Consumer Color Preferences and the Economics of Bean Consumption in Malawi

by

Austin Mbamba

B.S., University of Malawi, 2012

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2019

Approved by:

Major Professor
Vincent Amanor Boadu

ABSTRACT

Different dry bean crop varieties with different colors are produced in Malawi. Yet, little is known about the drivers of consumer preferences for the different dry bean varieties grown based on color. Literature shows that consumers link bean color to taste, cooking time, gravy quality and other desirable characteristics. The main objective of this research was to assess factors that determine consumption of different types of dry beans in Malawi based on color to determine preferences for different consumer segments and hence the potential value of these preferences communicated across the dry bean supply chain, to enhance the probability of success for breeders' efforts and the bean value chain's initiatives.

The research used survey data that was collected by the Bean Value Chain Research Network in Lilongwe District, Malawi. The sample size of the dataset was 687 households from three different economic strata. The research focused on four dry bean colors: Red, Red Mottled, White and Cream Mottled bean. These were found to be the most prominent colors by sales and stated preference in Malawi. Two econometric approaches were used in the data analysis. A bivariate analysis using Pearson's chi-square was used to test the significance of the association between bean consumption (dependent variable) and household as well as product characteristics explanatory variables. A logit model was run on each of the four color types to assess the extent to which the explanatory variables influence consumer preferences for alternative colors of dry bean products.

Results showed that 40.8% of the respondents consumed red beans, 12.6% consumed red mottled, 14.6% consumed White and 32% consumed Cream mottled beans.

In terms of demographic characteristics, respondents' marital and employment status as well as household size were found to have no significant influence the consumption of all the four colors. Being educated decreased probability of consuming white and cream mottled beans. Household characteristics were also found to influence preferences for color. For example, households in low and middle-income households were shown to have a lower likelihood of consuming white beans.

The characteristics of the beans were also important in influencing preferences. For example, medium grain size beans influenced preference for red beans while fast cooking beans negatively affected the consumption of mottled red beans. The results provide insights for bean breeders in their attempts to contribute to increased producer incomes through a careful response to consumer preferences and not just producer demands for agronomic traits.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

I would like to thank the Master of Agribusiness faculty and staff for their time and tireless efforts. Special thanks goes to Deborah Kohl and Mary Bowen for always being supportive and always there when needed. I would also like to acknowledge Dr. Allen Featherstone for his support during the program.

I thank Dr. Vincent Amanor-Boadu for his tireless efforts in guiding me to complete the thesis timely and also ensuring that it is of the at most acceptable quality. I also thank Dr. Lawrence Mapemba for his encouragement and support throughout the whole program. I thank the Bean Value Chain Research Network, a project funded by the Legume Innovative Laboratory, a USAID Innovation Laboratory, for providing the financial support to pursue this degree.

I thank Dr. Kara Ross, who served not only as my committee member but as an advisor and guide, especially with the data used for this research. I also thank my MAB classmates of Class 2019. Everyone was very welcoming and supportive whenever I needed them. Special thanks goes to my family for their support during the whole process and more especially my brother, Victor Mbamba, who offered support whenever needed so I could complete the thesis timely. In all things, God is good!!!

CHAPTER I: INTRODUCTION

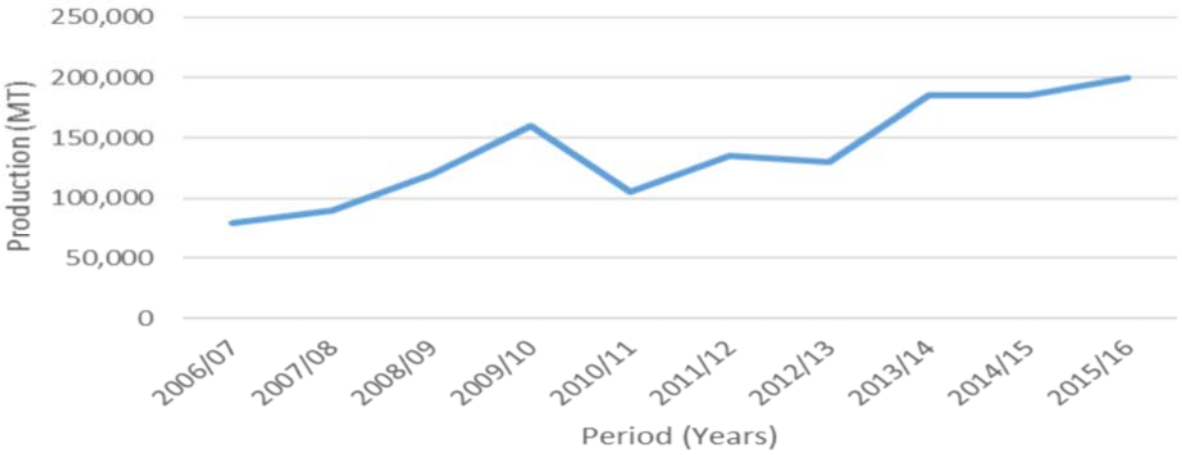
1.1 Background Information

Malawi is a small country located in the southern part of Africa with an estimated land area of 11.8 million hectares, of which approximately 56 percent is cultivable. The Malawi economy is characterized by a high dependence on agriculture and a narrow industrial base. The agricultural sector currently accounts for about 36 percent of the country's $.5.4 billion GDP and 80 percent of export earnings (Chalira 2010).

Legumes are an important crop in Malawi's agriculture. Malawi produces a variety of legumes such as pigeon peas, cowpeas, soybean and groundnuts. One of the most common dry legumes that are produced in the country and contributes to the GDP is the Common Dry bean, *Phaseolus Vulgaris* (Chirwa and Phiri 2014). The common dry bean being one of the most important leguminous crops grown by farmers in Malawi, is commonly eaten as an accompaniment to maize, the main staple food (CIAT 2007). Farmers usually produce a wide range of bean varieties that vary in grain size, color, and shape (Chirwa and Phiri 2014). As a high value cash crop, it also provides a good source of income in addition to contributing to household food security for many Malawians.

Figure 1.1 shows the trend in dry bean output in Malawi between 2006 and 2016. Bean output has been on the increase due to different organizations, including Non-Governmental Organizations (NGOs) as well as government advocating for bean production, especially due to its nutrition content and the role it plays in fixing fertility in farm lands (AICC 2016).

Figure 1.1: Bean Production Trend in Malawi



Source: AICC, 2016

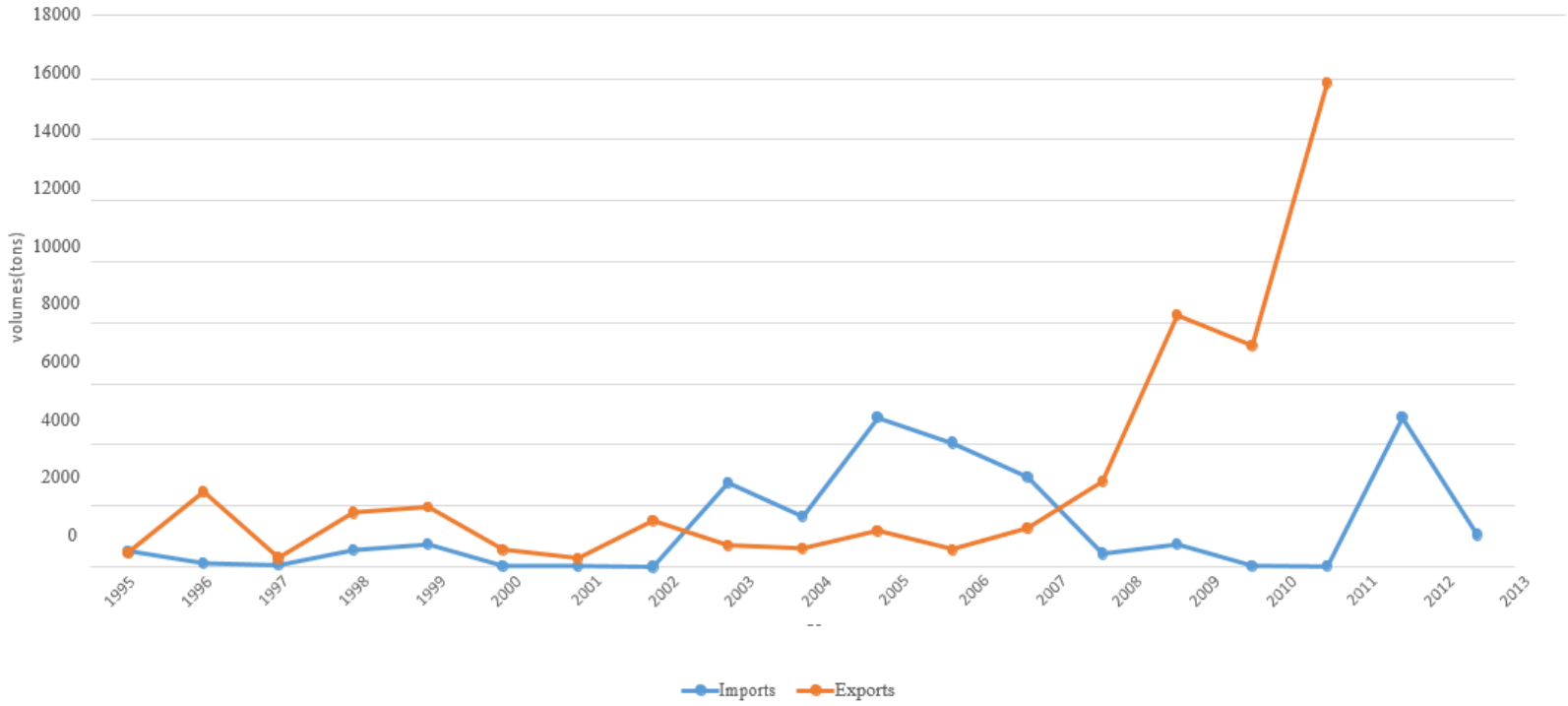
However, despite the increase in output over the years, the area utilized for growing common beans production is only about 3% (203,700ha) of cultivable land in Malawi and less than 1% of the hectare-age allocated for dry beans production in Africa. As such, despite being an important crop, production may still be considered to be relatively on the lower side. Production of dry beans has not increased as expected since the expansion of irrigated land pushes pulses into marginal zones with the better land used to grow high yielding varieties of cereals (AICC 2016). If policies can be put in place to increase dry bean production, it would help in achieving food security while at the same time alleviating poverty when farmers market their dry bean produce. However, this underlines the significance of producing dry bean types that are preferred and can easily be marketed by different consumers.

1.2 Common Dry Bean Color Varieties Grown in Malawi

Common dry bean color varieties grown in Malawi include red, red mottled, white, cream mottled, green, brown, black and purple beans. All the varieties are grown throughout Malawi, in areas between 1000 and 1700 meters above sea level, with annual rainfall ranging from 800 mm to 1500 mm. However, along the lakeshores and in the Shire Valley, beans are cultivated less because the crop does not adapt there. Such bean varieties are mostly grown under various farming systems, including pure crop, mixed crop (usually with maize), relay crop after maize, in household gardens, on residual moisture, under irrigation after a rice crop, and in alleys of tree crops (Petautchere 2015). The research focused on four colors: Red, Red Mottled, White and Cream mottled. These colors are the most popular based on sales and stated preference in Malawi (Chirwa and Phiri 2014).

Figure 1.2 below shows import and export figures of common dry beans from 1995 to 2013. From 1995 to 2013 imports of beans had been below 200MT while exports increased especially from 2007 to 2013. This is attributed to the export operations of such companies as Demeter Malawi which exported beans to other countries like South Africa.

Figure 1.2: Common Bean Imports and Exports in Malawi from 1995-2013



Source: Mapemba, Mazunda, & Moyo, 2016

Beans are an important legume crop since they are an important source of protein for many people both in rural and urban areas, especially those who cannot afford animal protein (Beeb 2008). Thus, bean consumption is important in the sense that it has high potential in alleviating hunger and food security challenges in the country as well as malnutrition problems (Petautchere 2015).

Over the years, a lot of effort has been put in research for development to improve bean varieties, so that farmers have access to better and more productive bean varieties. In that regard, farmers grow a wide range of varieties, and part of their produce is sold in the markets. Nevertheless, very little is known about consumer preferences which influence choice of bean variety in relation to its color in the market. It is also a known fact that bean varieties have different characteristics that could in one-way or another determine their attractiveness to consumers (Chirwa and Phiri 2014).

1.3 Problem Statement

Different dry bean crop varieties are produced in Malawi. Organizations like National Smallholder Farmers Association of Malawi (NASFAM) and Farmers Union of Malawi (FUM) encourage farmers to produce these leguminous crops as a way of improving soil fertility, to enhance food and nutrition security, and to increase farmers' incomes. Consumers provide the final step in farmers' ability to achieve the foregoing objectives. Yet, little is known about consumer preferences for the different dry bean varieties grown. Without this knowledge about consumer preferences, bean breeders have been working to enhance characteristics they believe are useful, usually agronomic characteristics such as yield and pest resistance. However, no matter how successful they are in their efforts, if consumers do not choose to consume these products, the whole chain

fails. If preferences can be determined for different consumers and the potential value of these preferences communicated across the dry bean supply chain, it will be possible to enhance the probability of success for breeders' efforts and the bean value chain's initiatives. Hence this study seeks to determine the predictors of consumption of different bean varieties based on color.

1.4 Objectives of the Study

The literature shows that consumers link bean color to taste, cooking time, gravy quality and other desirable characteristics. The main objective of this research is to assess factors that determine consumption of different types of dry beans in Malawi based on color. The specific objectives are as follows:

1. Determine the demographic and product characteristics influencing consumer preferences for alternative colors of dry bean products.
2. Compare the extent to which different demographic and product characteristics influence preferences for the alternative dry bean products.
3. Use the results to inform the upstream supply chain in the bean industry on breeding, producing and marketing different bean products in Malawi.

CHAPTER II: LITERATURE REVIEW

This chapter presents both theoretical and empirical literature review pertaining to the determinants of dry bean consumption. The theoretical literature reviewed focuses on consumer and random utility theories. The empirical literature reviewed focuses on studies assessing the impact of demographic and product characteristics on the consumption of dry bean varieties based on color in Malawi and other countries.

2.1 Theoretical Literature

2.1.1 Lancaster's Theory of Consumer Choices

Lancaster (1966) provides the seminal development in consumer demand. He describes, in his new approach to consumer theory, a view that deviated from the traditional concept that goods are the direct objects of utility. That is, goods are just goods, and consumers are rational in their choices. Lancaster proposed that utility is derived from the intrinsic properties and characteristics of goods. He argues that consumption is an activity in which goods, singly or in combination, are inputs and in which the output is a collection of characteristics. Thus, utility or preference comparisons may be ranked on the collections of characteristics that goods possess (Lancaster 1966). The primary assumptions of Lancaster's new approach are summarized as follows:

1. The good per se, does not give utility to the consumer but possesses characteristics which give rise to utility.
2. A good will possess more than one characteristic, and many characteristics will be shared by more than one good.
3. Goods in combination may possess characteristics different from those pertaining to the goods separately.

The New Consumer Theory provides the primary context in which this research is constructed. We focus on color as an intrinsic characteristic of dry beans and assess how it influences consumer

preferences. In this sense, the color of the product is a proxy for its collective intrinsic characteristics, such as cooking time and taste. In other words, red beans may be preferred to white beans because they cook faster and produce better gravy consistency. Likewise, yellow beans may be preferred to brown beans because they tend to be small grain and taste better.

2.1.2 Random Utility Theory

The random utility theory assumes that individuals are rational and will select the highest utility-yielding alternative (Hall, Haas and Louvriere 2004). Thus, the probability of selecting a particular alternative increases with the utility it provides compared to its alternatives. The utility, U of an individual *i,* achieved from the consumption of a product *j*, may be represented as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{0.1}$$

where V_{ij} is the deterministic indirect utility function and ε_{ij} is the stochastic portion of the utility, assumed to be independently and identically distributed (iid). The deterministic portion of Equation (2.1) is assumed to be a linear function of independent variables expressed as:

$$V_{ij} = X_{ij}^{'}\beta_j \quad \forall\, i = 1,2,...N;\ j = 1,2,...J \tag{0.2}$$

where $X_{ij}^{'}$ is a vector of observable variables, *j*, for each individual consumer, *i*. The β_j is the vector of estimated coefficients of the observable variables. The probability (Pr) of Consumer *i* choosing Product *j* in a choice task with *k* alternatives may be expressed as:

$$\begin{aligned} \Pr(j) &= \Pr(U_{ij} > U_{ik}) \\ &= \Pr(V_{ij} + \varepsilon_{ij}) > \Pr(V_{ik} + \varepsilon_{ik}) \quad \forall\ j \neq k \end{aligned} \tag{0.3}$$

Pr (j)=Prob(Uij>Uik) $\forall j \neq k$ =Prob(Vij+ εij>Vik+εik) $\forall j \neq k$

With the Random Utility Theory, it can be assumed that a consumer will choose the bean type that maximizes utility with respect to the different individual and product characteristics among different alternative choices of bean types. For instance, if both red beans and red mottled beans

are seen to be fast cooking beans among the alternative bean types, if red beans cook faster than red mottled beans, then a consumer will choose to consume red beans if fast cooking time is a significant character that influences his choice.

2.2 Empirical Literature Review: Factors Influencing Food Consumption

Different factors influence food choice and consumption. The Lancaster theory suggests that these factors may be intrinsic and/or extrinsic. The latter include demographic and socio economic variables such as education and household size. The education level of household heads is especially important (Mor and Sethia 2005).

2.2.1 Demographic Factors

The research looked at a number of demographic factors such as age of food decision maker in a household, the size of the household, the area of residence, marital status of the food decision maker, employment status of the food decision maker and the household tradition or culture concerning bean consumption.

Literature shows that geographical area of a household, size of the household, culture, marital status of the household head or food decision maker as well as employment status of the household head or food decision maker can have either a positive or negative influence on choice of food consumption in a household (Devine, et al. 1999).

Literature shows that for red kidney and red mottled beans there is a positive association between gender and choice of the two dry common bean varieties. Female respondents are more likely to choose red kidney and red mottled beans compared to male respondents (Tumeo, et al. 2017). This may be attributed to their good cooking properties, since women are the ones mostly involved in food preparation in the households (Katungi 2011).

According to Fanning, Marsh and Stiegert (2002), household size is positively associated with the probability of consuming a particular food product. In the research it was found that the probability of consuming fast foods increased as household size increased up to 7, and then decreased.

In research conducted in America on factors affecting dry bean consumption, it was found that low-income Americans consume more cooked dry beans than their better-off counterparts, where with respect to household income measured against the federal poverty level, households less than the 130 percent of the poverty level (cut off line for food stumps eligibility) represented 19 percent of the U.S population and consumed 27 percent of all cooked dry beans, thus lower income Americans consumed more beans than their better-off counterparts (Lucier, et al. 2000). Income offers an opportunity of widening the range of consumption options. It gives people the ability to buy diverse, nutritious foods instead of eating only their own crops, at the same time giving them more disposable income for expenditure on other luxuries they could not afford in the first place. The increasing dependence of much consumption on private income means that changes in income have a dominant influence on changes· in consumption. When incomes rise, all other things remaining unchanged, food consumption rises but at a decreasing rate. For the same reason, when incomes decline, consumption falls sharply, with devastating consequences for human well-being (Mor and Sethia 2005).

In that respect, income changes are expected to influence bean consumption. Beans in most cases are considered a poor man's meat (Tharanathan and Mahadevamma 2003). In that regard, it is expected that as income levels increase in households or individuals, the share of beans in food consumption will decrease as consumers substitute animal products for beans as they escape poverty.

Tumeo et al. (2017) found that educational attainment variables denoting primary, secondary, vocational training, and university significantly influenced choice and quantities of dry common beans consumed, for instance, quantities of red kidney beans consumed increased with an increase in education level. Thus, there is a positive association between education and consumption of dry common beans.

2.2.2 Product Factors

Product factors included in the research were bean price, grain size, gravy quality and cooking time of beans. A research in Zambia on factors affecting bean consumption and choice found that cooking time and gravy quality influenced consumption in such a way that slow cooking time decreased probability of consuming beans by 25.1% while poor gravy quality decreased probability of consumption by 92.1% (Mwiinga and Tembo 2017). Tumeo et al. (2017) found that individuals/households were more likely to consume red kidney beans if the grains were medium sized. Medium sized grains influenced consumption of red kidney beans where medium and large grains were associated with 0.86 and 0.56-kilogram increase in consumption of white beans. Cooking time was also found to significantly influence choice of common beans. Respondents were more likely to choose red mottled beans that were fast cooking. Good gravy quality significantly influenced choice of red kidney beans. Respondents were more likely to choose red kidney beans if the gravy was of good quality.

In a study on drivers of dry common beans trade in Lusaka, Zambia (Sichilima, Mapemba and Tembo 2016) it was revealed that yellow color would significantly fetch a higher price by ZMW1.28 and ZMW1.081 than mottled grain. Similarly, white and yellow color was also found to significantly affect the price for beans; white and yellow color increases the pricing of common

beans by ZMW1.58 and ZMW1.788 more than mottled beans. Thus, color is significant in determining price of beans on the market.

In as much as color is seen to influence prices on the market for different bean varieties, the research explored the extent to which price influences preferences of such bean types, in line with the demographic and product characteristics of different types of dry bean according to color.

CHAPTER III: DATA AND METHODS

This chapter discusses the data and methods used to conduct the analyses. It has two sections: the first section discusses the sources of data and tools used and the second section specifies the models used to conduct the econometric analysis.

3.1 Data

The research used data collected by the Bean Value Chain Research Network. The Bean Value Chain Research Network is a collaborative research initiative comprising Lilongwe University of Agriculture and Natural Resources, Sokoine University of Agriculture, University of Zambia and Kansas State University.[1] The Bean Value Chain Research Network was sponsored by US Agency for International Development (USAID)'s Legume Innovation Laboratory, which was managed by Michigan State. The objective of the Legume Innovation Laboratory was to contribute to poverty reduction, food and nutrition security and economic development in Sub-Saharan Africa and Latin America through knowledge and technology generation. In its collaborative research and outreach arrangements with participating US and host country institutions, the legume Innovation Laboratory sought to achieve the foregoing objectives through productivity enhancements in production and across legume value chains and transfer. Its product scope was grain legume (dry beans, cowpeas, tepary beans, etc.).

The Bean Value Chain Research Network survey in Malawi was one of three such surveys conducted in Malawi, Tanzania and Zambia in 2015. The survey used a structured

[1] The principal investigator at Kansas State University (PI) for the Bean Value Chain Research Network was Dr. Vincent Amanor-Boadu and host country investigators were Dr. Lawrence Mapemba (Malawi), Dr. Fredy Kilima (Sokoine University of Agriculture) and Dr. Gelson Tembo (University of Zambia). The project's co-PIs at Kansas State University were Dr. Kara Ross and Dr. Allen Featherstone. The project ran from 2013 through 2017.

questionnaire and was administered to a sample of 687 respondents in Lilongwe District. The sampling was done using a two-stage sampling approach. The first stage involved purposively selecting specific areas in the district with known income characteristics. These formed the strata: Low Income; Medium Income and High Income Areas.[2]. For the high income stratus, the selected areas were Areas 3, 9, 10 and 43. The medium income areas selected Areas 6, 12, 14 and 47and the low income areas encompassed Areas 8, 18, 21, 23, 36 and 49. Figure 3 below is a map showing locations of these areas in Lilongwe City. The second stage involved a random sampling of households in the selected areas. The Lilongwe District was selected for this study because it was representative in its demographics of other large cities in the country and presented the most potentially viable market for dry common beans and bean products (National Statistical Office 2008).

[2] These strata corresponded to the area's population density in reverse, i.e., high income corresponded to low population density and low income correspondent to high population density.

Figure 2.1: Map of Lilongwe City

Source: The Eye Magazine (http://www.theeyemw.com/lilongwe%20map.html). Accessed April 12, 2017.

3.2 Conceptual Model Specification

Two econometric approaches were used in the analysis; a bivariate analysis using Pearson's chi-square, and a logit model.

3.2.1 Pearson Chi-square Statistic

Pearson chi-square statistic was performed to test the significance of the association between dependent variable and the explanatory variables. Chi-square test of independence was conducted for categorical variables, and is given as:

$$\chi^2 = \sum_{j=1}^{J} \frac{(f_j - h_j)^2}{h_j} \tag{1.1}$$

where f_j and h_j are the observed and expected (theoretical) counts respectively, for the different categories, *j*, evaluated for values ranging from 1 to *J*.

3.2.2 Logit Model

A number of variables on demographic characteristics of households and product characteristics were assessed if they influence consumer preferences for alternative colors of dry bean products and to compare the extent to which these characteristics influence preferences for the alternative dry bean products depending on color, with a focus on value chain development since research has shown that beans is among the highly consumed food substances in Malawi (Chirwa and Phiri 2014).

$$Yi = \begin{cases} Red\ beans \\ Red\ Mottled\ beans \\ White\ beans \\ Cream\ mottled\ beans \end{cases}$$

The response variable, Y_i, is consumption preference of a bean type which the i^{th} consumer/household maximizes. Suppose the utility of choosing Alternative *j* is defined mathematically as follows:

$$U_{ij} = X_{ij}^{'}\beta_j + \varepsilon_{ij} \quad (1.2)$$

where all variables are as defined. The i^{th} consumer chooses Bean Alternative j^{th} if such type offers maximum benefit/utility. The model works in assumption that a household either consumes a particular bean type, or not. Thus, if it consumes, then $Y_i > 0$ or else $Y_i = 0$ if a bean type is not consumed. If a particular bean type is consumed, the model calculates probabilities of a household preferring that bean type according to color with respect to the different Product characteristics and household demographic characteristics. Formulating a linear regression model yields

$$y = X\beta + e \quad (3.3)$$

where *e* represents unknown error terms and β are parameters to be estimated. A logit model is specified to identify the relationship between household/product characteristics and the likelihood of consuming a particular bean type. The probability of consuming a bean type is modeled by

$$P(Y_i = 1) = \frac{e^{\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}}}{1 + e^{\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}}} \quad (3.4)$$

In equation 3.4, K represents explanatory variables explaining probability of consuming a bean type. The logit model was run four times for each of the four types of beans.

3.2.3 Diagnostic Tests

Robust Standard errors were estimated to deal with heteroscedasticity problem as it causes standard errors to be biased. Ordinary Least Squares (OLS) assumes that errors are

both independent and identically distributed; robust standard errors relax either or both of those assumptions. Hence, when heteroscedasticity is present, robust standard errors tend to be more trustworthy since the test statistics will give you reasonably accurate p-values (Williams 2015)

For multicollinearity problem to which most categorical variables are prone to have, Pair-Wise Colleration Analysis (PWCA) was employed to detect multicollinear variables. Multicollinearity problem in estimation leads to large standard errors hence can mislead hypothesis testing (Studenmund 2016)

3.2.4 Interpretation of Results

In order to obtain information on how the probabilities respond to changes in the explanatory variables, marginal effects were computed in Stata since the estimated coefficients (or exponentiated coefficients expressed as odds ratios) are often difficult to interpret from a practical standpoint. Empirical economic research often reports 'marginal effects', which are more intuitive (Bogard 2016). Equation 3.5 below shows its calculation, where j is the consumption choice

$$\frac{\partial p(Y_i = 1)}{\partial X_{ji}} = \frac{e^{\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}}}{\left(1 + e^{\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}}\right)^2} \beta_j \qquad (3.5)$$

3.3 Description of Variables

3.3.1 Dependent Variables

In this study, four dependent variables were used based on the type of bean color consumed: those who chose to consume red beans, those who consumed red mottled beans, those who consumed white beans, and those who consumed cream mottled beans.

3.3.2 Independent Variables

Table 3.1 shows the independent variables on demographic characteristics of households that were included in the model.

Table 0.1 Individual/ Household Characteristics

Variable	Description of Variable	Expected Sign
Age	Age of household food decision maker	(+)
Gender	Gender of household food decision maker presented as a dummy variable; female respondents (0/1)	(+/-)
Education status	Education Status of household food decision maker. This is classified into the following 2 dummy variables 1. No education (0/1) 2. Educated (0/1)	(+/-)
Household size	Number of members of the household	(+)
Area of Residence (Population density)	Location of the household classified according to income levels and population density. These are presented as dummy variables; 1. Low density/high income areas (0/1) 2. Middle density/middle income areas (0/1) 3. High density/low income areas (0/1)	(+/-)
Marital Status	Marital Status of the household decision maker 1. Single (0/1) 2. Married (0/1)	(+/-)
Employment	Employment of the food decision maker 1. Unemployed (0/1) 2. Employed (0/1)	(+/-)
Tradition/culture	Culture or traditions associated with beans eating in a household	(+/-)

Table 3.2 show the independent variables on product characteristics that were included in the model.

Table 0.2 Product Characteristics

Variable	Description of Variable	Expected Sign
Effect of Price	Effect of Price on preference of bean type according to color	(-)
Cooking time	Length of time taken to cook, presented as dummy variables 1. Fast cooking time (0/1) 2. Slow cooking time (0/1)	(+)
Gravy Quality	Quality of gravy after cooking presented as dummy variables 1. Good quality (0/1) 2. Poor Quality (0/1)	(+)
Grain size	Grain size of the bean presented as dummy variables 1. Small grain size (0/1) 2. Medium grain size (0/1) 3. Large grain size (0/1)	(+)

CHAPTER IV: RESULTS AND ANALYSIS

This chapter presents and discusses the main findings of the research. The first section presents the results of diagnostic tests. The second section provides the summary statistics of the variables used in the study. The third section provides the results of the bivariate analysis of the variables that are included in the logit models. The final section provides results of the logit models where the significant explanatory variables are discussed.

4.1 Results of Diagnostic Tests

Diagnostic tests were carried out to check that estimation and statistical inferences of the models are made with accuracy. All the variables were tested for multicollinearity using pair-wise correlation analysis and none of the correlation coefficient between any two variables was greater than 0.8. This indicates that multicollinearity is not a serious problem. Any possible heteroskedasticity problem was corrected for by using robust standard errors.

4.2 Summary Statistics

The research found that 40.8% of the respondents consumed red beans, 12.6% consumed red mottled, 14.6% consumed White and 32% consumed Cream mottled beans. Table 4-1 shows summary statistics of household and product characteristics that were analyzed in the study. Due to the nature of the data, most of the variables were binary and this presented a high possibility of having a problem of dummy variable trap. Dummy variable trap which is also known as perfect multicollinearity happens when all categories of one variable are included in a model as explanatory variables (Studenmund 2016). For instance, in this paper on grain size the variable had multiple categories namely; small, medium and large. Including all these categories in the model as explanatory variables, the

dummy variable trap would result. To deal with this problem, one category was used as a reference category and as such not included in the model.

Table 0.1 Descriptive Statistics of Individual/Household and Product Characteristics

Variable	Mean	Std. Dev.	Min	Max
Age (years)	36.85277	13.11411	14	84
Gender (female)	0.850148	0.357191	0	1
Culture of Eating Bean types				
Red Beans	0.245997	0.430991	0	1
Red Mottled Beans	0.085881	0.280392	0	1
White Beans	0.074236	0.262345	0	1
Cream Mottled Beans	0.07278	0.259965	0	1
Education Status (Educated)	0.954876	0.207727	0	1
Marital Status (Married)	0.723435	0.447625	0	1
Household size	5.091703	2.059332	1	14
***Employment Status* (Employed)**	0.624454	0.484616	0	1
Area of Residence				
Low density	0.851528	0.355826	0	1
Middle density	0.081514	0.273822	0	1
High density	0.062591	0.242402	0	1
Grain Size				
Small Grain Size	0.54294	0.498516	0	1
Medium Grain Size	0.110626	0.313897	0	1
Large Grain Size	0.637555	0.481057	0	1
Gravy Quality				
Good Gravy	0.80786	0.394269	0	1
Poor Gravy	0.197962	0.398754	0	1
Cooking time				
Cook Fast	0.813683	0.389646	0	1
Cook Slow	0.240175	0.427501	0	1
Effect of Price of Beans				
Price of Red Beans	0.094614	0.292895	0	1
Price of Red Mottled Beans	0.050946	0.220048	0	1
Price of White Beans	0.085881	0.280392	0	1
Price of Cream Mottled Beans	0.052402	0.222998	0	1

4.3 Results of Bivariate Analysis using Chi-square

The analysis reveals the association between individual/ household and product characteristics with the dependent variable of bean consumption according to color. Table

4.2 shows the explanatory variables that have a significant association with bean consumption according to the bivariate analysis results using Chi-square (for the full output results see appendix B). The results show that Red bean consumption has a significant association with household tradition of eating red beans, residence of a household and price of red beans at 1% significance level while grain size was at 5% significance level. The consumption of red mottled beans has a significant association with tradition of eating red mottled beans and price of red mottled beans at 1% significance level. For white beans, gender of household decision maker, tradition of eating white beans, marital status of the food decision maker and price of white beans have significant association at 1% level while household size and education at 10% level. The association of consuming cream mottled beans with tradition of eating Cream Mottled Beans, education status of food decision maker and Effect of price is significant at 1%.

Table 4.2 Bivariate Chi-square results at different levels of significance

Bean Type	Variables Significant at 1%	Variables Significant at 5%	Variables Significant at 10%	Chi-square	P-Value
Red	Tradition of eating Red Beans			9.6732	0.002
	Residence (locale)			26.0963	0.000
	Price of Red Beans			10.3361	0.001
		Grain Size		6.286	0.043
Red Mottled	Tradition of eating Red Mottled beans			60.5222	0.000
	Price of Red Mottled Beans			50.0591	0.000
White	Gender			7.1021	0.008
	Tradition of eating White Beans			44.2335	0.000
	Marital Status			3.8081	0.051
	Price of White Beans			82.7615	0.000
			Household size	19.7101	0.073
			Education of Household Food Decision Maker	3.6593	0.056
Cream Mottled			Gender	3.3471	0.067
	Tradition of eating Cream Mottled Beans			43.1949	0.000
	Education Level			8.8795	0.003
	Price of Cream Mottled Beans			49.4317	0.000

The chi-square (χ^2) distribution is used as the measure of overall significance of a model in the logit model estimation. The results indicate that not all the variables that were included explaining choice of consumption fit the model well, where only the variables in table 4-3 do fit the model. Nevertheless, all the variables including employment status, gravy quality and cooking time of beans were run in the models as literature shows they can have influence on choice of food consumption.

4.4 Logit Model Estimate Results

All explanatory variables that were significant in the Chi-square analysis were included in the logit models. Additionally, all the other variables that were not significant were also included in the logit model because according to Devine, et al. (1999) and Fanning, Marsh and Stiegert (2002) such variables turned out to be significant in the logit model even though they were not significant in the Chi-square analysis.

Results of the logit model analysis in Table 4.3 show goodness of fit of the four logit models based on the p-values. For all the models, the results show that they fit very well at 1% level of significance. This implies that the joint null hypothesis of coefficients of all explanatory variables included in the model are zero is rejected at less than 1% level of significance.

Table 0.3 Overall Fitness of the 4 Models

	Red	Red Mottled	White	CRM Mottled
Wald chi2 (15)	46.21	95.02	95.79	480.11
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1043	0.1459	0.1687	0.1348

The parameter estimates of the Logit model provide only the direction of the effect of the independent variables on the dependent (response) variable. Estimates do not represent actual magnitude of change or probabilities (see Appendix A). Hence the marginal effects from the Logit models, which measure the expected change in probability of a particular choice being made with respect to change in an independent variable, are discussed in section 4.5.

4.5 Discrete Changes in Predicted Probabilities

4.5.1 Discrete Changes in Individual/Household Characteristics

Table 4.4 presents the marginal effects of a change in the predicted probabilities along with the levels of statistical significance.

Table 0.4 Marginal Effects Results of Logit Models

Variables	Consumption of Beans by Color Type Marginal Effects			
	Red beans	**Red Mottled beans**	**White beans**	**Cream Mottled beans**
Individual/Household Characteristics				
Age, years	0.000293	-0.00161	-0.00280*	-0.00343**
	(0.000922)	(0.00151)	(0.00154)	(0.00168)
Gender				
Female	0.00544	-0.0183	-0.116**	-0.0911
	(0.0355)	(0.0540)	(0.0502)	(0.0570)
Culture of Eating Beans	0.0818***	0.487***	0.474***	0.475***
	(0.0232)	(0.0655)	(0.0739)	(0.0668)
Education Level				
Educated	0.00356	-0.0979	-0.173*	-0.314***
	(0.0564)	(0.0947)	(0.0906)	(0.106)
Marital Status				
Married	0.00972	0.0193	-0.0446	-0.0329
	(0.0279)	(0.0424)	(0.0387)	(0.0454)
Household size	0.00172	0.0121	-0.00413	-0.00389
	(0.00587)	(0.00959)	(0.00903)	(0.00968)
Employment Status				
Employed	0.00754	0.000358	0.0353	0.0539
	(0.0255)	(0.0419)	(0.0376)	(0.0422)
Area of Residence				
Low density	0.161	-0.250	-0.287	0.686***
	(0.193)	(0.260)	(0.297)	(0.0307)
Middle density	0.0331	-0.144	-0.165*	0.863***
	(0.0901)	(0.136)	(0.0944)	(0.0122)
High density	-0.0670	-0.170	-0.166*	0.842***
	(0.161)	(0.117)	(0.0876)	(0.0133)
Product Characteristics				
Grain Size				
Medium Grainsize	0.0664**	0.0413	0.0682	-0.0224
	(0.0290)	(0.0653)	(0.0678)	(0.0632)
Large Grainsize	-0.0746***	0.0485	0.0233	-0.0227
	(0.0284)	(0.0490)	(0.0452)	(0.0511)
Gravy Quality				
Good Gravy	0.0335	-0.0324	-0.0350	-0.0527
	(0.0506)	(0.0939)	(0.0796)	(0.0911)
Cooking Time				
Cook Fast	-0.0393	-0.258**	-0.140	-0.0255
	(0.0374)	(0.100)	(0.0863)	(0.0812)
Effects of Price of Beans	0.126***	0.531***	0.534***	0.584***
	(0.0215)	(0.0782)	(0.0656)	(0.0655)
Observations	**673**	**673**	**673**	**673**

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Results show that age has a significant effect on choice of consumption of cream mottled beans and white beans. Increasing in age decreases probability of consuming white beans by 0.28% and that of Cream Mottled beans by 0.34%. This may be attributed to the fact that people are becoming more aware of healthy eating habits and lighter colored beans are less nutritious than the red colored beans (Lee 2017).

It was also found that being female decreases probability of consuming white beans by 11.6%. This is in line with the findings of Katungi et al (2011) where it was found that most women's preference of growing light colored beans was low due to yield content.

Culture of eating beans has been found to significantly influence choice of bean consumption basing on color. It was found that culture of consuming a type of bean according to color increased the probability of choosing to consume red beans by 8.2%, red mottled beans by 48.7%, white beans by 47.4% and cream mottled beans by 47.5%. Education status had a significant negative influence on choice of consumption of Cream Mottled beans and White beans whereby being educated decreased probability of consuming Cream Mottled beans by 31.4% and White beans by 17.3%. These findings are similar to the findings of Kearney, et al. (2000) who found that education has significant influence on consumption of beans due to awareness of healthy eating habits, and color of beans denotes nutrition content of the beans, for instance red beans are seen to be more nutritious than lighter (White and Cream mottled) beans (Lee 2017).

Marital status of the household food decision maker was found to not have significant influence on probability of consuming any of the bean colors. Household status and Employment status of the food decision maker as well were found to have no significant influence on probability of consuming all the four color types.

Area of residence had a significant influence on choice of red bean consumption, where households residing in low density areas increased probability of choosing Cream Mottled beans by 68.6% while those in middle density areas increased probability of choosing Cream Mottled beans by 86.3% while decreasing probability of choosing White beans by 16.5%. Living in high density but low income areas increases probability of choosing Cream Mottled beans by 84.2% while decreasing probability of choosing White beans by 16.6%. This is in line with a research done in the U.S.A on Determinants of fast food consumption which indicated that the geographical location of a household has influence on choice of food consumption (Fanning, Marsh and Stiegert 2002).

4.5.2 Discrete Changes in Product Characteristics

On product characteristics, grain size, cooking time and price were found to significantly influence choice of bean type according to color. Medium grain size increased probability of choosing red beans by 6.6% while large size decreased probability of choosing to consume red beans by 7.5%, of which this may be attributted to the reason that size has an impact on cooking time, where large size takes comparatively longer time to cook (Wani, et al. 2017).

Cooking time decreased probability of choosing fast cooking red mottled beans by 25.8%. This may be due to the reason that slow cooking beans are creamy and tender. Influence of Price was significant on choice of all four colors, with the greatest influence in cream mottled beans where a subjectively acceptable price increases probability of choosing by 58.4%. The data on price was in a dummy form where respondents were asked if price was a factor in their choice of bean type or not. Effect of price had the least

influence in choice of red beans, where an acceptable price increased probability of choosing by 12.6%.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary and Recommendations

The research was motivated by lack of literature on consumer preferences of dry bean consumption with respect to different colors. In Malawi different dry bean crop varieties with different colors are produced and yet, little is known about the drivers of consumer preferences for the different dry bean varieties grown based on color. Literature shows that consumers link bean color to taste, cooking time, gravy quality and other desirable characteristics. The main objective of this research was to assess factors that determine consumption of different types of dry beans in Malawi based on color to determine preferences for different consumer segments and hence the potential value of these preferences communicated across the dry bean supply chain, to enhance the probability of success for breeders' efforts and the bean value chain's initiatives.

The research used data that was collected by a Bean Value Chain Research Network Survey in Lilongwe district, Malawi, covering a sample size of 687 households. The research focused on four colors; Red, Red Mottled, White and Cream Mottled bean colors as they are the most popular based on sales and stated preference in Malawi. Two econometric approaches were used in the data analysis. A bivariate analysis using Pearson's chi-square was used to test the significance of the association between bean consumption (dependent variable) and household as well as product characteristics explanatory variables). A logit Model was run on each of the four color types to assess the extent to which the explanatory influence consumer preferences for alternative colors of dry bean products.

Results showed 40.8% of the respondents consumed red beans, 12.6% consumed red mottled, 14.6% consumed White and 32% consumed Cream mottled beans.

Household culture of consuming a particular bean color type influenced choice of consumption in all colors. Education status had a significant negative influence on choice of consumption of Cream Mottled beans as well as White beans. Age had negative significant influence on choice of consumption of Cream Mottled beans and White beans while being female also reduced probability of choosing to consume White beans. Marital status, Household size and Employment status had no significant influence on choice of consumption of beans according to color type.

Area of residence according to population density and income levels was found to have significant influence on choice of consumption of bean types basing on color. Such results have potential to affect production and marketing decisions by different bean value chain players to enhance bean consumption by different consumers.

On product characteristics, grain size, cooking time and price were found to be the most significant characteristics influencing choice of bean according to color type. This is in line with results of other research like CIAT (2007) and Chirwa & Phiri (2014) which found that cooking time, grain size and price could influence choice of consumption. Color can be a proxy for such characteristics hence has great influence on choice of beans.

The research shows that different individual/household and product characteristics do influence choice of consumption. It is recommended that red bean breeders should focus on producing medium grain sized red bean varieties. The research also shows that cooking time is an important factor, especially on red mottled beans and as such, it is recommended that bean breeders should produce red mottled bean varieties with slow cooking characteristics. Marketers of red beans can take advantage of the relatively lower effect of price in their pricing strategies to increase profitability.

5.2 Limitations of the Study and Further Research

Data used for this research did not have specific prices for the particular bean types, and the analysis only used a dummy variable on whether price is a factor in choice of consumption or not. Further research should include prices so as to effectively analyze how changes in price would affect probability of choice of bean consumption.

The research only analyzed four color types. There are numerous color types that have been developed in Malawi by different bean breeders, further research should analyze characteristics that influence choice of consumption and probably draw conclusions on how to improve the product characteristics during breeding or identify suitable market segments for effective marketing.

Further study could be done to analyze elasticity of demand for different bean types according to color in regards to changes in product characteristics like price, size cooking time as well as changes in individual and household socio-economic factors.

WORKS CITED

AICC. 2016. "Common Bean Outlook."

Beeb. 2008. ""improving resource use efficiency and reducing risk of common bean production"in Africa, Latin America and the Caribbean."

Bogard, Matt. 2016. March 11. http://econometricsense.blogspot.com/2016/03/marginal-effects-vs-odds-ratios_11.html.

Chalira, Bridget. 2010. *Trade Policy Review: Malawi.* Stellenbosch: tralac.

Chirwa, R.M, and M.A.R Phiri. 2014. "Factors that Influence Demand for Beans in Malawi." Lilongwe.

CIAT. 2007. "Consumer preferences for beans in Malawi and its Influence on Price." *Highlights: CIAT in Africa.*

Devine, C.M, E.A Wolfe, Frongillo Jr, and C.A Bisogni. 1999. "Life-course events and experiences: Association with fruit and vegetable consumption in 3 ethnic groups." *Journal of the American Dietetic Association 99(3)* 185-190.

Fanning, Jasper, Thomas Marsh, and Kyle Stiegert. 2002. "DETERMINANTS OF FAST FOOD CONSUMPTION." California .

Hall, J.R, M Haas, and J Louvriere. 2004. "Using Stated Preference Discrete Choice Modeling to Evaluate Health Care Programs." *Journal of Business Research 57 (9)* 1026-1032.

Katungi, E., D. Wozemba, and J.C. Rubyongo. 2011. "A Cost Benefit Analysis of Farmer Based Seed Production for Common Bean in Kenya." *African Crop Science Journal 19 (4)* 409-415.

Lancaster, Kelvin J. 1966. "A new Approach to Consumer Theory." *Chiacago Journals* 132-157.

Lee, Mathew. 2017. *LIVESTRONG.COM.* October 3. Accessed March 12, 2018. https://www.livestrong.com/article/284447-red-kidney-beans-nutrition/.

Lucier, Gary, Biing Hwan Lin, Jane Allshouse, and Linda Scott Kantor. 2000. "Factors Affecting Dry Bean Consumption in the United States."

Mor, Kiran, and Navneet Sethia. 2005. "Factors That Influence Household and Individual Food Consumption: A Review of Research and Rekated Literature." *GYANPRATHA-ACCMAN Journal of Management 5(2).*

Mwiinga , Mukwiti, and Gelson Tembo. 2017. "Factors Affecting Bean Consumption and Choice in Zambia."

National Statistical Office. 2008. "2008 Malawi Population and Housing Census – Preliminary Report." Zomba.

Petautchere, Richard. 2015. *Beans in NASFAM: A Study of the value chain for the bean sub-sector among NASFAM members.* Lilongwe: Epic Consulting Limited.

Sichilima, Timothy, Lawrence Mapemba, and Gelson Tembo. 2016. "Drivers of Dry Common Beans Trade in Lusaka, Zambia: A Trader's Perspective." Lusaka.

Smith, John, and Bill C. Jones. 2007. "The Impact of Subsidity Funding." *Agricultural Economics* 2 (4): 65-68.

Studenmund, A.H. 2016. *Using Econometrics: A Practical Guide.* Boston: Pearson.

Tharanathan, R.N, and S Mahadevamma. 2003. "Grain legumes—A boon to human nutrition. Trends in Food Science & Technology."

Tumeo, Marynia, Lawrence Mapemba, Ebdi Khalil Edriss, and Horace Phiri. 2017. "Consumer Choice of Dry Common Beans in Malawi." Lilongwe.

Wani, Idrees Ahmed, Dalbir Singh Sogi, Ali Abas Wani, and Bameet Singh Gill. 2017. "Physical and cooking characteristics of some Indian kidney bean (Phaseolus vulgaris L.) cultivars." *Journal of the Saudi Society of Agricultural Sciences* 7-15.

Williams, Richard. 2015. "Heteroskedasticity." *University of Notre Dame.* January 30. https://www3.nd.edu/~rwilliam/.