FACTORS UNDERLYING COMMON BEANS' (*Phaseolus vulgaris* L.) CONSUMPTION DECISIONS IN DAR ES SALAAM, TANZANIA

ELIZABETH MEDARD

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ABSTRACT

Beans are a major grain legume widely consumed in Tanzania. They serve as a major source of protein especially to low income households. Consumption of beans in the country is low despite their nutritional benefits reasons for which are not established. The limited information on factors influencing beans consumption and preference affects the ability of chain actors to respond to demand requirements of consumers. This study was conducted to identify factors shaping consumers' preferences for, ultimate choices and consumption of beans. Specifically, the study objectives were to; determine factors influencing the decision to consume beans at household level, examine households' consumption frequency of different beans and bean products, and assess factors influencing consumers' choices of beans. Data collected under Legume Innovation Lab Project SO2.2 from a random sample of 754 households were analysed to address the study objectives. Binary probit, descriptive statistics and Cragg's double hurdle models were used in the analysis. Results reveal that the decision to consume beans at household level was significantly influenced by income status of the household, age and education of the main decision maker. Dry red beans were the most frequently consumed followed by dry brown and dry mottled beans. Processed bean products were the least frequently consumed. Choices and willingness to pay for beans were significantly influenced by gravy quality, cooking time, income status of the household, age, education and sex of the main decision maker. Future efforts to promote beans consumption should take into consideration the consumption requirements and preferences of different consumer categories.

DECLARATION

I, Elizabeth Medard, do hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own original work done within the period of registration, and that to the best of my knowledge, it has neither been submitted nor being concurrently submitted to SUA or any other institution for award of academic qualification.

....

Elizabeth Medard Date

(MSc. Agric. Economics Candidate)

The above declaration is confirmed

....

Prof. Fredy T. M. Kilima Date

(Supervisor)

....

Prof. Gilead I. Mlay Date

(Supervisor)

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DEDICATION

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LIST OF ABBREVIATIONS AND SYMBOLS

ADM	Archer Daniels Midland company
APEs	Average Partial Effects
BMI	Body Mass Index
BTC	Belgium Development Agency
BVC	Bean Value Chain project
EAs	Enumeration Areas
FAO	Food and Agriculture Organization
iAGRI	Innovative Agricultural Research Initiative
LDA	Linear Discriminant Analysis
MSc.	Master of Science
mt	Metric tonnes
NBS	National Bureau of Statistics
NGOs	Non- Governmental Organizations
QDA	Quadratic discriminant Analysis
SAEBS	School of Agricultural Economics and Business Studies
SUA	Sokoine University of Agriculture
UNICEF	United Nations International Child Education Fund
URT	United Republic of Tanzania
USA	United States of America
USAID	United States Agency for International Development
WTP	Willingness to pay

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Beans are a major grain legume widely consumed in Tanzania (BTC, 2012). They are considered as main source of protein for most of the low income households as they are cheaper compared to fish, meat and other animal sources of protein (Akibode, 2011; Birachi, 2012; BTC, 2012; Mishili *et al*, 2009a). Studies on human nutrition reveal that consumption of dry beans is associated with both nutrition and health benefits (Curran, 2012; Neutrasource Diagnostic Inc., 2013; Sichilima *et al*., 2016; URT, 2010). The fact that beans are rich in fibre and low in fat content makes them a useful means in controlling obesity, colon cancer and constipation for old people (ADM, 2016; Maredia, 2012).

Moreover, the consumption of beans can help to lower cholesterol level in the body and prevents heart diseases (ADM, 2016; Kabagambe *et al*., 2005). Thus beans are important to a wide range of consumers including infants, adults, pregnant women, and to both rich and poor households (Sichilima *et al*., 2016).

Beans are also considered as a source of income to farmers and other chain actors (Mishili et al, 2009a). They have the potential to generate more income if market requirements are taken into consideration during production and at all other stages of the value chain. It is reported that poor access to market information by chain actors is one of the challenges that undermine this potential (Birachi, 2012; BTC, 2012). Therefore, this study sought to explore factors shaping consumers' preferences for, ultimate choices and consumption of beans so as to inform stakeholders on factors they should consider to meet consumer preferences in order to increase income, improve health and nutrition security of consumers and other chain actors.

1.2 Problem Statement

In spite of the increase in population, total consumption of beans in Tanzania remained almost stagnant between 1980 and 2009 (Nedumaran *et al.*, 2015). Reasons for such stagnation are not well established. The annual per capita consumption of beans declined from 9.4 kg in 1986 to 6.2 kg in 2007 equivalent to 17 gm/day a rate far below the FAO minimum recommended rate of 30 gm/day (FAO, 2008; NBS, 2012).

However, statistics indicate that 10% of women in Tanzania have low BMI and almost 50% of children under five years of age are stunted (UNICEF, 2009), placing the country among the 10 worst affected countries in the world (Lovo and Veronesi, 2015). Beans would be the best option for these groups as they are rich in protein, complex carbohydrates, minerals and antioxidants which all contribute to good health (Curran, 2012; Neutrasource Diagnostic Inc., 2013). Moreover, beans are relatively cheaper compared to the animal sources of protein (Akibode, 2011; Birachi, 2012; BTC, 2012; Mfikwa and Kilima, 2014; Mishili *et al,* 2009a).

On the other hand, production is reported to have remained almost flat with 6% growth from 1994 to 2008 (Akibode and Maredia, 2011). In 2009 the aggregate production of beans in Tanzania was estimated at 949 000 mt, which is considered to be below the potential of between 1 900 000 and 3 800 000 mt (Ronner and Giller, 2012; Hillocks *et al*., 2006). Studies on production report lack of reliable markets including foreign markets as one of the factors affecting beans production in Tanzania (Birachi, 2012; BTC, 2012; Ronner and Giller, 2012).

There have been several initiatives by the government, international development partners and NGOs to promote production and consumption of beans in Tanzania (Ronner and

Giller, 2012). However, these interventions were conceived without sufficient knowledge of factors influencing beans consumption and preferences (Legume innovation Lab project SO2.2, 2013). This affected the programmes' effectiveness due to failure by chain actors' to match production and marketing plans with specific demand requirements of consumers (Ronner and Giller, 2012).

The few studies that were conducted in the country used market level data to assess relative importance of bean quality attributes in influencing consumers' willingness to pay (Mishili *et al*, 2009a; BTC, 2012). These studies were focused on improving specific marketing functions such as sorting, grading and storage. In such studies consumers' socio-economic and demographic factors were not studied which are important in understanding preferences of different consumer categories. Addressing this knowledge gap is critical to provide stakeholders with basic information for devising effective policies and strategies to promote beans consumption and utilization for improved income, food and nutrition security of consumers and all actors on the value chain.

1.3 Main Objective

The main objective of this study was to explore factors shaping consumers' preferences for, ultimate choices and consumption of beans so as to inform stakeholders on the specific factors they should focus on to promote consumption.

1.4 Specific Objectives

The specific objectives of this study were to:

1. Determine factors influencing the decision to consume beans at the household level.

2. Examine the households' consumption frequency of different beans and bean products.
3. Assess factors influencing consumers' choices of beans.

1.5 Hypotheses

The research hypotheses for this study were;

1. Socio-demographic factors do not significantly influence the decision to consume beans at the household level.
2. Beans attributes do not significantly influence consumers' choices of beans

1.6 Justification of the Study

The limited information on factors underlying beans' preferences and consumption affects the ability of chain actors to respond to specific demand requirements of consumers (Ronner and Giller, 2012). This undermines the on-going efforts to improve the consumption and utilization of beans in Tanzania for increasing income and improving food and nutrition security of chain actors (Legume innovation Lab project SO2.2, 2013; Ronner and Giller, 2012; Mishili *et al*, 2009a).

The findings of this study will contribute to the understanding of the factors that affect beans consumption in Tanzania and serve as basis for formulation of strategies for promoting production and local consumption. Information on consumers' preferences will be of value to breeders as they contemplate developing varieties that appeal to consumers. The benefits of new varieties of beans will be felt directly by producers as they will be able to get better markets for their products. Moreover, findings of this study will contribute to the existing body of knowledge on consumer behaviour and serve as a stepping stone for further research.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Consumer Behaviour Theory

Researchers have developed keen interests knowing how consumers make their consumption decisions since the last three centuries (Richarme, 2007). In that period the approach was purely based on economic perspective and focused completely on the consumer act of purchase. These early economists came up with what is commonly known as 'utility theory' which suggests that consumers are rational decision makers who make choices based on the expected outcomes (Schiffman and Kanuk, 2007). As per this theory, consumers make choices that will maximize utility subject to resource constraints. Contemporary researchers developed further this theory as they established that consumers derive satisfaction from not only the goods but also the attributes of such choices (Lancaster, 1966).

Though there are different approaches that have been applied to understand consumer behaviour, most of the contemporary researchers defined consumer behaviour in a similar way. They define it as 'the behaviour that consumers display in searching for, choosing, using, and evaluating products and services that they expect will satisfy their needs' (Schiffman and Kanuk, 2007). Theory reveals that consumer behaviour is a complex phenomenon that is influenced by diverse and interactive factors. These factors are categorized as cultural factors, socio-economic factors, personal factors, psychological factors, biological factors, situational factors and intrinsic/extrinsic product characteristics (Babicz-Zielinska, 2001; Koster, 2007).

However, empirical studies suggest that consumer behaviour is largely influenced by socio-economic and demographic characteristics including sex, age, education level and

nutritional knowledge of the main decision maker (Leterme, 2002; Mitchell *et al*., 2009). Other studies consider factors like household size and income, price of the commodity and its attributes to also influence consumer decision making (Banterle *et al*., 2013; Begum *et al*., 2010). Furthermore, food availability, culture, religious beliefs and spatial differences in life styles are also reported to influence consumer behaviour (Vu, 2008).

2.2 Conceptual Framework

The conceptual framework adopted in the study was proposed by Babicz-Zielinska, (2001) with researcher's improvement to reflect the main focus of the study (Figure 1). Food consumption decision making process involves six major stages namely decision to consume a product, information on-and search for product, pre-consumption evaluation of alternatives, choice of a product, actual consumption and post-consumption evaluation of alternatives. These stages are hypothesized to be influenced by factors within the consumer's environment (household size, available bean types and economic status of the household), bean attributes (grain colour, grain size, cooking time and quality of gravy) and individual specific factors such as socio-demographic characteristics of the main decision maker including age, sex and level of education.

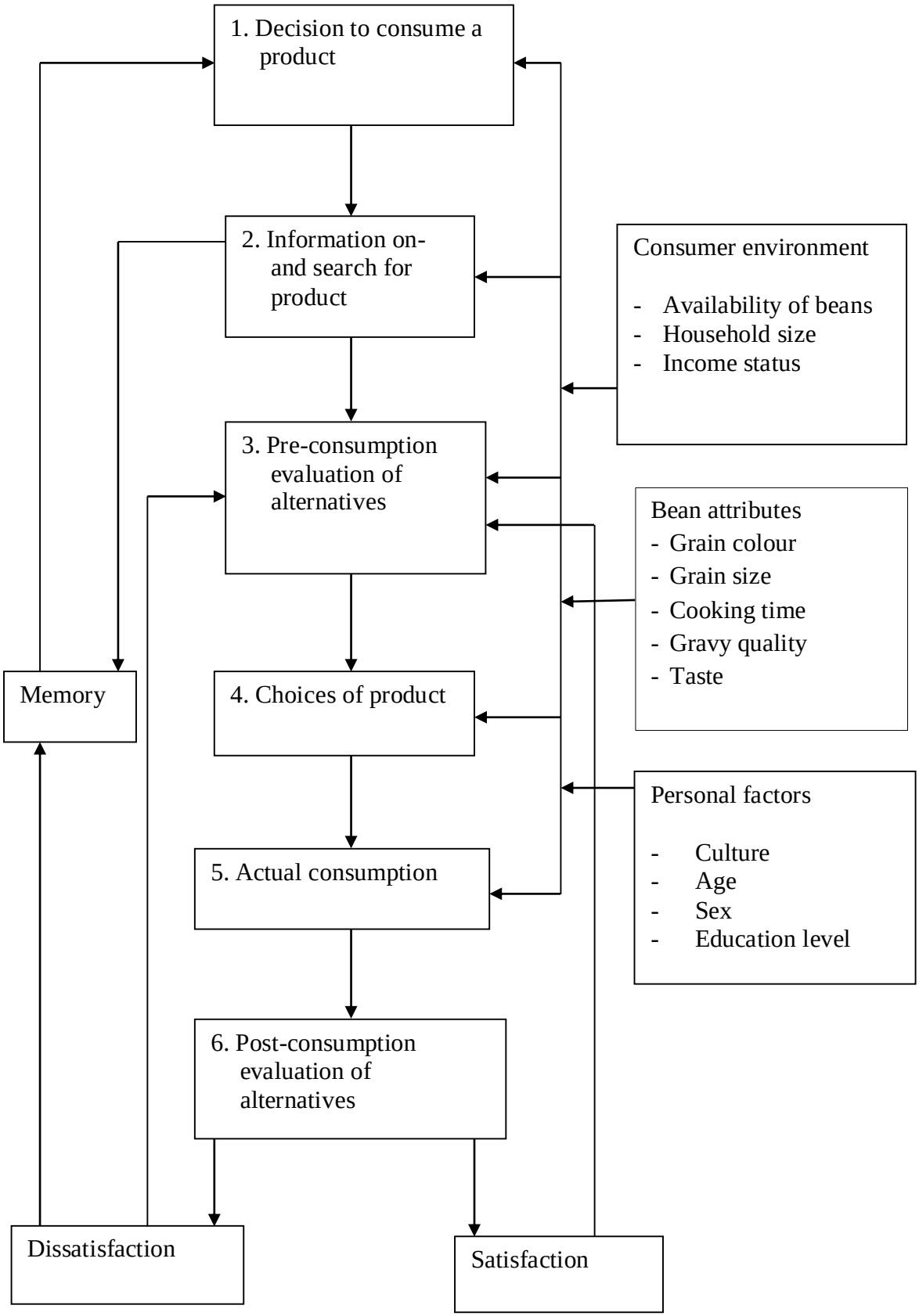

Figure 1: Conceptual framework

2.3 Previous Studies on Beans Consumption

Different studies have been conducted to study behaviour of beans' consumers. IPSOS REID (2010) studied factors influencing pulse consumption including beans in Canada and reported age, education level, marital status and race of the decision maker as significant factors. A similar study in the United States of America that focused on dry beans identified consumer's economic, sociological and demographic characteristics to have significant influence on the consumption (Lucier *et al*., 2000).

Studies conducted in Africa have revealed beans attributes such as grain colour, cooking time, taste and availability as significant factors underlying consumers' preferences for beans in Malawi (Chirwa and Phiri, 2007). Similar attributes with addition of grain size were also reported in Kenya (Katungi *et al*., 2011). Moreover, Sichilima *et al*. (2016) used a hedonic pricing model to study drivers of common beans trade in Zambia and reported grain size and colour to significantly influence consumers' preferences. Although many factors have been identified to influence beans consumption elsewhere, it is uncertain whether the same factors influence preferences for and consumption of beans in Tanzania in the same way.

The few studies that were conducted in Tanzania focused on bean quality attributes and their influence on consumers' willingness to pay (Mishili *et al*., 2009a; BTC, 2012). These studies used market level data and a hedonic pricing model and reported grain colour and damage level to be significant factors. In these studies, household socio-economic and individual demographic characteristics that have been reported to influence beans consumption and preference in other countries were not studied. To the contrary this study was based on a consumer perspective and used household level data to assess relative importance of socio-economic and demographic factors in influencing consumers'

decision to consume beans. The study also assessed the frequency of consumption and consumers' choices of beans. The findings of the study are deemed useful for a wide range of stakeholders including breeders, farmers, traders, nutritionists, policy makers and many others.

2.4 Modelling Consumption Decision

Consumers make decision on whether to consume a particular product or not based on the expected benefits or satisfaction. However, these outcomes are unobservable. What the researcher observes is whether one consumes the product or does not consume it. This results into a binary observable variable which takes the value of one if the consumer consumes the product and zero otherwise. The decision is considered to be influenced by household and individual socio-economic and demographic factors.

Literature reveals different approaches that can potentially be adopted to model binary dependent variables. Some of the alternatives are linear probability, probit, logit, gumbel and complementary log log models (Gessner, *et al.*, 1988; Greene, 2012). Other models include linear discriminant analysis (LDA) and quadratic discriminant analysis (QDA) (Gessner *et al.*, 1988). The literature further reveals subtle difference between the models in terms of abilities to properly classify observations (Gessner, *et al*., 1988; Greene, 2012; Hellevik, 2009). However, the major difference is reported to be in the interpretation of coefficients resulting from these competing models and thus the choice of an appropriate model depends on the nature of information to be analyzed and purpose of the analysis (Gessner *et al*., 1988; Hoetker, 2007). Uzunoz and Akcay (2012) suggested that linear probability, logit and probit are qualitative response models that relate the probability of an event to various independent variables and are often useful when assessing consumer characteristics that are associated with consumption decisions.

A review of empirical studies that involve binary dependent variables shows that some researchers recommend the use of linear probability model (Hellevik, 2009). It is important noting that this approach is criticized on the grounds that it produces both unrealistic probability outcomes outside the range of 0 and 1, and negative variances if some of the continuous independent variables have a non-linear association with the dependent variable or there are interactions in the data (Frolich, 2006; Greene, 2012). Other researchers favoured the logit model arguing that it is computationally easier to use (Adeogun *et al*., 2008; Frolich, 2006) while a majority preferred probit model on the basis of repeated use (Caglayan and Un, 2012; Li, 2011; Uzunoz and Akcay, 2012).

Greene, (2012) reported that probit and logit are the most commonly used models in econometric application involving a binary dependent variable and that they resemble each other with minor differences. The author further revealed that it is difficult to justify the choice of logit or the probit model on theoretical grounds rather on mathematical convenience and in most cases the choice between the two does not make much difference. Probit and logit are traditionally viewed as models suitable for estimating parameters of interest when the dependent variable is not fully observable as it is the case with studies involving consumer utility (Wooldridge, 2009). Wooldridge (2009) further stressed that despite the close similarities between the two models; logit provides better estimates in small samples while probit is relatively superior in studies involving large samples. Considering the sample size reported in section 3.1, binary probit was used to model the decision to consume beans at household level in this study.

2.5 Modelling Food Choices

Previous studies used different approaches to estimate individuals' preferences for food attributes. Some used methods that measure consumers' acceptance and willingness to pay

for product such as the hedonic pricing which are based on revealed preference (BTC, 2012; Mishili *et al*., 2009a; Sichilima *et al.*, 2016). Such models assume that the price of a good is a function of its attributes and the interest is to estimate contribution of each attribute of interest to the final price of the product (Lancaster, 1966). It is important to note that the approach is criticised that it regards consumers as price setters while in a competitive market price is determined by forces of demand and supply.

Other researchers used choice modelling approach to model consumer choices (Alphonce and Alfnes, 2017; Carlsson *et al*., 2012; Gaudice *et al*., 2014; Lusk *et al*., 2001). The approach is based on stated preference and has its grounds in random utility theory which attempts to understand consumers' preferences over the product attributes rather than the product itself. Results from choice models are reported to correspond well with the actual behaviour of consumers (Louviere *et al*., 2010; Lusk *et al.*, 2001).

Depending on the assumptions made on the distribution of the residuals, choice models may have probit or logit distribution (Louviere *et al*., 2010). Standard logit model relies on strong assumptions of homogeneity of consumers' tastes and independence from irrelevant alternatives (Carlsson *et al*., 2012). On the other hand, mixed logit model allows for taste variation, substitution between attributes, accommodates repeated choices and is not restricted to normal distributions (Gaudice *et al*., 2014). The use of mixed logit is appropriate when respondents' choices are informed by all alternative choices and choice attributes.

Informed by design of the choice experiment described in section 3.2 where respondents were provided with each of the choice alternatives independently and eventually given a fixed amount of money to spend over their choices, mixed logit could not be implemented.

Instead, the study adopted Cragg's double hurdle model whereby the first hurdle represents the decision to choose a given alternative and the second hurdle models willingness to pay (WTP) for the alternative given that it was selected in the first hurdle. A similar approach was also used by Ross *et al*. (2010) to model consumers' choice of markets and expenditure on the selected markets at Michigan State in USA. The model is more appropriate when there are a large number of zero observations on the dependent variable and some of which result from a discrete decision. A typical case is observing zero willingness to pay for a variety when a respondent did not select it. When these zero observations are ignored lead to biased results.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Source of Data

In this study, data collected under Legume Innovation Lab project SO2.2 were analysed to meet the study objectives. The data were collected in 2015 from 754 households in 100 enumeration areas (EAs) in Dar es Salaam that were randomly selected in consultation with the National Bureau of Statistics (NBS). NBS was consulted to obtain list of households in their respective enumeration areas as they are used in national census to facilitate the sampling process.

Dar es Salaam was selected to represent the nation due to heterogeneity of its population in terms of diversity of social, ethnic and economic backgrounds. Another reason to justify the choice of this region is that it is the largest consumer market that accounts for about 26% of total bean consumption in the country (BTC, 2012).

The EAs were stratified into high, middle and low income residences based on NBS classification of residences as used in national studies. Then 100 EAs were randomly selected from the three strata. Finally, individual households were randomly selected from those EAs to make a sample of 754 households.

3.2 Design of the Choice Experiment

The choice experiment involved four beans attributes namely grain colour, grain size, cooking time and gravy quality each with different levels. Colour had four levels i.e. “soya supa”, “soya kawaida”, mottled red and yellow while size had three levels which are small, medium and large. Moreover, cooking time had two levels, slow (cook for more

than 120 minutes) and fast (cook for less than 90 minutes). Similarly, gravy quality had two levels, poor (watery) and good (thick). Factorial design was used in the experiment where attributes were treated as factors with their different levels to generate 48 choice tasks.

There are challenges associated with having many attributes and attribute levels. These include difficulties in explaining and understanding of the choice alternatives to the respondents (Alphonce and Alfnes, 2017). Also it takes a lot of time to complete the experiment for each respondent. To address these challenges, the choice tasks were blocked into six choice sets, each consisting eight hypothetical choice alternatives such that every respondent was subjected to only one of the choice sets.

For every sampled household, the person who mostly make food consumption decisions was considered to be the respondent for the household. After responding to the other survey questions, the respondent was presented with each of the choice alternatives in a given choice set, informed about the attributes of the alternative and asked to state whether would choose it or not independent of the other alternatives. Finally, the respondent was presented with all the choices made (alternatives that he/she selected), given 14 000 Tsh and asked to spend over the choices until is exhausted. The respondent was free to either spend the entire amount of money on a single choice or distribute it over more than one choices.

The design was meant to reflect the actual purchasing practice of beans consumers in traditional markets in Tanzania and most other developing countries. In such markets, it is unlikely that a consumer will find all types of beans in one site at once. Rather, a consumer is likely to find one or few types at one place (table), decide to buy or move to a different place (table) until he/she finds the desired type.

3.3 Methods of Data Analysis

3.3.1 Objective one

The first objective was analysed using a binary probit model to determine the socio-demographic factors that influence the decision to consume beans at household level. The decision to consume beans is a binary dependent variable which takes values one and zero. It is one when a household consumes beans and is zero otherwise. The index model was specified as:

$$Y^* = X'_i\beta + \varepsilon_i \quad \ldots\ldots (1)$$

$$Y_i = \begin{cases} 1 \text{ if } Y^* > 0 \\ 0 \text{ if } Y^* \leq 0 \end{cases} \quad \ldots\ldots (2)$$

Where Y^* (equation 1) is unobservable (latent) variable that reflects net benefits to a household consuming beans, X is a vector of socio-demographic factors hypothesized to influence the decision to consume beans, β is a corresponding vector of coefficients, ε is an error term and Y_i (equation 2) is the observable dependent variable which takes the value of one if the i^{th} household consume beans and zero otherwise.

The probit model assumes that the error term follows a normal distribution with mean zero and a constant variance i.e. $\varepsilon_i \sim N(0, \sigma^2)$. Standardizing the variance to one, the probability of a household to consume beans is given as:

$$P(Y_i = 1/ X) = P(Y^* > 0) = \boldsymbol{\Phi}(X'_i\beta) \quad \ldots\ldots (3)$$

where $\boldsymbol{\Phi}$ (.) is the cumulative normal distribution function. Since the regression is non-linear, estimation process is done through maximum likelihood method (Green, 2012).

The relationship between a specific explanatory variable and the probability of the outcome is interpreted by means of the marginal effect, which accounts for the partial

change in the probability resulting from a unit change in the explanatory variable. Green (2012) cautions that coefficients in limited dependent variable models are not marginal effects as they are in linear regression models. The marginal effect associated with continuous explanatory variables X_k on the probability $P(Y_i = 1 |X)$, holding the other variables constant, can be derived as follows:

$$\frac{\partial P_i}{\partial X_{ik}} = \phi\ (X'_i\beta)\beta_k \qquad (4)$$

where ϕ (.) represents the probability density function of a standard normal variable.

The marginal effect of dummy variables is estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived as follows;

$$\Delta P = \Phi(X'_i\beta, d = 1) - \Phi(X'_i\beta, d = 0) \qquad (5)$$

The marginal effects provide insights into how the explanatory variables shift the probability of consuming beans. These were evaluated at every observation and the sample averages also known as average partial effects (APEs) were used in interpreting results. Green, (2012) argue that marginal effects vary with the explanatory variables, thus should be evaluated at the mean of sample observations or at every observation and use the sample average.

3.3.2 Objective two

The second objective was analysed using descriptive statistics where by percentages of respondents were used in reporting consumption frequency of different beans and bean products. Consumption frequencies were also examined across sex, age, education and

residence categories to see whether there are differences in consumption frequency between such categories. The beans types that were analysed are dry brown, dry yellow, dry red, dry purple, dry black, dry khaki/cream, dry mottled and dry mixed beans. Moreover, the consumption frequency of bean products such as bean flour, baked beans and canned whole beans was also analysed.

3.3.3 Objective three

Informed by the design of the choice experiment described in section 3.2, the third objective was analysed using Cragg's double hurdle model. The model assumes that consumers make two separate decisions with regard to selection and willingness to pay for a product, each of which is represented by a different latent variable (Akinbode and Depeolu, 2012; Yimer, 2011). The four bean colours involved in the choice experiment represented four bean varieties namely mottled red, "soya supa", "soya kawaida" and yellow beans. Instead of including colour levels as dummy variables, the analysis was split into four categories based on the four varieties. For each variety (colour) there were varying levels of the remaining three attribute i.e. grain size, cooking time and gravy quality. Four separate models were estimated (one for each variety). The first hurdle in each model (equation 1) represents the respondents' decision to select the variety while the second hurdle (equation 3) represents the respondents' willingness to pay for the variety given that it was selected.

$$D_i^* = Z'_i\alpha + \varepsilon_i \quad \text{Selection equation} \quad \ldots\ldots (1)$$

$$D_i = \begin{cases} 1 \text{ if } D_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \ldots\ldots (2)$$

$Y_i^* = X'_i\beta + U_i$ Willingness to pay…….. (3)

$$Y_i = \begin{cases} Y_i^* \text{ if } Y_i^* > 0 \text{ and } D_i > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{……} \quad (4)$$

Where D_i^* (equation 1) is a latent variable describing the *i*th respondents' decision to select the product, D_i (equation 2) is the observable discrete variable, Y_i^* (equation 3) is a latent variable describing *i*th respondent's optimal expenditure on the variety, Y_i (equation 4) is the observed dependent variable (*i*th respondent's willingness to pay), Z_i is a vector of variables explaining the selection decision, X_i is a vector of variables explaining the willingness to pay, ε_i and U_i are the respective error terms assumed to be independent and normally distributed as $\varepsilon_i \sim N(0,1)$ and $U_i \sim N(0, \sigma^2)$. Though the model is based on the assumption of normality of the error term, it can be transformed to accommodate non-normal error term and the likelihood function of the transformed double hurdle model can be presented (William, 2009) as;

$$L=\prod_{Yi=0}[1-\Phi(Z'_i\alpha)]\prod_{Yi>0}\Phi(Z'_i\alpha)\left[\Phi\left(\frac{X'_i\beta}{\sigma_i}\right)\right]^{-1}\frac{1}{\sigma_i}\phi\left[\frac{T(Y_i)-X'_i\beta}{\sigma_i}\right] \text{……...……} \quad (5)$$

Estimation is done through maximum likelihood method. For the generalized double hurdle model, the probability of observing positive willingness to pay is

$P(Y_i>0) = \boldsymbol{\Phi}(Z'_i\alpha)$…….. (6)

The condition mean of Y_i which measures the average willingness to pay given that the probability of selection is greater than zero is

$$E(Y_i/Y_i>0) = \left[\Phi\left(\frac{X'_i\beta}{\sigma_i}\right)\right]\int_0^{\infty} Y_i\frac{1}{\sigma_i}\phi\left[\frac{T(Y_i)-X'_i\beta}{\sigma_i}\right]dY_i \text{……} \quad (7)$$

The unconditional mean of Y_i which measures the overall average willingness to pay is given as

$E(Y_i) = E(Y_i/Y_i>0)\ P(Y_i>0)$……(8)

Marginal effects were obtained by partial differentiation of equations (6) to (8) with respect to each of the significant explanatory variables (Yimer, 2011).

3.4 Variables included in the probit and double hurdle models and anticipated effects

In the first objective, factors that were hypothesized to influence the decision to consume beans at household level are household size, age, education level and sex of the main decision maker, and income status of the residence area as a proxy variable for household income.

Household size is expected to influence the decision to consume beans positively as large households are likely to choose less expensive foods since they need more food to meet the household requirements (Mfikwa and Kilima, 2014). Since beans are relatively cheaper sources of protein as compared to animal products, increase in household size is likely to increase the probability of consuming beans. Age and education level of the main decision maker are expected to influence the probability to consume beans negatively. More aged decision makers are likely to have more income from their life time investments and be able to afford other expensive sources of protein relative to decision makers who are still young (Mak *et al.*, 2012). Also previous studies relate old age to health problems such as stomach ulcers and increased concern about social embarrassment due to flatulence which are expected to affect the possibility of consuming beans negatively. Similarly, more educated decision makers are likely to secure more paying jobs and afford other expensive sources of protein (Bonabana-Wabbi *et al.*, 2012).

Sex is thought to influence the decision to consume beans due to differences in nutritional concerns and preferences for low calories foods between males and females. Male

decision makers are expected to have higher probabilities of consuming beans relative to females since beans are high calories foods and females are reported to prefer low calories foods (Mfikwa and Kilima, 2014). Moreover, income status of the residence is expected to influence the probability of consuming beans negatively. This is because households with more income are likely to afford other sources of protein such as animal products (Yimer, 2011).

In the third objective, factors that were considered to influence consumers' choices and willingness to pay for the chosen bean alternatives are grain size, cooking time, gravy quality, household size, age, education level and sex of the main decision maker, and income status of the residence area.

Different studies reported that consumers' choices of food products are mainly influenced by the attributes of the product (Annunziata and Vecchio, 2012; Chirwa and Phiri, 2007; Katungi *et al.*, 2011; Lusk *et al.*, 2001). Large grain, fast cooking and good gravy attributes are expected to influence positively both the probability of selection and willingness to pay for the selected variety.

Generally, consumers' socio-economic and demographic factors are thought to influence choices and willingness to pay for beans through perception developed from knowledge, experience, access to information, etc., which affect their ability to receive, process information and make judgement. This finally shape their consumption behaviour and the way they make choices (Mak *et al*., 2012). In that case, the same attributes may appeal differently to different consumers based on their perception. For example, certain food attributes may be interpreted to signify modernity, superiority or inferiority by certain consumers (Mak *et al*., 2012).

Past experience show that large households and those with low income prefer large grained legumes for the reason that they swell when cooked and thus a small amount would be sufficient for the household (Katungi *et al.*, 2011; Mfikwa and Kilima, 2014; Mishili *et al.*, 2009b). Literature also reports that female decision makers associate consumption of red coloured grain legumes with increase in blood haemoglobin in the consumer's body (Katungi *et al.*, 2011). These are just some of the studies that reported influence of socio-economic and demographic factors on consumers' food choices.

In the choice experiment, choice alternatives were not priced and respondents were given a fixed amount of money to ensure that respondents' choices and willingness to pay for the selected alternatives explicitly reflect their levels of preference over them. Thus, the two variables were not included in the analysis. Table 1 provides a description of the variables included in the two analytical models and anticipated effects on dependent variables.

Table 1: Variables included in the models and their expected signs

Variable	Description	Sign
Probit model		
Household size	Continuous variable, number of household members	+ve
Age_middle	Dummy 1 if age is medium (30 – 55 yrs), 0 otherwise	-ve
Age_old	Dummy 1 if age is old (>55 years), 0 otherwise	-ve
Education_sec	Dummy 1 if education is secondary, 0 otherwise	-ve
Education_col/univ	Dummy 1 if education is college/higher, 0 otherwise	-ve
Education_tech/voc	Dummy 1 if education is tech/vocational, 0 otherwise	-ve
Sex_male	Dummy 1 if sex is male, 0 otherwise	+ve
Residence_medium	Dummy 1 if residence is medium income, 0 otherwise	-ve
Residence_high	Dummy 1 if residence area is high income, 0 otherwise	-ve
Cragg's double hurdle model		
Size_medium	Dummy 1 if grain size is medium, 0 otherwise	+ve
Size_large	Dummy 1 if grain size is large, 0 otherwise	+ve
Cooking_fast	Dummy 1 if cooking time is fast, 0 otherwise	+ve
Gravy_good	Dummy 1 if gravy quality is good, 0 otherwise	+ve
Age_middle	Dummy 1 if age is medium, 0 otherwise	+ve/-ve
Age_old	Dummy 1 if age old, 0 otherwise	+ve/-ve
Education_sec	Dummy 1 if education is secondary, 0 otherwise	+ve/-ve
Education_col/univ	Dummy 1 if education is college/higher, 0 otherwise	+ve/-ve
Education_tech/voc	Dummy 1 if education is tech/vocational, 0 otherwise	+ve/-ve
Sex_male	Dummy 1 if sex is male, 0 otherwise	+ve/-ve
Household size	Continuous variable, number of household members	+ve/-ve
Residence_medium	Dummy 1 if residence is medium income, 0 otherwise	+ve/-ve
Residence_high	Dummy 1 if residence area is high income, 0 otherwise	+ve/-ve

3.5 Post estimation (diagnostic) tests

Estimation of models for objective one and three involve certain assumptions which when violated affect the validity and reliability of the results. Therefore, to check whether the underlying assumptions hold, post estimation tests are necessary. In this study, statistical tests for multicollinearity, heteroscedasticity and autocorrelation were carried out. Variance inflation factors were used to test for multicollinearity among the explanatory variables and results revealed that there was no multicollinearity. Similarly, Breusch-

Godfrey autocorrelation tests indicated that the residuals were not correlated. However, Breusch Pagan tests revealed that the residuals in both models were heteroscedastic. To address the challenge, robust estimation was adopted for the probit model to generate robust standard errors and the model for objective three was transformed as specified in section 3.3.3.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Respondents' characteristics

Results from sample descriptive statistics (Table 2) indicate that majority of respondents were female (87%) while few were male (13%). This is due to the fact that in most of the households, women are mainly responsible for making food consumption decisions (Lusk, *et al*., 2001). With regard to age, results show that about 40% of respondents were less than 30 years of age, 46% were aged between 30 to 50 years and about 14% were above 50 years of age.

Moreover, majority of respondents had primary education (58%) followed by those with secondary education (22%). Only few had no formal education (9%), college/university education (8%) or technical/vocation training (3%).

Results further indicate that about 40% of respondents were from low, 46% from medium, and approximately 14% from high income residence areas. Majority of the households from low, medium and high income residence areas reported to consume beans (96%, 97% and 95% respectively) while few (4%, 3% and 5%) reported that they did not consume beans at all.

Table 2: Respondents characteristics

Variable name	Frequency	Percent
Sex		
Male	98	13
Female	656	87
Age		
Less than 30 years	302	40
30 to 50 years	347	46
51 years and above	105	14
Education		
None	68	09
Primary	437	58
Secondary	166	22
College/university	60	08
Technical/vocational	23	03
Status of residence area		
Low income	302	40
Medium income	347	46
High income	105	14
Whether consume beans		
Low income residence		
Yes	290	96
No	12	04
Medium income residence		
Yes	337	97
No	10	03
High income residence		
Yes	100	95
No	05	05
n = 754		

Source: Researcher's findings

4.2 Factors influencing the decision to consume beans at household level

In Tanzania, it is very uncommon to find a household that does not consume beans. As reported on descriptive statistics, only 4% of the sampled households did not consume beans. With the interest of promoting consumption, the researcher wished to know the reasons for these households not to consume beans and what would persuade them to consume beans. Descriptive analysis of multiple responses on reasons for not consuming beans obtained from households which reported not to consume beans (Table 3) reveals that majority of respondents from low, medium or high income residence areas did not consume beans because of health reasons (100%, 80% and 80% respectively). Others

reported that someone in the household did not like beans and hence the entire household decided not to consume beans with 15%, 40% and 40% being respondents from low, medium and high income residences respectively.

Furthermore, not knowing the health benefits of beans was also another reason for some households not consuming beans which was reported by 23% and 20% of respondents from low and medium income residences respectively. Also 8% and 30% of respondents from the two residence categories reported risk of social embarrassment due to flatulence as another reason while another 8% and 10% from the same categories reported that beans have never been part of their household's meal.

Table 3: Reasons for not consuming beans at household level

Reason (n = 30)	Low income residence (%)		Medium income residence (%)		High income residence (%)	
	Yes	No	Yes	No	Yes	No
Beans are inferior goods	0	100	0	100	20	80
Health Reasons	100	0	80	20	80	20
Religion or cultural factors	0	100	0	100	0	100
Price is too high	0	100	0	100	0	100
Social embarrassment due to flatulence	8	92	30	70	0	100
Takes too long to prepare	0	100	20	80	0	100
Someone in the family does not eat beans	15	85	40	60	40	60
Beans have never been part of the hh meal	8	92	10	90	0	100
Does not know how to prepare	0	100	0	100	0	100
Does not know the health benefits of beans	23	77	0	100	20	80

Source: Researcher's findings

Moreover, few respondents (20% from medium income residence) reported preparation inconvenience (takes too long to cook) and beans being inferior goods (20% from high income residence) as other reasons for not consuming beans.

When asked how they would respond to several statements about persuading them to eat beans or bean products, results indicate that knowledge that consumption of beans improves the ability to absorb iron which is vital for health of reproductive age women would highly influence non-beans consumers to consume beans. About 24% of non-beans consumers reported that they would definitely consume beans if they had that knowledge which is the highest among the provided statements (Table 4).

Other statements that had strong influence include the knowledge that beans are extremely rich in protein, beans are much more economical sources of protein than animal sources, beans have good health benefits and if there was no social embarrassment risk associated with eating beans where by 15%, 10%, 10% and 10% of respondents' reported that they would definitely consume beans given those facts respectively.

Table 4: Responses on what would persuade respondents to consume beans

Persuasion statement	Respondents' responses (%), n = 30				
	Never	Unsure	Probably	Definitely	Total
People you respect love eating beans	62	24	09	05	100
Beans are highly nutritious	57	09	29	05	100
Beans are extremely reach in protein	52	19	14	15	100
Beans are more economical source of protein	57	24	09	10	100
Beans have faster cooking time	52	19	24	05	100
Beans have good health benefits	38	09	43	10	100
Eating beans reduce risk of getting cancer	38	14	43	05	100
Eating beans enhance social status	52	29	19	00	100
No social embarrassment associated with beans	47	19	24	10	100
Consuming beans improve ability to absorb iron	28	19	29	24	100
Improved options on beans preparation methods	81	14	05	00	100
Income increased by 10%	76	19	05	00	100
Income increased by 30%	62	19	14	05	100

Source: Researcher's findings

Factors influencing the decision to consume beans at household level were analysed by binary probit. The observable dependent variable takes the value of one if the household consumes beans and zero otherwise. The estimated probit model had a log likelihood of about -736 with a $\chi^2 = 495$ which is significant at one percent and the pseudo R^2 was 0.46. The results from the model (Table 5) indicate that the decision to consume beans at household level was significantly influenced by household size, middle and old age were significant relative to young age, technical/vocational education was significant relative to at most primary, and medium income residence was significant relative to low income residence.

Table 5: Estimation results from probit model (n = 754)

Variable	Coefficient	Robust s.e.	z	P>z
Household size	0.179	0.026	6.83	0.000
Age_middle	-0.485	0.073	-6.68	0.000
Age_old	-0.629	0.104	-6.07	0.000
Education_sec	-0.054	0.074	-0.74	0.459
Education_col/univ	-0.158	0.104	-1.52	0.129
Education_tech/voc	-0.692	0.134	-5.16	0.000
Sex_male	0.134	0.088	1.52	0.127
Residence_medium	0.229	0.071	3.20	0.001
Residence_high	-0.102	0.089	-1.14	0.253
Constant	1.328	0.112	11.83	0.000

Source: Researcher's findings

The percentage of correct model prediction was about 96% and the partial effects of significant regressors on the probability of observing positive consumption are presented in Table 6.

Table 6: Partial effects of significant regressors on probability of consumption

Variable	Coefficient	Std. Error
Household size	0.014***	0.010
Age_middle	-0.037***	0.027
Age_old	-0.048**	0.034
Education_tech/voc	-0.057**	0.023
Residence_medium	0.018***	0.013

Source: Researcher's findings

Results in Table 6 indicate that one more member in the household increases the probability of a household to consume beans by 0.014. As mentioned earlier, large households are more likely to choose less expensive foods. Since beans are reported to be cheaper sources of protein compared to animal sources, increase in household size increases the possibility of consuming beans. Similar findings were reported by Mfikwa and Kilima, (2014) on consumption of pulses in Tanzania. Significant influence of

household size on the decision to consume a food product was also reported by He *et al*. (2003) on beef, poultry and seafood in USA and Bonabana-Wabbi *et al*. (2012) on fast-food in Uganda.

Moreover, households whose main decision makers were aged between 30 and 50 years and those aged above 50 years had lower probabilities of consuming beans relative to households whose main decision makers were less than 30 years of age. The probability decreased by 0.037 and 0.048 for the two age categories respectively. This is because more aged decision makers are likely to have higher income from investments over their life time and afford other sources of protein. Moreover, old age is also associated with increased conscious about social embarrassment due to flatulence and health challenges. Age was also reported to influence significantly the intention of consumers to purchase organic products in Malaysia (Omar *et al*., 2016) and on the decision to consume fruits and vegetables in the same country (Ab Karim *et al*., 2012).

Similarly, households whose main decision makers had technical/vocational training had lower probability of consuming beans by 0.057 relative to those with at most primary education. Decision makers with high education are likely to secure better jobs, earn more income and afford to buy other sources of protein such as animal products. Significant influence of education on the decision to consume food products was also reported in previous studies (Ab Karim *et al*., 2012; He *et al*., 2003; Omar *et al*., 2016). Furthermore, households residing in medium income residences had higher probability of consuming beans relative to those residing in low income areas and the difference was 0.018. This could be a result of high cost of fuel which is mostly the case in urban areas. Since beans take time to cook, they use more fuel and some of the low income households may not be able to meet that cost as compared to medium income households. Also the income of

medium income earners may not be sufficiently high to enable them afford more expensive sources of protein and thus beans remain to be their major source.

4.3 Consumption frequency of different beans and bean products

Descriptive statistics on consumption frequency of different beans and bean products indicate that, dry red beans were the most frequently consumed beans. 51% of respondents who participate in beans consumption reported to consume dry red beans once or more per week which was the highest percent among the studied bean types (Table 7). Moreover, only 24% of them reported not to consume dry red beans at all which was the lowest among the studied options. Dry brown beans were the second frequently consumed after dry red beans. About 36% of respondents who consume beans reported that they consume dry brown beans once or more per week while 40 % reported not to consume dry brown beans at all. Other bean types that were frequently consumed are dry mottled and dry purple beans with 16% and 14% of respondents reporting to consume them once or more per week, respectively.

However, results reveal that dry black, dry mixed, dry yellow and dry khaki/cream beans were less frequently consumed where by 3%, 2%, 1% and 0% of respondents reported to consume them once or more per week, respectively. On the other hand, 84%, 92%, 94% and 95% of them reported that had never consumed those types of beans respectively.

Table 7: Consumption frequency of different beans and bean products

Type of beans/bean product	Consumption frequencies (%) n = 724					
	Never	Less than once per month	Once per month	Once per two weeks	Once/more per week	Total
Dry brown	40	8	7	9	36	100
Dry yellow	94	4	1	0	1	100
Dry red	24	7	6	12	51	100
Dry purple	54	10	10	12	14	100
Dry black	84	8	4	1	3	100
Dry khaki	95	4	0	1	0	100
Dry mottled	66	6	4	8	16	100
Dry mixed	92	3	1	2	2	100
Bean flour	98	2	0	0	0	100
Baked beans	98	2	0	0	0	100
Canned whole	98	2	0	0	0	100
Others	98	2	0	0	0	100

Source: Researcher's findings

Results further indicate that processed bean products were the least frequently consumed with no respondent reporting to consume them once or more per week and almost 98% of them reporting never to have consumed them at all. This can be due to lack of knowledge on alternative preparation methods and uses of beans in the society.

Comparison of households' consumption frequency across sex categories of the main decision makers shows that there was no difference in consumption frequencies between households with male or female main decision makers (Table 8).

Table 8: Consumption frequency of beans/bean products across sex categories

Sex	Consumption frequencies (%) Male = 98, Female = 656					
	Never	Less than once per month	Once per month	Once every two weeks	Once or more per week	Total
Male	77	5	2	4	11	100
Female	79	5	3	4	10	100

Source: Researcher's findings

Similarly, households whose main decision makers were less than 30 years of age, between 30-50 years and those above 50 years showed little difference in their consumption frequencies even though those aged above 50 years had slightly higher consumption frequencies relative to the other two categories (Table 9).

Table 9: Consumption frequency of beans/bean products across age categories

Age	Consumption frequencies (%) youth = 302, middle age = 347, old = 105					
	Never	Less than once per month	Once per month	Once every two weeks	once or more per week	Total
Below 30 years	80	5	2	3	10	100
30-50 years	79	4	3	4	11	100
Above 50 years	73	7	4	5	11	100

Source: Researcher's findings

Moreover, there were also little differences in consumption frequencies between households with main decision makers from different education categories. However, households whose main decision makers had college or university education showed slightly but consistently lower consumption frequencies relative to those with no formal, primary, secondary or technical/vocational education (Table 10).

Table 10: Consumption frequency of beans across education categories

Education	Consumption frequencies (%) No educ = 68, Primary = 437, sec = 166, tech/voc = 23, col/univ = 60					
	Never	Less than once per month	Once per month	Once every two weeks	once or more per week	Total
No formal	75	5	4	4	12	100
Primary	79	4	3	4	11	100
Secondary	78	6	3	4	9	100
Tech/vocational	76	4	2	4	13	100
Coll/university	82	5	2	3	8	100

Source: Researcher's findings

Furthermore, there were no major differences in consumption frequency between households from low, medium or high income residences (Table 11).

Table 11: Consumption frequency of beans/product across residences

Residence status	Consumption frequencies (%) Low = 302, Medium = 347, High = 105					
	Never	Less than once per month	Once per month	Once every two weeks	once or more per week	Total
Low income	78	4	3	4	11	100
Medium income	78	5	3	4	10	100
High income	81	5	1	4	9	100

Source: Researcher's findings

4.4 Factors influencing consumers' choices of beans

Observations from the choice experiment were analysed by Cragg's double hurdle model to assess the factors that influence consumers' choices of beans and the extent to which such factors influence the corresponding willingness to pay for the selected alternatives. Four separate models were estimated one for each bean variety. Generally, the estimated models for all the four bean varieties were significant at 99% confidence level.

4.4.1 Factors influencing selection and WTP for mottled red beans

Results on mottled red beans (Table 12) indicate that gravy quality had significant influence on both the probability of the variety being selected and corresponding WTP, and large grain size was significant relative to small grain size. Fast cooking time influenced significantly the probability of selection but had no significant influence on WTP while secondary education was significant relative to at most primary education. Similarly, medium and high income residences were significant relative to low income residence on WTP.

Table 12: Factors influencing selection and WTP for mottled red beans

Variable	Coefficient	Robust s.e.	z	P>z
Selection equation				
Size_medium	0.13	0.88	1.44	0.15
Size_large	-0.65	0.98	-6.56	0.00
Cooking_fast	0.83	0.83	9.98	0.00
Gravy_good	1.31	0.76	17.12	0.00
Age_middle	-0.22	0.85	-0.26	0.79
Age_old	0.12	0.12	1.00	0.32
Education_sec	-0.07	0.10	-0.78	0.43
Education_col/univ	0.17	0.14	1.16	0.24
Education_tech/voc	-0.01	0.25	-0.05	0.96
Sex_male	-0.19	0.13	-1.48	0.14
Household size	-0.01	0.02	-0.38	0.70
Residence_medium	0.02	0.08	0.25	0.80
Residence_high	0.06	0.12	0.51	0.60
Willingness to pay				
Size_medium	-958.55	497.95	-1.93	0.05
Size_large	-1531.79	607.67	-2.52	0.01
Cooking_fast	788.72	564.50	1.40	0.16
Gravy_good	893.78	515.42	1.73	0.08
Age_middle	-729.84	504.51	-1.45	0.15
Age_old	849.39	660.53	1.29	0.20
Education_sec	950.92	517.34	1.84	0.07
Education_col/univ	592.08	867.58	0.68	0.50
Education_tech/voc	404.59	1548.62	0.26	0.79
Sex_male	119.69	688.98	0.17	0.86
Household size	60.38	81.98	0.74	0.46
Residence_medium	1066.88	463.25	2.30	0.02
Residence_high	1375.54	701.42	1.96	0.05
Sigma				
Constant	4474.37	140.88	31.76	0.00

Source: Researcher's findings

Marginal effects reveal that gravy quality had the highest effect on the probability of mottled red beans being selected where-by mottled red beans with good quality had a 0.37 higher probability of being selected relative to those with poor gravy quality. Fast cooking mottled red beans also had a higher probability of being selected relative to slow cooking ones (Table 13). However, consumers seemed to prefer small sized grains since large grain sized mottled red beans had lower probability (by 0.18) of being selected relative to those with small grain size.

Table 13: Marginal effects of significant variables on mottled red beans

Variable	Mean	Standard deviation
Effects on probability of selection		
Size_large	-0.18	0.07
Cooking_fast	0.23	0.09
Gravy_good	0.37	0.14
Effects on conditional mean WTP (Tsh)		
Size_medium	-789.05	65.04
Size_large	-1251.57	103.17
Gravy_good	732.94	60.41
Education_sec	763.34	62.92
Residence_medium	856.05	70.56
Residence_high	1106.17	91.18
Effects on overall mean WTP (Tsh)		
Size_medium	-79.00	57.45
Size_large	-2276.63	1586.73
Gravy_good	3443.38	2400.64
Education_sec	63.93	46.71
Residence_medium	369.51	257.80
Residence_high	580.22	404.62

Source: Researcher's findings

Results show that consumers who selected this variety had lower mean WTP for large grain sized beans by about Tsh 1252 relative to the mean WTP for beans with small grain size (Table 13). The overall mean WTP (for the entire sample) was about Tsh 2277 less on large grain sized beans relative to that on small grains. Good gravy quality and secondary education of the main decision maker increased both mean MWP among those who selected mottled red beans (conditional mean WTP) and overall mean WTP for the entire

sample (unconditional mean WTP) relative to at most primary. Similarly, respondents from medium and high income residence were willing to pay more for mottled red beans relative to those from low income residence by about Tsh 856 and Tsh 1106, respectively.

4.4.2 Factors influencing selection and WTP for "soya kawaida" beans

Findings from the model reveal that, the probability of "soya kawaida" being selected was significantly influenced by grain size, cooking time and gravy quality while WTP for the variety given that it was selected was significantly influenced by gravy quality. Technical/vocational education was significant relative to at most primary and being male was significant relative to being female (Table 14).

Table 14: Factors influencing selection and WTP for soya kawaida beans

Variable	Coefficient	Robust s.e.	z	P>z
Selection equation				
Size_medium	-0.15	0.11	-1.37	0.17
Size_large	0.36	0.10	3.60	0.00
Cooking_fast	0.58	0.08	6.77	0.00
Gravy_good	1.32	0.09	13.94	0.00
Age_middle	0.01	0.09	0.11	0.91
Age_old	0.06	0.14	0.42	0.67
Education_sec	-0.10	0.10	-0.97	0.33
Education_col/univ	-0.05	0.17	-0.27	0.77
Education_tech/voc	-0.16	0.28	-0.57	0.57
Sex_male	0.00	0.13	-0.03	0.98
Household size	-0.01	0.02	-0.57	0.57
Residence_medium	0.03	0.09	0.28	0.78
Residence_high	-0.16	0.14	-1.11	0.27
Willingness to pay				
Size_medium	-1029.67	972.59	-1.09	0.29
Size_large	610.46	762.91	0.80	0.42
Cooking_fast	231.35	730.95	0.32	0.75
Gravy_good	3539.80	1233.20	2.87	0.00
Age_middle	-114.56	722.63	-0.16	0.87
Age_old	-634.26	1187.91	-0.53	0.59
Education_sec	388.04	865.09	0.45	0.65
Education_col/univ	1886.30	1386.85	1.36	0.17
Education_tech/voc	-4726.83	1644.81	-2.87	0.00
Sex_male	1810.21	1035.22	1.75	0.08
Household size	-132.06	128.14	-1.03	0.30
Residence_medium	885.13	736.31	1.20	0.23
Residence_high	1080.06	1102.59	0.98	0.33
Sigma				
Constant	4474.37	240.42	18.92	0.00

Source: Researcher's findings

Marginal effects of the significant explanatory variables (Table 15) show that gravy quality had the highest effect on the probability of "soya kawaida" being selected. It was predicted that "soya kawaida" with good gravy had a 0.29 probability of being selected higher than that of "soya kawaida" with poor gravy. Fast cooking also increased the probability by 0.12 relative to slow cooking beans. In this variety consumers showed preference over large grain size as large grain sized beans had a higher probability of being selected (by 0.08) relative to small sized ones.

Table 15: Marginal effects of significant variables on soya kawaida beans

Variable	Mean	Standard deviation
Effects on probability of selection		
Size_large	0.08	0.05
Cooking_fast	0.12	0.08
Gravy_good	0.29	0.18
Effects on conditional mean WTP (Tsh)		
Gravy_good	2079.44	486.44
Education_tech/voc	-2946.71	689.32
Sex_male	1148.68	268.71
Effects on overall mean WTP (Tsh)		
Gravy_good	2136.03	2096.32
Education_tech/voc	-875.07	854.69
Sex_male	260.09	253.55

Source: Researcher's findings

Furthermore, it was estimated that respondents with technical/vocational training were willing to pay about Tsh 2947 less than those with at most primary education. Conversely, good gravy quality increased mean WTP for soya kawaida by about Tsh 2079 and male respondents were willing to pay about Tsh 1149 higher than their female counterparts. Moreover, gravy quality had the strongest positive effect on overall mean WTP while technical/vocational education maintained a negative effect (Table 15).

4.4.3 Factors influencing selection and WTP for "soya supa" beans

Estimation results from Cragg's double hurdle indicate that the probability of "soya supa" being chosen was significantly influenced by cooking time, gravy quality and medium income residence was significant relative to low income residence (Table 16). Results further indicate that WTP for "soya supa" given that it was chosen was significantly influenced by grain size, cooking time and high income residence was significant relative to low income.

Table 16: Factors influencing selection and WTP for soya supa beans

Variable	Coefficient	Robust s.e.	z	P>z
Selection equation				
Size_medium	-0.14	0.09	-1.56	0.12
Size_large	0.02	0.09	0.20	0.84
Cooking_fast	0.30	0.07	4.08	0.00
Gravy_good	1.15	0.08	14.44	0.00
Age_middle	-0.08	0.08	-0.94	0.34
Age_old	-0.20	0.13	-1.56	0.12
Education_sec	0.00	0.09	-0.04	0.97
Education_col/univ	-0.01	0.16	-0.09	0.93
Education_tech/voc	0.14	0.23	0.60	0.55
Sex_male	0.00	0.12	0.01	0.99
Household size	0.01	0.01	0.71	0.48
Residence_medium	-0.18	0.08	-2.22	0.03
Residence_high	-0.19	0.12	-1.53	0.13
Willingness to pay				
Size_medium	-882.27	708.73	-1.24	0.21
Size_large	1629.99	671.70	2.43	0.02
Cooking_fast	1262.50	587.82	2.15	0.03
Gravy_good	759.32	798.33	0.95	0.34
Age_middle	-44.09	611.51	-0.07	0.94
Age_old	-143.63	1034.28	-0.14	0.89
Education_sec	-496.60	746.72	-0.67	0.51
Education_col/univ	-1738.33	1154.91	-1.51	0.13
Education_tech/voc	1151.32	1639.89	0.70	0.48
Sex_male	1191.24	1004.812	1.19	0.24
Household size	-84.87	141.82	-0.60	0.55
Residence_medium	144.57	607.50	0.24	0.81
Residence_high	1604.80	882.12	1.82	0.07
Sigma				
Constant	4737.07	178.88	26.48	0.00

Source: Researcher's findings

Findings on marginal effects analysis reveal that the probability of the variety being selected was highly affected by quality of gravy (Table 17). It was estimated that "soya

supa" beans with good gravy had higher probability of being chosen by 0.33 relative to "soya supa" with poor gravy. Likewise, fast cooking "soya supa" had higher chances of being chosen relative to slow cooking ones. To the contrary, households from medium income residence had lower probability of choosing it relative to those from low income residence.

Table 17: Marginal effects of significant variables on soya supa beans

Variable	Mean	Standard deviation
Effects on probability of selection		
Cooking_fast	0.08	0.03
Gravy_good	0.33	0.14
Residence_medium	-0.05	0.02
Effects on conditional mean WTP (Tsh)		
Size_large	1202.08	156.66
Cooking_fast	829.39	108.09
Residence_high	1177.58	153.47
Effects on overall mean WTP (Tsh)		
Size_large	378.29	279.09
Cooking_fast	815.45	610.83
Residence_high	-4.98	18.31

Source: Researcher's findings

In addition, respondents who selected "soya supa" were willing to pay more for large grains by about Tsh 1202 relative to small grains. Moreover, overall WTP for fast cooking "soya supa" beans was Tsh 815 higher than that on slow cooking beans. High income residence increased mean WTP among those who selected the variety while reduced the overall mean WTP relative to low income residence (Table 17).

4.4.4 Factors influencing selection and WTP for yellow beans

Results indicate that medium grain size and good gravy influenced significantly both the probability of selection and WTP for yellow beans (Table 18). Moreover, household size had significant influence on the probability of selection only. Technical/vocational and college/university education levels were significant relative to at most primary, and middle

and old ages were significant relative to young age. Being male was significant relative to being female on expenditure.

Table 18: Factors influencing selection and WTP for yellow beans

Variable	Coefficient	Robust s.e.	z	P>z
Selection equation				
Size_medium	0.53	0.10	5.34	0.00
Size_large	0.01	0.10	0.07	0.94
Cooking_fast	0.02	0.08	0.21	0.84
Gravy_good	0.92	0.09	10.57	0.00
Age_middle	0.03	0.02	2.09	0.04
Age_old	0.22	0.09	2.43	0.02
Education_sec	0.03	0.13	0.26	0.80
Education_col/univ	-0.17	0.10	-1.75	0.08
Education_tech/voc	-0.43	0.17	-2.47	0.01
Sex_male	-0.45	0.30	-1.50	0.13
Household size	0.14	0.12	1.15	0.25
Residence_medium	-0.07	0.08	-0.85	0.40
Residence_high	-0.32	0.24	-1.33	0.35
Willingness to pay				
Size_medium	-1483.27	868.48	-1.71	0.09
Size_large	77.71	898.03	0.09	0.93
Cooking_fast	590.27	715.74	0.82	0.41
Gravy_good	1676.50	900.73	1.86	0.06
Age_middle	239.74	161.23	1.49	0.14
Age_old	-505.32	775.01	-0.65	0.51
Education_sec	-2012.04	1218.20	-1.66	0.10
Education_col/univ	251.04	867.86	0.29	0.77
Education_tech/voc	1055.47	1720.21	0.61	0.54
Sex_male	-3686.98	1670.92	-2.21	0.03
Household size	51.50	1136.31	-0.05	0.96
Residence_medium	-397.85	732.01	-0.54	0.59
Residence_high	-1163.27	1415.30	-0.82	0.41
Sigma				
Constant	4212.97	374.97	11.24	0.00

Source: Researcher's findings

Marginal effects show that gravy quality had the highest effect on the probability of yellow beans being selected followed by grain size. It was estimated that yellow beans with good gravy had 0.22 higher probability of being selected relative to those with poor gravy. Likewise, yellow beans with medium grain size had 0.13 higher probability of being selected relative to those with small grains while household size, middle and old age had positive but relatively smaller effect (< 0.1) on the probability (Table 19). Contrary, respondents with secondary and college/university education had low probabilities of

selecting yellow beans relative to those with at most primary education by 0.04 and 0.08 respectively.

Table 19: Marginal effects of significant variables on yellow beans

Variable	Mean	Standard deviation
Effects on probability of selection		
Size_medium	0.13	0.05
Gravy_good	0.22	0.09
Household size	0.01	0.00
Age_middle	0.05	0.02
Age_old	0.02	0.01
Education_sec	-0.04	0.02
Education_col/univ	-0.08	0.04
Effects on conditional mean WTP (Tsh)		
Size_medium	40.82	7.92
Gravy_good	880.71	170.94
Sex_male	-1936.87	375.94
Effects on overall mean WTP (Tsh)		
Size_medium	-510.82	350.62
Gravy_good	1010.92	759.71
Sex_male	-793.75	598.63

Source: Researcher's findings

Furthermore, male respondents had lower conditional mean WTP by about Tsh 1937 relative to female. Good gravy increased both conditional and overall mean WTP for yellow beans by about Tsh 881 and Tsh 1011 respectively. Although conditional mean WTP for medium grains was slightly higher relative to that on small grains, the overall mean WTP was lower by Tsh 510 implying that majority of the respondents did not select yellow beans. Moreover, overall mean WTP by male respondents was about Tsh 794 less than that of female respondents (Table 19).

4.4.5 Comparison of respondents' preferences over the four bean varieties

Comparison of the estimation results from the four bean varieties reveals that mottled red beans had the highest predicted mean probability of being selected (0.35) relative to "soya kawaida", "soya supa" and yellow beans with 0.20, 0.27 and 0.19 predicted mean

probabilities respectively (Table 20). These results are consistent with findings by Mishili *et al*. (2009a). In that study it was reported that yellow beans were the least preferred in Tanzania relative to red canadian wonder and "soya kablanketi" varieties.

Considering the fact that choice alternatives were not priced and respondents were given a fixed amount of money, respondents' willingness to pay for the alternatives completely reflected their preferences. Predicted mean WTP for the four varieties indicate that mottled red beans were the most preferred followed by "soya supa" and "soya kawaida" while yellow beans were the least preferred ones. This was reflected by the predicted mean WTP where both conditional and overall mean WTP for mottled red beans (about Tsh 7892 and 2833) were higher as compared to those for "soya kawaida", "soya supa" and yellow beans (Table 20).

Table 20: Expected probabilities and mean WTP for the four bean varieties

Variety	Probability of being selected	Conditional mean WTP (Tsh)	Overall mean WTP (Tsh)
Mottled red	0.35	7891.85	2832.69
"Soya kawaida"	0.20	5635.80	1263.97
"Soya supa"	0.26	6872.11	1934.87
Yellow	0.19	4607.14	908.36

Source: Researcher's findings

With respect to the factors influencing respondents' choices, results reveal that beans attributes were the main determinants of respondents' choices as they significantly influenced both the probability of selection and willingness to pay for the selected alternatives in all the four models. The findings are supported by Annunziata and Vecchio

(2012) who reported that consumers' food choices are mainly influenced by the product attributes. A similar argument was made by Lusk *et al*. (2001) who reported that the probability of choice is rarely affected by demographic and individual specific characteristics because they don't vary across the choice tasks. However, World Bank (2007) argued that individual characteristics may interact with product attributes in shaping food choices.

Respondents showed high sensitivity to gravy quality relative to grain size and cooking time as it was observed to be significant and exerting the strongest effect in all the four models. This implies that consumers preferred beans with good gravy as compared to the other two attributes. Cooking time was the next most influential factor after gravy quality where consumers showed preference over fast cooking beans in three out of the four varieties. Similar results were obtained by Chirwa and Phiri (2007) when studied factors that influence demand for beans in Malawi. Also Katungi *et al*. (2011) reported significant influence of cooking time on the common beans variety demand in drought areas of Kenya. Jones *et al*., (2006) also reported that the ease of cooking of various legumes are amongst the most important traits favored by consumers. However, though grain size significantly influenced consumers' choices, its direction of effect was unstable. While consumers preferred small sized mottled red and "soya supa" beans, they showed preference on large "soya kawaida" and medium sized yellow beans. Also Sichilima *et al*. (2016) reported significant influence of grain size on common beans consumer preferences in Zambia. Mishili *et al*. (2009b) also found that cowpea consumers in Ghana, Nigeria and Mali preferred large grains.

Moreover, consumers with secondary education preferred mottled red beans relative to consumers with at most primary education while those with at most primary education

preferred yellow beans. Significant influence of education in food choices was also reported by CAN *et al*. (2015) on fish preferences in Turkey and Mak *et al*. (2012) on tourists' food preferences and consumption. This information is useful to producers and traders in devising appropriate consumer targeting strategies.

Other demographic factors that had significant influence include household size which influenced positively the probability of yellow beans being selected and negatively that of "soya kawaida" implying that large households preferred yellow beans over the other three varieties. Consumers from high income residence areas preferred mottled red beans relative to those from low income residences. Moreover, middle and old aged decision makers preferred yellow beans relative to youth and male decision makers preferred "soya kawaida" relative to their female counterparts. Significant influence of residence status, age and sex of the decision maker on food preference was also reported by Mak *et al*. (2012).

When respondents' socio-demographic characteristics were interacted with beans attributes, results from the four varieties consistently revealed that female decision makers preferred beans with large size and were more sensitive to gravy quality as compared to their male counterparts. On the other hand, male, old and technical education decision makers were more sensitive to the cooking time. Analysing interaction effects was suggested by World Bank (2010) who argued that individuals' socio-demographic factors interact with product attributes to influence consumers' choices of food products.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Findings from this study reveal that majority of households in Dar es salaam (96%) consume beans and only few (4%) do not consume beans. Consumption prospects are generally high among decision makers with large households, who reside in medium income areas, those aged less than 30 years, and those with no formal education or with primary education.

Moreover, there is high consumption frequency of dry red beans followed by dry brown, dry mottled and dry purple beans in that order. Processed bean products (such as bean flour, baked and canned beans) happen to be the least frequently consumed with majority of households reporting never to have consumed them at all.

Good gravy and fast cooking are the most appealing attributes to consumers in Dar es salaam. Good gravy strongly influenced the selection of all the four bean varieties followed by fast cooking time which influenced selection of three out of the four varieties and lastly grain size which influenced selection of at least one of the varieties.

Generally, mottled red beans are the mostly preferred relative to “soya supa”, “soya kawaida” and yellow beans especially by households from high income residences and decision makers with secondary education level. Yellow beans are uniquely preferred by households whose main decision makers have large families, are middle aged (30-50 years) or old (more than 50 years), and those with no formal education or with primary education.

Consumers seemed to be willing to pay more for beans with good gravy and those that cook fast. The effect of grain size on willingness to pay varied across consumers. Consumers from higher/medium income residences and secondary education were willing to pay more for small sized mottled red beans while consumers in low income residence were willing to pay more for large sized yellow beans. Previous studies associated preference for large grained legumes with the idea that they swell when cooked and thus a little amount (which has implication on reducing cost) would be sufficient for the household.

Therefore, efforts to promote beans consumption in the country should consider bean varieties and attributes that are preferred by different consumer categories.

5.2 Recommendations

Based on the study findings the researcher recommends that;

- Bean breeders should strive to induce attributes that meet consumers' preferences (good gravy, fast cooking) when they develop new varieties

- Future efforts to promote beans consumption should potentially target non-consumers, consumers in high income residences, those aged 30 years or above, and those with education above primary.

- Knowledge on alternative preparation methods such as baking and canning should be provided to consumers in order to minimize cooking time.

5.3 Limitations of the study

The major limitation of this study was the analytical tool used in analyzing consumers' choices of beans. The most ideal analytical too in analyzing consumer preferences in a choice experiment setting is a mixed logit model. However, because of data related challenges in implementing the mixed logit model, analysis of factors influencing choices of beans was based on Cragg's double hurdle model. Analysis focused on factors that influenced whether or not a particular bean variety was chosen and the extent to which these factors influenced willingness to pay for the selected varieties instead of analyzing factors influencing choice among the eight choice alternatives in a given choice set.

Furthermore, exclusion of price as an attribute in the choice alternatives is another weakness in the design of the experiment. This is because in the actual choice consumer behaviour choices are also affected by the relative prices of the choice alternatives.

Another limitation of this study is that it was conducted in Dar es salaam only. Therefore, findings from the study cannot be used to make generalizations about beans consumption and preferences in other places or the entire country.

5.4 Recommendations for further research

Since the study was conducted in Dar es salaam, similar studies should be conducted in other urban and rural areas in the country in order to compare results and provide broader information on consumer preferences. This will also be useful to farmers in targeting their produce to various areas in the country.

There is also a need for more comprehensive studies on the contribution of common beans to the household's food security and nutrition whose findings will serve as evidence for promoting beans consumption in the country and creating a reliable market for bean producers.

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