variables can reduce the magnitude of relationships. The missing data were also recognized as this can affect the path analysis result. A formal statistical test (Mahalanobis distance) was performed for the outliers to be detected as they change the statistics such as means, standard deviations, and correlations. The linearity was considered

(Scatterplots) whether the variables are linearly related, as nonlinearity reduced the magnitude of relationships.

Moreover, non-normality was checked whether the variables are generally distributed since non-normality affects the resulting Path Analysis. The study used the Kolmogorov-Smirnov test in detecting non-normality. After the basic assumptions had been met, data were analyzed through path analysis. The factors positively influencing the Willingness to Purchase GM Products (Figure 2) were the level of GM Products Acceptability and the level of GM Products Awareness. However, the latter was negatively affected by the level of Consumers' Ethnocentrism. The obtained regression coefficients in Figure 2 was specified by (1–3) through multiple regression analysis. It was observed that all of the exogenous variables were significant in the willingness to purchase GM products. Moreover, the GM Products Awareness (0.831*) and Consumers' Ethnocentrism (-0.058*) were significant to the GM Products Acceptability. Further, GM Products Awareness was significantly influenced towards Consumers' Ethnocentrism.

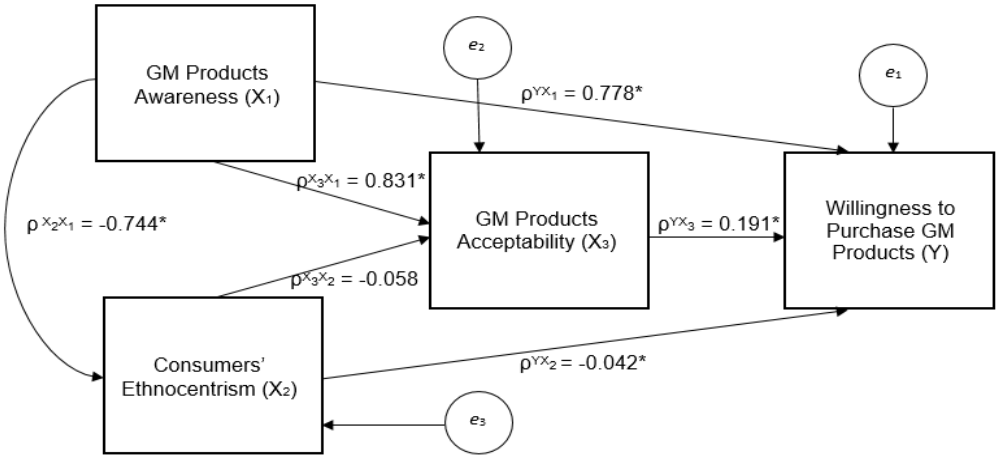

Figure 2. Causal Factor Models Affecting the Willingness to Purchase GM Products

Table 6 shows the calculation of observed correlation for the willingness to purchase a GM product model. The magnitude of the Pearson correlation coefficient determines the strength of the correlation. Although there are no concrete rules for assigning the strength of association to particular values, the study had used the general guideline provided by Cohen (1988):

Coefficient Value	Strength of Association
0.1 < | r | < 0.3	Small Correlation
0.3 < | r | < 0.5	Medium/Moderate Correlation
| r | > 0.5	Large/Strong Correlation

Based on the table, a statistically significant correlation is shown by a likelihood estimation of less than 0.05. This implies that the probability of getting such a correlation coefficient by chance is less than five times out of 100, so the outcome shows the presence of a relationship. The consumers' awareness (X_1) and acceptability (X_3) are factors directly related to willingness to purchase GM products (Y), which obtained *p*-values less than 0.05 level of significance. The strength of association from these variables revealed to have a large/strong correlation. This implies that as the consumers' willingness to purchase GM product increases, as well as their level of awareness and acceptability increases.

Meanwhile, the only factor that is inversely related to willingness to purchase GM products (Y) shown to be the consumers' ethnocentrism (X_2), which obtained a *p*-value less than 0.05 level of significance. The strength of association from these variables revealed to have a large/strong correlation. This implies that the level of consumers' willingness to purchase GM product builds, their level of ethnocentrism diminishes.

Table 6. Calculation of Observed Correlation for the Willingness to Purchase GM Product Model

		X_1	X_2	X_3	Y
X_1	Pearson Correlation	1	**-0.744****	**0.874****	**0.976****
	Sig. (2-tailed)		.000	.000	.000
	N	300	300	300	300
X_2	Pearson Correlation	**-0.744****	1	**-0.677****	**-0.750****
	Sig. (2-tailed)	.000		.000	.000
	N	300	300	300	300
X_3	Pearson Correlation	**0.874****	**-0.677****	1	**0.899****
	Sig. (2-tailed)	.000	.000		.000
	N	300	300	300	300
Y	Pearson Correlation	**0.976****	**-0.750****	**0.899****	1
	Sig. (2-tailed)	.000	.000	.000	
	N	300	300	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

To evaluate the model fit in Figure 2, the obtaining reproduced correlations and by comparing the empirical relationships must be needed to assess the consistency of the model and to determine the reproduced correlation between two variables involves the identification of all valid paths between the variables in the model. The complete set of path decompositions and duplicated relationships in the model shown in Figure 2 is presented in Table 7. Paths consisting only of causal links submitted causal effects, that is, only straight arrows or flow in one direction. Hence, in this study, a direct impact that is a causal path consisting of only one link is denoted by "D", a direct effect consisting of two or more links denoted by "I", and spurious effect that is any path components resulting from paths that have reversed casual direction at some point is denoted by "S".

Table 7. Calculation of Reproduced Correlation for the Willingness to Purchase GM Product Model

Reproduced Correlation	Path Decomposition
$\hat{r}_{12}$	$= \rho^{X_2X_1}$
	$= \mathbf{-0.744}$
	(D)
$\hat{r}_{13}$	$= \rho^{X_3X_1} + (\rho^{X_2X_1})(\rho^{X_3X_2})$
	$= 0.831 + (-0.744)(-0.058) = \mathbf{0.874}$
	$(D) \quad (I)$
$\hat{r}_{1y}$	$= \rho^{YX_1} + (\rho^{X_2X_1})(\rho^{YX_2}) + (\rho^{X_2X_1})(\rho^{X_3X_2})(\rho^{YX_3}) + (\rho^{X_3X_1})(\rho^{YX_3})$
	$= 0.778 + (-0.744)(-0.042) + (-0.744)(-0.058)(0.191) + (0.831)(0.191) = \mathbf{0.976}$
	$(D) \quad (I) \quad (I) \quad (I)$
$\hat{r}_{23}$	$= \rho^{X_3X_2} + (\rho^{X_2X_1})(\rho^{X_3X_1})$
	$= -0.058 + (-0.744)(0.831) = \mathbf{-0.676}$
	$(D) \quad (S)$
$\hat{r}_{2y}$	$= \rho^{YX_2} + (\rho^{X_3X_2})(\rho^{YX_3}) + (\rho^{X_2X_1})(\rho^{X_3X_1})(\rho^{YX_3}) + (\rho^{X_2X_1})(\rho^{YX_1})$
	$= -0.042 + (-0.058)(0.191) + (-0.744)(0.831)(0.191) + (-0.744)(0.778) = \mathbf{-0.750}$
	$(D) \quad (I) \quad (S) \quad (S)$
$\hat{r}_{3y}$	$= \rho^{YX_3} + (\rho^{X_3X_1})(\rho^{YX_1}) + (\rho^{X_3X_1})(\rho^{X_2X_1})(\rho^{YX_2}) + (\rho^{X_3X_2})(\rho^{YX_2})$
	$= 0.191 + (0.831)(0.778) + (0.831)(-0.744)(-0.042) + (-0.058)(-0.042) = \mathbf{0.866}$
	$(D) \quad (S) \quad (S) \quad (S)$

The set of legitimate paths in Table 6 was used to obtain the reproduced correlation that is, making the substitutions of path coefficients in Figure 2. In assessing the fit of the model in Figure 2, it can be gleaned from Table 8 that all of the reproduced correlations have no difference that is greater than 0.05. Hence, those reproduced correlations indicate that the model is consistent with the empirical data.

Table 8. Observed and Reproduced Correlation for the Willingness to Purchase GM Product Model

	X_1	X_2	X_3	Y
Observed Correlation				
X_1	1			
X_2	-0.744	1		
X_3	0.874	-0.677	1	
Y	0.976	-0.750	0.899	1
Reproduced Correlation				
X_1	1			
X_2	-0.744	1		
X_3	0.874	-0.676	1	
Y	0.976	-0.750	0.866	1

Based on the calculation of causal effects of the model presented in Table 9, all of the factors that were considered were significantly related to the willingness to purchase GM Products, and it can be observed that all of the coefficient paths on direct are noble predictors of desire to buy GM Products (i.e., p-values < 0.05). The table further showed that all factors explain about 96.20% of the variance on the willingness to purchase GM Products; hence, about 3.80% could be attributed to the other factors not included in the study.

It was also observed that consumers' GM Products Acceptability was significantly influenced by their Awareness and Ethnocentrism, which yielded an R^2 = 76.6%, and also consumers' ethnocentrism was significantly influenced by their Awareness yielded an R^2 = 54.40%.

Table 9. Summary of Causal Effects for the Willingness to Purchase GM Product Model

Outcome	Determinant	Causal Effects		
		Direct	Indirect	Total
Consumers' Ethnocentrism (R^2 = **0.544**)	GM Products Awareness	-0.744*	---	-0.744
GM Products Acceptability (R^2 = **0.766**)	GM Products Awareness	0.831*	0.043	0.874
	Consumers' Ethnocentrism	-0.058	---	-0.058
Willingness to Purchase GM Product (R^2 = **0.962**)	GM Products Awareness	0.778*	0.182	0.960
	Consumers' Ethnocentrism	-0.042*	-0.011	-0.053
	GM Products Acceptability	0.191*	---	0.191

5.0 Conclusion and Policy Recommendation

The causal factors considered in the study significantly influenced the willingness to purchase GM Products. Thus, it is concluded that consumers' willingness to purchase GM Products is remarkably attributed to their level of awareness, ethnocentrism, and acceptability. Among these factors, the level of awareness found to have the greatest influence on the possible consumers. Generally, consumers are interested in knowing about the newly developed products, especially on the food they consume, including its source and the ingredients that may have been added to it. Hence, it is recommended that the government may increase the public awareness of GM Products through media coverage and exposures. And also, marketers may consider the consumers' awareness, ethnocentrism, and acceptability when designing marketing programs of GM products in developing countries such as the Philippines.

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