Product attributes and consumer preference: The case of common beans in Zambia.

by

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Abstract

Beans play a major role in addressing malnutrition and poverty in Africa. Hence, several studies have been conducted over the last two decades on beans attributes in various African countries, including Zambia. The similarity of these studies is their emphasis on the importance of including consumer preferences in the beans supply chain. This study attempts to contribute to informing the bean supply chain about bean attributes and consumer characteristics influencing beans consumption so that downstream stakeholders can effectively seize the embedded opportunities in the bean supply chain.

Data used in this study were obtained from 900 surveyed households in Lusaka, Zambia and analyzed using a logit model. The study evaluated three attributes of beans: gravy quality; cooking time; and grain size. In addition, it assessed the price of beans associated with these attributes. The study sought to determine how these attributes influenced consumer preference for specific color beans. Results show that gravy quality, cooking time and price are important bean attributes influencing consumer preference for purple, mixed yellow and yellow bean while grain size has no statistically significant effect. The study also found that gender, education, and employment status of the household head or person purchasing food for the household, as well as the household's child dependency ratio, dual household income, residential area and perception of the bean food group's importance to consumers' nutritional security were statistically significant in their effect on preference for purple, mixed yellow and yellow beans. The study's results contribute to downstream stakeholders' efforts to improve their own decisions in identifying the market segments to engage in. For example, bean breeders, producers and traders might optimize limited resources available for their activities by investing in products that promise large markets to use volume to overcome any price disadvantage regarding profitability.

Similarly, they may also invest in high value low volume products that could also provide them with acceptable profitability. The option used would depend on their location and their own resource situation.

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Dedication

I dedicate this research to my sister for her love for knowledge.

Chapter 1 - Introduction

1.1. Background

Common beans, *Phaseolus vulgaris*, are an important class of legumes and one of the world's most nutritious and versatile crops. The protein in beans is similar in content to animal products such as chicken, beef and fish (Richter et al. 2015). A half-cup serving of beans is equivalent to an ounce of chicken, beef or fish in terms of protein content (USDA, 2015). Additionally, beans are an excellent source of fiber and micronutrients such as zinc, iron, folate and potassium (Messina, 1999).

Despite these nutritional opportunities, common beans' consumption is very low in Zambia, making up only 3.7% of households total food expenditures in Lusaka (Hichaambwa et al. 2009). While it may be argued that beans are not traditional ingredient in Zambian diets, it has been promoted as a nutritious food for people with significant income constraints (Beebe 2012; Birachi, 2012; Akibode, 2011).

According to studies (Quaye et al., 2011; Langyintuo et al. 2004; Temu & Lowenberg-Deboer, 2005), three main factors influence bean consumption: consumer characteristics, visible product attributes and invisible product attributes. Beans' visible product attributes include color, grain size and other attributes consumers can perceive prior to purchase while beans invisible product attributes are their expectations that are realized ex post. Consumers' expectations of products' invisible attributes are developed from history, experience, culture, advertisement and other information sources. The consumer characteristics includes demographic (age, gender), socioeconomic (income, education) and psychographic (tradition) characteristics.

Consumers perceive beans price, color and size prior to purchase. However, attributes such as gravy quality and cooking time are realized ex post. Consumers perception about these attributes emanates from experience, history and culture. The extent to which visible product attributes affect consumer choices is important in the commercial success of the product. Research shows that bean color carries the primary signal for consumer choice (Mishili et al., 2009; Magreta and Jambo, 2012). Studies on consumer preference for beans (Temu & Lowenberg-Deboer, 2005) and cowpea (Langyintuo et al., 2004) in Sub-Saharan Africa have established that bean color serves

as an indicator which consumers use to perceive the presence of invisible bean attributes such as cooking time and gravy quality.

Consumers are at the end of the supply chain and the forefront of all demand activities, therefore, the first and most essential factor critical to the success of a supply chain is the production of goods with attributes deemed valuable by the end user (Kinsey, 2001). Further, Langyintuo et al. (2003) stresses the importance of consumer information in improving breeders and producers' understanding of the market in which they operate. Taking into consideration consumer preference in product development is also vital in the adoption of new bean varieties (Katungi et al., 2010).

Increasing the bean supply chain appreciation of the effect of consumer characteristics on their preference for the different bean attributes may help in enhancing the profitability of the total chain, especially farmers whose income are significantly constrained by the choice of beans produced. Breeders would be able to incorporate this information in identifying the most potentially profitable varieties to develop and multiply, and farmers would be able to choose the varieties with the attributes that offer the highest value to consumers (Dalton, 2004; Adesina and Baidu-Forson, 1995).

1.2. Research question

In light of the foregoing, this research asks the following questions:

i. Which consumer characteristics influence consumer preference for different bean colors?
ii. To what extent are visible attributes and invisible attributes contributing to preference for bean colors?

We use beans consumption in Zambia as a case study of explaining consumer preference for products with both visible and invisible attributes given a dominant characteristic (color) of the product.

1.3. Research Objectives

The overall objective of this study is to determine the influence of bean attributes and consumer characteristics on consumer preference for bean color. The specific objectives are as follows:

1. Assess the consumer profile of bean in term of bean consumption frequency
2. Evaluate the probability of consumers choosing a particular bean color given bean attributes and consumer attributes.
3. Develop strategic directions for the common bean supply chain on how its stakeholders may utilize the information emanating from this research to enhance their profitability.

1.4. Research Outline

The next chapter is the literature review chapter. In this chapter, the Lancaster consumer theory, which provides basis for this study, is discussed. Further, the bean supply chain and studies on consumer preference for bean are reviewed. The third chapter involves the description of the data used in the study and a review of the econometric model used in analyzing the data. In the fourth chapter, the results from the statistical and econometric analysis used to achieve the first and second research objectives are presented. The third research objective is addressed using findings from the analysis. The last chapter provides the conclusion and summary for the study, as well as the its limitations and suggestions for further future research.

Chapter 2 - Literature Review

In this chapter, we present an overview of the literature on consumer theory and frame it within the context of product attributes and consumer characteristics. The chapter is organized into four sections. The first section provides an overview of traditional consumer theory and its consequences on understanding non-market characteristics of products and services. The second section discusses the importance of understanding consumer preference in the beans supply chain while the third section explores previous studies on consumer preference for bean attributes.

2.1. Consumer Theory

Based on the assumptions of traditional demand theory, consumers demand products based on prices and income. Prices include both that of the product of interest as well as those of other goods. Changes in own price affects the quantity of products demands, yielding the demand curve. Researchers with interest in consumer theory have found the assumptions of the traditional consumer theory limiting in empirical applications. The theory assumed that products are just products i.e. consumers obtain utility directly from products. The inadequacy of the theory started materializing in the second half of the last century.

In an attempt to make the utility function more favorable for empirical studies, Strotz (1957) proposed the utility tree. Strotz argued that consumer utility, U, for the consumption of a particular product comprises branch utility functions of components associated with the consumption of that product. Further, Strotz (1957) suggested that the utility tree is similar to the hierarchal process of budgeting, where budget is allocated first to different categories such as food and then to individual commodities within each budget category, such as beans and meat categories. Strotz utility tree may be expressed as:

$$U = U[X^A(c_{a1}, \dots\dots, c_{a\alpha}),\ X^B(c_{b1}, \dots\dots, c_{b\beta}), \dots\dots\dots,\ X^M(c_{m1} \dots\dots, c_{m\mu})] \quad (2.1)$$

where U is the consumer utility and $X^I(c_{i1}, \ldots\ldots\ldots\ldots, c_{ii})$ is the branch utility function. Each component $c_1 \ldots\ldots\ldots\ldots c_N$ are categorized into M separate branch utility functions, where $\alpha + \beta + \cdots \mu = N$ and N is the total number of commodities in the consumer utility function.

Improving on Strotz (1957) utility tree, Muth (1966) came up with a weakly separable[1] utility function. Muth (1966) illustrated that a consumer utility function, $U = U(X_1 \ldots\ldots\ldots\ldots X_P)$ comprises of products, X_i such as nourishment. He further stated that the consumer has P production functions $X_p = X_P(q_{p1}, \ldots\ldots\ldots, q_{pn})$ of commodities, q_i such as uncooked meat from which the products consumed by the consumer are derived.

Muth (1966) argued that for any two commodities used in producing a product consumed by the consumer, the marginal rate of substitution for consumption is the same as the marginal rate of substitution for the production of such product. The marginal rate of substitution of two commodities used in the production of a certain product is functionally independent of other commodities that are not involved in the production of that particular product ,hence, the consumer utility is weakly separable.

In his seminal article, Lancaster (1966) indicated how butter and margarine are often used as an example of substitutes while automobile and gasoline are used as an example of complement goods in fundamental textbooks as though the authors could perceive the intrinsic characteristics that make such products complements or substitutes of one another. Although previous utility theories by Strotz (1957) and Muth (1966) have indicated that utility is not derived directly from products per se, Lancaster's consumer theory further explored this line of thought by establishing that consumers do not derive utility directly from a product in and of itself, but rather from the product's attributes.

The following are Lancaster's (1966) assumptions:

i. Consumer utility is not obtained directly from a product but rather derived from its attributes.

[1] Weak separability imply that the marginal rate of substitution of two particular products is functionally independent of the quantity of other products.

ii. A product has multiple attributes and many products will share many attributes.
iii. The attributes possessed by a combination of products together may differ from the attributes possessed by each of the products separately.
iv. A product or combination of products are consumption activities in which the level of such activity has a linear relationship with the total goods required for the activity.
v. Each consumption activity generates a fixed set of characteristics; also, the relationship between the consumption activity and the characteristics is linear.
vi. Consumers rank products indirectly through products' attributes and will choose the combination of attributes that maximizes their utility.

The main limitation of Lancaster's consumer theory, as pointed out by Mark et al. (1981) and Green (1976), is the difficulty of identifying relevant and objectively measuring attributes. Mark et al. (1981) point out that the quality of a good is subject to consumer perception and there is often a difference between attributes considered relevant by consumers and those considered relevant by researchers. However, researchers could employ different approaches to overcome these limitations in empirical studies. However, researcher's professional knowledge as well as seeking advice from product designers or experts, conducting focus group or open-ended interview with consumers (Geistfeld et al., 1997) play an important role in identifying and objectively measuring relevant product attributes.

Lancaster consumer theory has been applied extensively in various fields, including economics (Rosen, 1974; Archibald and Rosenbluth, 1975), agricultural economics (Greig, 1983; Eastwood et al., 1986), food sciences (Shine et al., 1997), marketing studies (Shaw et al., 1997; Yahaya, 2015), finance (Franklin, 1979; Smith, 1974), social sciences (Lin, 1983; Kinzy, 1991) and international trade (Katrak, 1973).

2.2. Importance of Consumer Preference in the Bean Supply Chain.

Researchers define supply chain to suit what they are working with (Pienaar, 2009; Mentzer et al. 2001; Ayers, 2001; Chow et al. 1994; Beamon, 1998). Beamon (1998) defines supply chain as a process whereby commercial entities including the

manufacturer, processor and retailers work jointly to source raw materials, process them into finished goods and deliver the goods to the retailer. Within this premise, the supply chain is viewed from an industry perspective.

Further, Chow et al. (1994) incorporate logistics into the definition of the supply chain and define supply chains to involve all firms involved in production, sales and distribution of goods from the source to consumers. Mentzer et al. (2001) define supply chain as a process involving three or more agents who are responsible for the upstream and downstream flow of products, services or information from producer to consumers. For the purpose of this study, we employ the latter definition of supply chain.

A supply chain can be classified into two broad categories; coordinated and uncoordinated. A coordinated supply chain facilitates efficient movement of goods from upstream to downstream and flow of information of downstream needs to upstream actors. Since a coordinated supply chain often requires a form of investment from supply chain participants to foster trust within the supply chain, most supply chains are uncoordinated because not all supply chain actors are willing to make the investments required (Mwansa, 2013).

There are different types of channels in which smallholder farmers market their produce in Zambia. They include selling directly to local consumers, roadside market centers or through intermediaries who are often responsible for 50% to 75% sales of rural farm produce (McCullough et al., 2008). The intermediaries are essentially traders who purchase in bulk from more than one smallholder farmers and provide transportation of agricultural produce to wholesalers and retailers in urban areas. However, wholesalers also purchase directly from smallholder farmers who have larger bulk.

Studies (Mishili et al., 2009; Langyintuo et al., 2003; Temu and Lowenberg, 2005) indicate size and color as the most important bean attributes. However, visible attributes alone are not sufficient in influencing consumers purchase decision. Wortmann (1998) reported most African beans consumers base their purchase decision on other sensory attributes, like culinary quality and taste. Price is also a key factor influencing not only consumers' purchase but also farmers' planting decisions. Poor consumers and farmers substitute preferred bean varieties for less preferred alternatives with lower price

(Wortmann, 1998), thus, implying that low income consumers preference for beans price overshadows their preference for other beans attributes.

Figure 1: A schematic of Zambia's agricultural supply chain

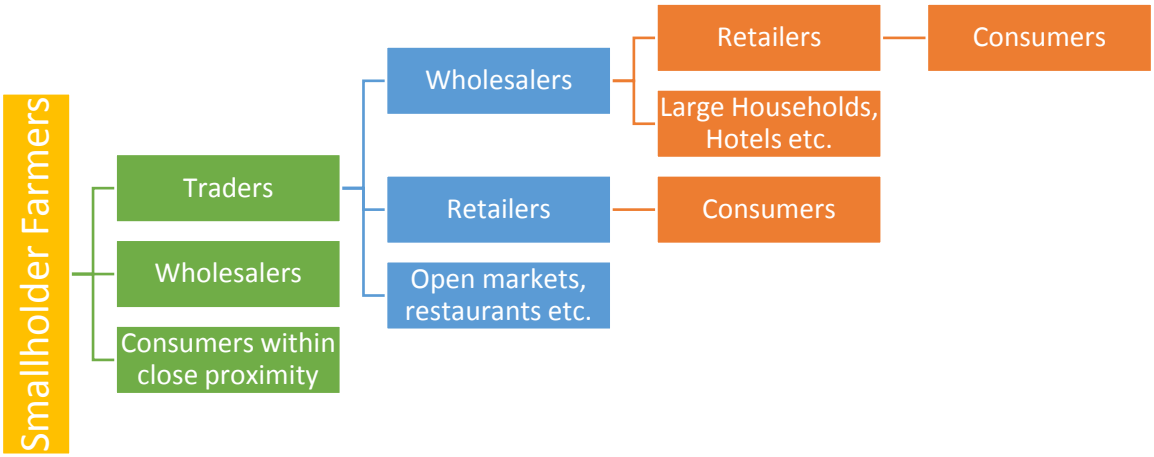

Fig 2-1 shows that with the exception to proximate consumers, Zambia smallholder farmers do not possess information on consumer preferences in distant areas. Mishili et al. (2009) also reported that this is the case for bean farmers in Tanzania. However, Quaye et al. (2011) found that traders' perception of consumer preference for bean attributes is similar to consumer stated preference in urban areas. As intermediaries, traders are in an excellent position to bridge the information gap between bean producers and consumers in the urban areas.

However, a study conducted by Chirwa (2007) in Malawi reveals that two-thirds of traders do not inform producers about consumer bean preferences, which result in higher price of preferred bean variety. While some traders claim the reason for not informing producers about consumer bean preference is the assumption that producers are aware of this information, others fear if producers are armed with the knowledge of

consumers beans preference, they will charge premiums for the preferred bean variety, thus facilitating adverse selection[2].

2.3. Consumer Preference for Beans Attributes

In the past twenty years, several studies have been conducted on consumer preference for bean attributes. Using various methods, researchers have assessed preferences for different bean attributes in various producing locations. Most of these studies (Mishili et al.,2009; Faye et al., 2004; Lanyintuo et al., 2003) employ hedonic price analysis to determine preferred intrinsic and extrinsic attributes and rank each attribute according to the premium or discount it commands.

In their study on consumer preference as drivers of common beans trade in Tanzania, Mishili et al. (2009) show both common bean and cowpea possess similar consumer preference in terms of grain size and color. Studies show that bean and cowpea attributes preference vary among consumers by the type of cuisine they are used for, method of processing, whether used whole or milled, geographical location, and household income level.

In a cross-national study conducted by Langyintuo et al. (2003) in Cameroon, Ghana, Nigeria and Senegal, findings indicate that premium price paid by consumers for large cowpea grain size was statistically significant in all countries except Nigeria. Lanyintuo et al. (2003) suggested that the vast heterogeneity in demographic characteristics in Nigeria influenced this finding. Mishili et al. (2009) found a similar result in their study on cowpea preference in Ghana, Mali and Nigeria urban markets. Langyintuo et al. (2003) found opposite behaviors between Ghanaian and Cameroonian consumers, where consumers respectively paid premiums and discounts for the same attributes. This difference in willingness to pay is due to their different cuisine and preparation methods. Cameroonians have low tolerance for the presence of black flecks caused from poor milling or winnowing in their cowpea fritters, while the presence of

[2] Adverse selection in this case imply a scenario where traders are equipped with knowledge of bean preference while farmers are not, thus, putting the latter at a disadvantage in transaction.

black flecks does not affect the quality of the Ghanaian tubani and other Ghanaian cowpea dishes (Langyintuo et al., 2003).

Langyintuo et al. (2004) assessed seven markets in Ghana and Cameroon; they observed that consumers were willing to pay a premium for grain size in all but two of the markets and will pay a premium for longer storage time. In a study by Temu and Lowenberg (2005), they treated bean grain weight and grain size as separate attributes and compared their results to studies that use grain size and weight interchangeably (Langyintuo et al., 2003; Langyintuo et al., 2004; Faye et al., 2004; Mishili et al., 2009). Temu and Lowenberg (2005) discovered that while consumers are willing to pay a premium between 1 and 2 percent per 100g in bean size, they discounted bean grain weight.

Quaye et al. (2011) carried out a study in two Ghanaian cities, Accra and Kumasi, using data collected on consumer stated preference, and consumer preference for cowpea attributes perceived by traders. The cowpea attributes considered for the study are as follows: color, cleanliness, cooking time, size, taste, dryness, weevil damage and place of origin. Result shows bean attributes preference ranking was similar for traders and consumers with grain color, cooking time, grain size and taste being among the top five of eight bean attributes. The place of origin attribute is perceived by consumers to represent presence of certain attributes. For instance, consumer prefer beans from Nigeria because these beans are perceived to be cleaner than locally produced cowpeas while beans from Togo are preferred because they are less expensive, have fast cooking time and are perceived to be tastier than locally produced beans.

Katungi et al. (2011) explored preference for bean production and consumption attributes among farm households in drought areas of Kenya using a Lancastrian consumer demand and Singh Squire Strauss non-separable household model. Results from the study indicate that all respondents place an importance on all production attributes but their preference for consumption attributes is diverse. Findings also show wealthier farming households are willing to pay premium for larger grain size while low and middle-income households are indifferent.

Faye et al. (2004) surveyed six markets across Senegal over a five-year period to determine the influence of cowpea characteristics on cowpea prices. The markets were

chosen based on level of cowpea production in their locations: Mpal and Sagatta markets were chosen for being major cowpea production area; Bambey and Niro markets are located in areas where farmers consider cowpea a secondary crop; and Tilene and Castor markets are located in Senegal's capital, Dakar, where there is no cowpea production.

Result from the study reveals that consumers are willing to pay a premium for large grain size in all markets. However, their willingness to pay was highest in Mpal market. Consumers do not discount for bruchid holes in all markets except in Tilene market. When compared with cowpeas with white testa, consumers in Mpal market are willing to pay a premium for cowpeas with red testa while discounting cowpeas with black speckled testa. However, consumers in Bambey market are willing to pay a premium for cowpeas with black speckled testa. While consumers in Sagatta, Bambey and Castor markets are indifferent to cowpea eye color and texture, consumers in Nioro, Mpal and Tilene are willing to pay a discount for black eye cowpeas and smooth textured cowpeas. This is associated to consumers perception that smooth textured cowpea to have a longer cooking time (Faye et al. 2004).

A survey conducted in three markets in Lusaka, Zambia indicates that nearly 90% of traders thought small grain size is important (Sichilima et al., 2016). However, findings from a hedonic price analysis reveals consumers are willing to pay a premium for medium grain size and certain grain color (yellow and white). The study further emphasized on the importance of incorporating consumers and traders' bean attribute preference particularly grain size and grain color preference in the value chain.

Although, several studies have been conducted using the revealed preference method to analyze consumer preference for bean attributes, most of these studies (Mishili et al., 2009; Langyintuo et al., 2004; Quaye et al., 2011) used only product attributes to analyze factors influencing consumer preference for bean attributes. Few studies using the revealed preference have assessed the influence of both consumer and product attributes on consumer preference for beans (Mfikwa et al., 2014; Katungi et al., 2011; Langyintuo et al., 2004), however, none of these studies used the stated preference approach.

Chapter 3 - Data, Study Location and Methods

In this chapter, we discuss the model and the variables used in this study. The chapter is divided into three main sections. In Section 3.1, the theoretical foundation of the model and the empirical model used in the study are discussed. Section 3.2 discussed the data used in the study and Section 3.3 explains the variables used in the model and their hypothesized effect.

3.1. Logit Model

The logit model is used in this study to model whether a consumer prefers a certain color of beans to others. The dependent variable is a binary choice indicator representing consumer preference for a particular color of bean, taking on the value of "1" if the consumer indicates a preference for it and "0" if not. A logit model is a probabilistic choice model developed by Luce (1959) based on the assumption of independence of irrelevant alternatives (IIA), i.e., the error term is identically and independently distributed across alternatives. The binary logit model can be derived using three different approaches: the nonlinear probability approach, the latent variable approach and the random utility approach. For the purpose of this study, we are going to employ the random utility approach.

3.1.1. The Random Utility Approach

The consumer theory assumes that consumers are rational and maximize their utility subject to the alternatives available to them and given their incomes. This imply that given the choice between two alternatives, consumers would always choose the alternative that provides them with the highest utility.

The random utility theory is based on four assumptions.

i. Consumer *n* considers mutually exclusive alternatives available in their choice set I^n when making a choice: moreover, choice set vary by consumers.

ii. Consumer *n* assigns perceived utility to each alternatives in his choice set I^n and chooses the alternative that maximizes this utility.

iii. The utility assigned to each alternative is a function of the attributes of the alternative and the consumer characteristics.

iv. External observers cannot determine with certainty the utility assigned to each alternative by a consumer. Thus, in modelling consumer choice behavior, the uncertainty element of a consumer utility must be represented by a random term.

Although, consumers' choice cannot be predicted with certainty, the likelihood of a consumer choosing an alternative can be captured. Consumer *n* given the choice between consuming bean i or not, would choose to consume bean i only if the utility derived from consuming bean i, U_{ni}, is greater than the utility obtained from not consuming bean i, U_{nj}.

$$P^n(i|I^n) = Pr(U_{ni} > U_{nj}) \quad \forall\, i \neq j;\ i,j \in I^n \tag{3.1}$$

The utility derived from consuming bean i, U_{ni} can be decomposed into two components.

$$U_{ni} = V_{ni} + \varepsilon_{ni} \tag{3.2}$$

where V_{ni} is the systematic utility, which is a function of observable consumer characteristics and bean attributes such as color, size, cooking time and gravy quality. ε_{ni} is the stochastic term which represents component of consumer utility function unknown to the researcher. According to Manski (1977), the stochastic component could be a result of unobserved individual characteristics, measurement error, proxy variables and unobserved attributes. The logit model is derived based on the assumption that the stochastic term has a gumbel distribution i.e. independent and identically distributed extreme value (Train, 2009).

The probability that a consumer prefer bean i can thus be expressed as:

$$P_i = \Pr(U_{ni} > U_{nj}) \tag{3.3}$$

$$= \Pr(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) \tag{3.4}$$

$$= \Pr(V_{ni} - V_{nj} > \varepsilon_{nj} - \varepsilon_{ni}) \tag{3.5}$$

3.1.2. The Empirical Model

The study covered eight bean colors: purple; yellow; mottled red; mixed yellow; white; red; mottled brown and white with brown spots. Five of them were discarded because they were consumed by less than 25% of the respondents, presenting too few responses to facilitate an effective analysis. Thus, we focused on the three remaining beans varieties and estimated the probability of each beans being consumed given their attributes and consumer characteristics. According to Greene (2003), the standard form of the logit model can thus be expressed as:

$$Prob\ (y = 1|x) = \frac{\exp(x'\beta)}{1 + \exp(x'\beta)} \tag{3.6}$$

where *y* is the binary dependent variable used in the model and x' is a vector of covariates including consumers' socioeconomic and demographic characteristics that are assumed to determine consumer bean preference. The logit model can be further simplified to:

$$P = \frac{\exp(x'\beta)}{1 + \exp(x'\beta)} \tag{3.7}$$

$$P(1 + \exp(x'\beta) = \exp(x'\beta) \tag{3.8}$$

$$P + P(\exp(x'\beta)) = \exp(x'\beta) \tag{3.9}$$

$$P = \exp(x'\beta) - P(\exp(x'\beta)) \tag{3.10}$$

$$P = (1 - P)\exp(x'\beta) \tag{3.11}$$

$$\frac{P}{1 - P} = \exp(x'\beta) \tag{3.12}$$

$$ln(\frac{P}{1 - P}) = x'\beta \tag{3.13}$$

In total, three different logit models were ran; one for each color.

Let *P* represents $ln(\frac{P}{1-P})$, three empirical models can thus be specified as:

$$P_{nj} = \beta_0 + \beta_1 X_{1j} + \ldots\ldots\ldots\ldots\ldots + \beta_i X_{ij} + \varepsilon_{nj} \tag{3.14}$$

$$P_{nk} = \beta_0 + \beta_1 X_{1k} + \ldots\ldots\ldots\ldots\ldots + \beta_k X_{ik} + \varepsilon_{nk} \tag{3.15}$$

$$P_{nl} = \beta_0 + \beta_1 X_{1j} + \ldots\ldots\ldots\ldots\ldots + \beta_l X_{il} + \varepsilon_{nl} \qquad (3.16)$$

Where:

P_{nj} is the dependent variable that represent the probability of consumer n consuming purple bean j.

P_{nk} is the dependent variable that represent the probability of consumer n consuming yellow bean k.

P_{nl} is the dependent variable that represent the probability of consumer n consuming mixed yellow bean l.

$X_{1j} \ldots\ldots\ldots\ldots\ldots X_{ij}$ are regressors used in the model and they include product attributes (purple bean size, cooking time and price) and consumer characteristics

$X_{1k} \ldots\ldots\ldots\ldots\ldots X_{ik}$ are regressors used in the model and they include product attributes (yellow bean size, cooking time and price) and consumer characteristics

$X_{1l} \ldots\ldots\ldots\ldots\ldots X_{il}$ are regressors used in the model and they include product attributes (mixed yellow bean size, cooking time and price) and consumer characteristics

An in-depth description and measurement of these variables are presented in section 3.2. The $\beta_1 \ldots\ldots \beta_j$ are the coefficient of the regressors obtained from the model, using the "or" option in STATA, the coefficients obtained from the model are reported in odds ratio.

3.2. Data and Survey Description

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. The Legume Innovation Laboratory, funded under the Feed the Future Innovation Initiative of

the United States Agency for International Development (USAID), funded the network and its research activities.

The data used in this study are obtained from household survey conducted in Zambia's capital city, Lusaka. The survey employed a multi-stage sampling technique to ensure that the sample represents the different categories of people within the population. The first stage involves choosing clusters from three strata of the population, the strata includes high density, medium density and low-density population areas. These strata are related to the income level of the population living in these areas, high-income households typically reside in the low population density areas, middle-income households usually reside in the medium population density areas and low-income households resides in the high population density areas. The second stage involved randomly selecting households from the selected clusters to form the sample for the study.

Trained enumerators using structured questionnaires conducted the survey. Eight hundred and eighty-four households were interviewed and only 2.3% of the households indicated not consuming beans, suggesting a very high level of bean consumption in Lusaka. In preparing the data for analysis in this study, those households that do not consume beans were removed from the dataset. Another 53 households were removed from the list of households used for the final analysis because of incomplete data. Thus, nearly 92% of the total sample was used in the analysis.

3.3. Definition and Description of Variables.

The product and consumer characteristics included in the model are discussed below.

3.3.1. Dependent variable

Bean color: Consumers use beans colors to assume the presence of invisible beans attributes such as cooking quality. In Zambia, beans varieties are recognized by their color. Below are the commonly consumed bean varieties in Lusaka that are used in the study.

Table 3-1: Color and local name bean varieties consumed in Zambia

Bean Variety (Color)	Local name
Purple	**Kablangeti***
Yellow	**Lusaka**
Mixed yellow	**White and yellow**
Mottled red	Solwezi
White	Plain white
Red	Red
Mottled brown	Butter
White with brown spot	Sugar beans

* The bolded ones are the ones used in the study because they were consumed by more than 25% of consumers.

3.3.2. Independent variables

In the previous chapter, we established that consumers derive utility from product attributes. We also reviewed studies that analyzed the effect of consumers' characteristics on their preference for beans. In this study, we investigate how consumer characteristics and beans attributes influence consumer preference for beans varieties. Thus, independent variables used in the model comprise of two major categories: beans attributes and consumers characteristics.

3.3.2.1. Bean attributes.

In this study, two visible attributes (price and size) and two invisible attributes (cooking time and gravy quality) are thought to be important in bean consumption decisions. Thus, data was collected on which beans attributes influence the consumption of each beans variety used in the study. Specifically, respondents were asked whether each of the four bean attributes motivate their consumption for a beans variety or not.

Price motivator: Because price varies by products, product location and time, this would imply that price is an important factor that consumers consider in making beans consumption decisions. The price variable is presented as a binary in the choice decision task, the binary variable that takes the value of "1" if the price is factored in their choice of consuming each beans variety and "0" otherwise.

Cooking time motivator: Due to the cost of domestic fuel in low-income countries, consumers are sensitive to the amount of fuel used in cooking beans. Therefore, it is important to determine how cooking time attribute influence consumers bean consumption decision. Cooking time motivator is a binary variable that takes the value of "1" if the consumer is motivated by beans cooking time in consuming a particular bean variety and "0" otherwise.

Grain size motivator: Studies (Langyintuo et al., 2004; Temu and Lowenber-Deboer, 2005) have shown that beans consumers consider grain size in making purchase decision. The grain size variable is a binary variable that takes the value of "1" if the consumer is motivated by beans size in consuming a particular beans color and "0" otherwise.

Gravy quality motivator: Beans gravy is a liquid secondary product that consumers obtain from cooking beans. Beans gravy quality is important in Zambians' cuisine because beans is often paired with semi solid or solid food like Nshima (Tembo, 2012). The gravy quality motivator is a binary variable that takes the value of "1" if the consumer is motivated by beans gravy quality in consuming a particular beans color and "0" otherwise.

3.3.2.2. Consumer and Household Characteristics

In this section, we will discuss the demographic and socioeconomic characteristic of the consumers used in the analysis at both the individual and the household level.

Age: Dietary requirement varies with age, thus, age is thought to be a major factor that influence consumers' dietary decision. In this study, age is captured as a continuous variable that measures the age in years of the person in charge of the household food decision-making.

Gender: As with age, consumer dietary requirement differs by their gender**.** For the purpose of this study, we present gender as a binary variable that takes the value of "1" if the respondent is not male and "0" if the respondent is male.

Education: Education influences peoples' choices. In this study, we use binary variable to capture education, where the variable takes the value of "0" if the respondent has no secondary education and "1" if the respondents has at least a secondary education i.e. secondary education, vocational education or college education.

Household size: This continuous variable captures the number of people residing in a consumer's household including the consumer. Since increasing household size is associated with increasing level of food consumption, it is assumed that different household size will have varying food consumption pattern.

Child dependency ratio: This represents the ratio of dependent members of the household to other members in the household. In this study, the dependent members of the household are those below the age of 18 years while other members of the household are 18 years old or above. Thus, a household with higher child dependency ratio will have more members dependent on the household income compared to household with low child dependency ratio. Since households may have varying child dependency ratios, food consumption pattern may differ by child dependency ratio.

Marital status: Marital status influence consumers' food choices. Married people' food choices are more likely to be influenced by their spouse compared to people who are not married. Food choices are expected to differ among consumers based on their marital status. In this study, marital status is captured as a binary variable that takes the value of "1" if the consumer is married and "0" if otherwise such as cohabiting, divorce, widowed.

Household monthly income: Researchers have coined beans as the poor man's meat. Further, studies have shown that as consumers' income increases, beans are substituted for meat as a source of protein in consumers' diet. Thus, it is important to understand to what extent consumers are influenced by their income. In this study, household income is captured as a continuous variable representing the total monthly income earned by members of the household.

Residential area: We noted that there are three residential area categories in Lusaka based on population density, which represent the number of people per km^2 in each of the area. The variable takes the value of "0", "1" and "2" if the consumer live in area with high population, medium population and low population density respectively. Since the residential area is associated with the residents' income, food choices are expected to differ among residential areas.

Dual household income: This binary variable takes the value of "1" if both spouses in a household are earning an income and "0" if otherwise. Households where both spouses earn income are likely to have more disposable income, thus, these households will have more food alternatives compared to households with only one source of income. Hence, dual household income have an effect on consumers' food choices.

Legume budget share: This continuous variable represents the proportion of household food budget allocated to legumes. It is thought that consumers' bean preference will differ by their household legume budget share.

Food category importance: The importance of a food category to consumers' food security influence consumers' preference for beans. This categorical variable take ranges between the values of 1 to 6, where "1" means the food category have a small impact on consumer's food security and "6" means the food category is critical to consumer's food security.

Employment status: Consumers who work part time are more likely to earn less than consumers who work full time. In addition, consumers who are self-employed have more control on how their working time is spent compared to consumers who are employees. Hence, consumers' employment status has an effect on their food choices. In this study, consumers' employment status is presented as a categorical variable that assumes the value ranging from "0" to "4" for unemployed, full-time employee, part-time employee, full-time self-employed and part-time self-employed respectively.

Table 3-2-2: Dependent Variables, Definition and Summary Statistics

Variable	Metric	Definition
Gender	Binary	1 – Female 0 – Male
Age	Continuous	Respondents age in years
Education level	Binary	0 – No secondary education 1 – Secondary education or more
Marital status	Binary	0 – Not married 1- Married
Household size	Continuous	The total number of members in the household
Child dependency ratio	Continuous	Ratio of household members under 18 years old to household members who are 18 years old and above.
Household monthly income	Continuous	The total amount of income earned by household members in a month in US dollars.
Employment status	Categorical	0 – Unemployed 1 – Salaried (FT) 2 – Salaried (PT) 3 – Self-Employ (FT) 4 – Self-Employ (PT)
Residential area	Categorical	0 – High population density area 1 – Medium population density area 2 – Low population density area
Dual household income	Categorical	0 – No Dual Household Income 1 – Dual Household Income
Food category importance	Categorical	1: food category have a small impact on consumer's food security 6: food category is critical to consumer's food security
Legume budget share	Continuous	The ratio of household's legume expenditure to household's total food expenditure.

Chapter 4 - Analysis and Result

This chapter presents the results of the study. The study's first research objective is to assess the profile of an average consumer in terms of beans consumption frequency. This was achieved using a summary statistic of consumers who consume beans at least once a month for each beans variety. The second research objective is to evaluate the probability of a consumer choosing a particular beans variety given beans attributes and consumer characteristics, a logit analysis was conducted to achieve this objective. The third research objective developed strategic directions for stakeholders to utilize the information emanating from this research to enhance their profitability. Analyses were all programmed using STATA/IC 14.2 in conjunction with Microsoft Excel.

4.1. Beans Consumption Frequency

Table 4.1 presents consumers' consumption frequency for each beans color. Over 90% of consumers do not consume mottled brown and white with brown spot colored beans while over 84% of consumers never consume red colored and mottled red colored beans. About 77% consumers do not consume white colored beans. Over 64% of consumers never consume yellow colored and mixed yellow colored beans; however, only 16 % consumers never consume purple colored beans.

The purple colored bean is the most consumed bean, about 40% consumers consume purple beans at least once a week and about 84% consume purple beans. The second and third most consumed beans are the mixed yellow and yellow colored beans respectively. Approximately 30% consumers consume mixed yellow colored beans at least once a month while 24% consume yellow colored beans at least once a month.

For further analysis, we focused on the top three most consumed bean color; purple, mixed yellow and yellow bean color. Moreover, the "less than once a month", "once a month", "once every two weeks" and "once or more per week" bean consumption frequency values are all summed into one bean consumption frequency value. Thus, our new bean consumption frequency variable becomes a binary variable that takes the value of "0" for never and "1" for at least less than once a month.

4.2. Characteristics of Purple Beans Consumers.

Table 4-2 presents the characteristics of purple beans consumers. About 75% of purple bean consumers are motivated by purple beans' gravy quality while 49% are motivated by its cooking time. Grain size and price motivated 41% and 28% consumers, respectively, to consume purple beans.

The average age of purple beans consumers is approximately 35 years and females account for 84% of purple beans consumers. Almost 70% of purple beans consumers have at least a secondary level education. On average, purple beans consumers have a 2:1 ratio of non-adults (below 18 years old) children to adults (18 years old and above) in their households. Almost half of the purple beans consumers and their spouses are both income earners. While the average monthly income of purple beans consumers is approximately $374, 42% of purple beans consumers are unemployed. An average purple beans consumer spends 10% of household food budget on legume, which is larger than the legume budget share of 4% estimated for urban households in Zambia in 2016 (CSO, 2016). About 52% of purple beans consumers live in high population density area. Fruits, vegetables and cereals have a relatively low impact on purple beans consumers' nutrition security.

Table 4-1: Percentage of consumers by bean consumption frequency.

Consumption Frequency	Purple Beans	Mixed Yellow	Yellow	White	Red Mottled	Red	Mottled Brown	White with Brown Spots
	N = 827	N = 789	N = 795	N = 789	N = 788	N = 786	N = 785	N = 783
Never	16.32	64.64	68.93	76.68	84.14	88.93	93.25	96.3
Less than once a month	6.77	5.58	6.54	6.46	4.57	3.82	3.82	2.55
Once a month	11.85	9.51	10.06	6.34	3.05	2.29	1.02	0.77
Once every 2 weeks	24.79	9.25	6.92	5.2	3.3	1.78	0.64	0.13
Once or more per week	40.27	11.03	7.55	5.32	4.95	3.18	1.27	0.26
Total	100	100	100	100	100	100	100	100

Table 4-2: Summary statistics of purple beans consumers (n=557)

Variable	Mean	Std. Dev.	Min	Max
Product attributes				
Price motivation (1 = Yes)	28%	--	0	1
Grain size motivation (1 = Yes)	41%	--	0	1
Cooking time motivation (1 = Yes)	49%	--	0	1
Gravy quality motivation (1 = Yes)	75%	--	0	1
Consumer characteristics				
Age	34.8	11.8	15	86
Gender (1 = Female)	84%	--	0	1
Education (1 = Secondary or more)	69%	--	0	1
Child Dependency Ratio	2.3	1.8	0	15
Marital Status (1 = Married)	81%	--	0	1
Legume budget share	0.1	0.1	0.0	0.4
Dual Household Income (1 = Yes)	47%	--	0	1
Monthly Household Income (USD)	374.2	529.9	19.7	7865.8
Employment (base = unemployed)				
Salaried (FT)	21%	--	0	1
Salaried (PT)	5%	--	0	1
Self-Employ (FT)	16%	--	0	1
Self-Employ (PT)	16%	--	0	1
Residential area (base = high population density)				
Medium population density	12%	--	0	1
Low population density	36%	--	0	1
Food Importance				
Fish and seafood	2.1	1.1	1	6
Fruits and vegetables	1.7	1.0	1	6
Cereal	1.9	1.2	1	6
Roots and tubers	3.1	1.4	1	6
Animal products	2.0	1.1	1	6

4.3. Characteristics of Mixed Yellow Beans Consumers.

Table 4-3 presents the characteristics of mixed yellow beans consumers. It shows that 225 consumers consume mixed yellow beans and a majority of these consumers is motivated by its cooking time attribute (59%) while a relatively smaller percentage (27%) are motivated by its grain size attributes. The age range of mixed yellow beans consumers is between 15 to 81 years and the average age is 35 years.

About 85% of mixed yellow beans consumers are female and 84% are married, this is not surprising because the survey respondents are people in charge of household food decision making which is the typical gender role of a wife in the household (SOFA Team and Doss, 2011). Approximately 72% of mixed yellow beans consumers have a secondary, vocational or college education; however, only 65% are employed. This would suggest that not all consumers with at least a secondary education are employed.

The average monthly household income is $402.3. Like purple bean consumers, legume accounts for 10% of mixed yellow beans consumers' budget share. A majority of mixed yellow beans consumers live in high population density area. Fruits, vegetables and cereals are less critical to mixed yellow beans consumers' nutrition security than other food groups.

4.4. Characteristics of Yellow Bean Consumers.

Table 4-4 presents 205 consumers in the survey consume yellow beans. Among yellow beans attributes, more consumers are motivated by cooking time attribute while a relatively lower percentage of consumers are motivated by grain size attribute. Half of yellow beans consumers are motivated to consume by its gravy quality while a third of its consumers are motivated to consume by its price. According to this result, cooking time and gravy quality are the most important attributes consumers consider when making the decision to consume yellow beans.

The age range of yellow bean consumers is between 13 to 86 years with average age of approximately 36 years. Similar to purple beans and mixed yellow beans consumers, most yellow beans consumers are female. Although only 25% of yellow beans consumers have less than a secondary education, 36% are unemployed. About half of yellow beans consumers live in household were both spouses earn an income. Average monthly household income is $468.3. A minority (18%) of yellow beans consumers live in medium population density area. Fruits, vegetables and cereals are more critical to yellow beans consumers' nutrition security than other food groups.

Table 4-3: Summary statistics of mixed yellow beans consumers (n=225)

Variable	Mean	Std. Dev.	Min	Max
Product attributes				
Price motivation (1 = Yes)	42%	--	0	1
Grain size motivation (1 = Yes)	27%	--	0	1
Cooking time motivation (1 = Yes)	59%	--	0	1
Gravy quality motivation (1 = Yes)	58%	--	0	1
Consumer characteristics				
Age	34.8	11.2	15	81
Gender (1 = Female)	85%	--	0	1
Education (1 = Secondary or more)	72%	--	0	1
Child Dependency Ratio	2.4	1.8	0	8
Marital Status (1 = Married)	84%	--	0	1
Legume budget share	0.1	0.1	0.0	0.4
Dual Household Income (1 = Yes)	51%	--	0	1
Monthly Household Income (USD)	402.3	442.1	19.7	3277.4
Employment (base = unemployed)				
Salaried (FT)	20%	--	0	1
Salaried (PT)	8%	--	0	1
Self-Employ (FT)	23%	--	0	1
Self-Employ (PT)	15%	--	0	1
Residential area (base = high population density)				
Medium population density	14%	--	0	1
Low population density	32%	--	0	1
Food Importance				
Fish and seafood	2.1	1.2	1	6
Fruits and vegetables	1.7	1.1	1	6
Cereal	1.8	1.3	1	6
Roots and tubers	3.0	1.5	1	6
Animal products	2.0	1.2	1	6

There are more similarities than differences among purple beans, mixed yellow beans and yellow beans consumers. For all the three bean types, the average consumer is around 35 years old, married, female, and most of them have at least a secondary level education. The average consumer also ranks fruits and vegetables as being less critical to her nutrition security than other food groups and roots and tubers as being the least critical.

Table 4-4: Summary statistics of yellow beans consumers (n=205)

Variable	Mean	Std. Dev.	Min	Max
Product attributes				
Price motivation (1 = Yes)	34%	--	0	1
Grain size motivation (1 = Yes)	27%	--	0	1
Cooking time motivation (1 = Yes)	54%	--	0	1
Gravy quality motivation (1 = Yes)	50%	--	0	1
Consumer characteristics				
Age	35.5	12.6	15	86
Gender (1 = Female)	81%	--	0	1
Education (1 = Secondary or more)	75%	--	0	1
Child Dependency Ratio	2.5	2.0	0	15
Marital Status (1 = Married)	78%	--	0	1
Legume budget share	0.1	0.1	0.0	0.4
Dual Household Income (1 = Yes)	51%	--	0	1
Monthly Household Income (USD)	468.3	639.1	19.7	3932.9
Employment (base = unemployed)				
Salaried (FT)	24%	--	0	1
Salaried (PT)	8%	--	0	1
Self-Employ (FT)	15%	--	0	1
Self-Employ (PT)	17%	--	0	1
Residential area (base = high population density)				
Medium population density	18%	--	0	1
Low population density	41%	--	0	1
Food Importance				
Fish and seafood	2.2	1.2	1	6
Fruits and vegetables	1.8	1.1	1	5
Cereal	2.1	1.3	1	6
Roots and tubers	2.9	1.5	1	6
Animal products	2.1	1.3	1	6

Most consumers are motivated to consume purple beans because of its gravy quality attributes while the lowest percentage of purple beans consumers are motivated by its price attributes. However, yellow and mixed yellow beans consumers are motivated to consume these beans because of their cooking time attributes and gravy quality. Grain size is not an important motivating bean attributes to yellow and mixed yellow beans consumers. A majority of purple beans consumers (52%) and mixed yellow beans consumers (53%) live in high population density areas. Purple beans consumers have the

highest unemployment rate (42%) and the lowest household monthly income ($374) compared to mixed yellow and yellow beans consumers.

4.5. Factors affecting purple bean consumption

Table 4-5 shows the estimates of the logit regression for purple beans. The p-value indicates that the model is statistically significant at a 1% level of significance with Wald statistics of 105.42. The post estimation analysis indicates that there is no multicollinearity among the variables in the model. However, results from the misspecification test using STATA's linktest command, implies that the model is misspecified.

The result indicates that the odds of purple beans consumers being motivated by price, grain size, cooking time or gravy quality attributes is higher than not. Gravy quality is not only the most important invisible beans attribute but also the most important beans attribute overall while price is the most important visible attribute. Among purple beans attributes, gravy quality has a higher odds of motivating purple bean consumption than not while the odds of being motivated by its grain size is relatively low. This result suggests that the gravy quality is a very important attribute to purple beans consumers. Price has about 37 times the odds of motivating purple beans consumption than not while cooking time has 23 times the odds of motivating purple beans consumption than not, both of these findings are statistically significant at 1% level of significance.

Females have about 65% lower odds of consuming purple bean compared to males and the result is statistically significant at 5% level. Full time and part time employees have lower odds of consuming purple beans compared to unemployed consumers. Moreover, consumers living in low population density area have more than twice the odds of consuming purple beans than consumers who resides in high population density area. The higher the importance of fruits, vegetables and cereals is to consumers' food security, the higher the odds of consuming purple beans.

Table 4-5: Logit regression result for purple beans consumption (n=557)

Variables	Odds Ratio	Robust Std. Err.	z	P>z
Price motivation (1 = Yes)	37.057***	33.883	3.950	0.000
Grain size motivation (1 = Yes)	15.820*	23.989	1.820	0.069
Cooking time motivation (1 = Yes)	23.424***	28.612	2.580	0.010
Gravy quality motivation (1 = Yes)	104.399***	82.261	5.900	0.000
Age	1.008	0.013	0.620	0.533
Gender (1 = Female)	0.345**	0.181	-2.030	0.043
Education (1 = Secondary or more)	0.835	0.300	-0.500	0.616
Child Dependency Ratio	1.021	0.099	0.210	0.835
Marital Status (1 = Married)	0.957	0.428	-0.100	0.921
Legume budget share	2.859	7.722	0.390	0.697
Dual Household Income (1 = Yes)	1.762	0.877	1.140	0.255
Monthly Household Income	1.000	0.000	-1.370	0.170
Employment				
Salaried (FT)	0.238***	0.117	-2.920	0.003
Salaried (PT)	0.162**	0.150	-1.970	0.049
Self-Employ (FT)	0.497	0.292	-1.190	0.234
Self-Employ (PT)	1.058	0.713	0.080	0.933
Residential area				
Medium population density	2.146	1.147	1.430	0.153
Low population density	2.536**	0.970	2.430	0.015
Food Importance				
Fish and seafood	0.889	0.141	-0.740	0.458
Fruits and vegetables	1.363**	0.213	1.980	0.047
Cereal	1.384**	0.222	2.020	0.043
Roots and tubers	0.952	0.106	-0.440	0.660
Animal products	0.895	0.137	-0.720	0.471
Constant	0.139	0.196	-1.400	0.162

*, **, *** denotes statistical significance at 10%, 5% and 1% level respectively.

4.6. Factors affecting mixed yellow bean consumption

Table 4-6 reports the estimates of logit regression for mixed yellow beans consumption. The Wald statistics with 23 degree of freedom is 147.14 and the p-value indicates that the model is statistically significant at 1% level of significance. Findings from misspecification test conducted in STATA reveals that the model is correctly specified. The mean variance inflation factor (VIF) of 1.37, this finding imply there is no multicollinearity in the model

The odds of mixed yellow bean consumers being influenced by the cooking time of mixed yellow beans is lower than the odds of being influenced by its price attribute. Gravy quality attributes have 620 times the odds of influencing the consumption of mixed yellow beans than not. In order of importance, gravy quality is the most important invisible bean attribute and the most important bean attribute while grain size remains the least important visible bean attribute. These findings correspond with that of purple beans.

Consumers who possess at least a secondary education have more than twice the odds of consuming mixed yellow beans than consumer that have no secondary education. Consumers living in medium population density area have thrice the odds of consuming yellow beans than consumers who resides in high population density area. Increasing importance of cereal to household food nutrition security is associated with higher odds of consuming mixed yellow beans. High child dependency ratio is associated with higher odds of consuming mixed yellow beans.

4.7. Factors affecting yellow bean consumption

Table 4-7 presents the estimates of logit regression for yellow bean consumption. Result shows that the Wald statistics with 23 degrees of freedom is 111.11 and the p-value indicates the model is statistically significant at 1% level of significance. Findings from administering the "linktest" and "collin" command in STATA indicates that while the model is misspecified, there is no multicollinearity among variables in the model

Table 4-6: Logit regression result for mixed yellow beans consumption (n=225)

Variables	Odds Ratio	Robust Std. Err.	z	P>z
Price motivation (1 = Yes)	224.653***	260.201	4.670	0.000
Grain size motivation (1 = Yes)	8.162	18.884	0.910	0.364
Cooking time motivation (1 = Yes)	139.960***	90.906	7.610	0.000
Gravy quality motivation (1 = Yes)	620.942***	701.143	5.700	0.000
Age	0.974	0.017	-1.500	0.133
Gender (1 = Female)	0.538	0.251	-1.330	0.185
Education (1 = Secondary or more)	2.553**	1.187	2.020	0.044
Child Dependency Ratio	1.147*	0.092	1.710	0.087
Marital Status (1 = Married)	1.241	0.612	0.440	0.662
Legume budget share	0.034	0.107	-1.070	0.286
Dual Household Income (1 = Yes)	0.588	0.293	-1.060	0.287
Monthly Household Income	1.000	0.000	0.080	0.932
Employment				
Salaried (FT)	0.812	0.527	-0.320	0.748
Salaried (PT)	3.175	2.472	1.480	0.138
Self-Employ (FT)	2.793	1.787	1.600	0.108
Self-Employ (PT)	1.821	1.247	0.880	0.381
Residential area				
Medium population density	2.955**	1.317	2.430	0.015
Low population density	1.618	0.636	1.220	0.221
Food Importance				
Fish and seafood	0.923	0.136	-0.540	0.588
Fruits and vegetables	1.104	0.172	0.640	0.525
Cereal	1.463**	**0.222**	**2.510**	**0.012**
Roots and tubers	0.860	0.104	-1.250	0.210
Animal products	0.953	0.117	-0.390	0.694
Constant	0.024	0.034	-2.610	0.009

*, **, *** denotes statistical significance at 10%, 5% and 1% level respectively.

Similar to purple beans and mixed yellow beans results, invisible attribute is the most important attribute to yellow beans consumers. Cooking time is the most important beans attribute while grain size is least important among yellow bean consumers. However, yellow beans have relatively low price sensitivity among consumers compared to purple and mixed yellow beans. The odds of yellow bean consumers being influenced by the price of yellow beans is 15 times the odds of not being influenced by its price. Yellow beans cooking time has 30 times the odds of motivating yellow bean consumption than not. The odds of yellow bean consumers being influenced by its gravy quality is 28 times more than not being influenced by its gravy quality.

Furthermore, consumers residing in households were both spouses are income earners have lower odds of consuming yellow beans compared to consumers living in households where only one spouse is earning income. Increasing monthly household income neither decrease nor increase the odds of consuming yellow beans. Consumers who are employed have higher odds of consuming yellow beans than those who are unemployed.

Consumers living in medium population density areas have approximately 6 times the odds of consuming yellow beans than consumers residing high population density area. Similarly, consumers living in low population density area have thrice the odds of consuming yellow beans than consumers living in high population density area. Further, the higher the importance of roots and tubers to consumers' household food nutrition security the higher the odds of consuming yellow beans.

Table 4-7: Logit regression results for yellow beans consumption (n=205)

Variables	Odds Ratio	Robust Std. Err.	z	P>z
Price motivation (1 = Yes)	15.013***	13.228	3.070	0.002
Grain size motivation (1 = Yes)	3.755	5.289	0.940	0.348
Cooking time motivation (1 = Yes)	30.740***	19.370	5.440	0.000
Gravy quality motivation (1 = Yes)	28.667***	19.416	4.950	0.000
Age	1.003	0.015	0.230	0.816
Gender (1 = Female)	0.720	0.277	-0.850	0.393
Education (1 = Secondary or more)	0.936	0.314	-0.200	0.845
Child Dependency Ratio	1.063	0.071	0.920	0.360
Marital Status (1 = Married)	1.165	0.438	0.410	0.685
Legume budget share	0.483	1.203	-0.290	0.770
Dual Household Income (1 = Yes)	0.387**	0.145	-2.530	0.011
Monthly Household Income	1.000**	0.000	2.280	0.023
Employment				
Salaried (FT)	1.989*	0.832	1.640	0.100
Salaried (PT)	4.933***	2.674	2.940	0.003
Self-Employ (FT)	2.474*	1.311	1.710	0.087
Self-Employ (PT)	3.813**	2.038	2.500	0.012
Residential area				
Medium population density	5.742***	2.333	4.300	0.000
Low population density	3.396***	1.008	4.120	0.000
Food Importance				
Fish and seafood	0.833	0.093	-1.640	0.102
Fruits and vegetables	1.012	0.127	0.090	0.925
Cereal	0.874	0.109	-1.080	0.281
Roots and tubers	1.329**	0.145	2.610	0.009
Animal products	0.894	0.115	-0.880	0.382
Constant	0.091	0.105	-2.070	0.038

*, **, *** denotes statistical significance at 10%, 5% and 1% level respectively.

4.8. Summary of Results

The study shows that, in general, invisible bean attributes are more important than visible bean attributes in the consideration of consumption of purple, mixed yellow and yellow beans. Gravy quality is an important bean attributes for all the different colors considered, but it is the most important for purple and mixed yellow beans while cooking time is the most important attribute motivating yellow beans consumption. Mixed yellow beans consumers are very sensitive to beans price. Grain size does not significantly influence mixed yellow and yellow bean consumption, though it influences purple bean consumption at only 10% level of significance. While this result does not support findings from the study conducted by Sichilima et al. (2016) in Lusaka, it is similar with the study conducted by Mishili et al. (2009) in Tanzania who reported that consumers neither discounted nor pay a premium for beans grain size attribute.

The odds associated with consumer characteristics influencing beans consumption are not as large as the odds associated with beans attributes. Consumer characteristics influencing bean consumption are unique for each bean variety. Age, marital status, legume budget share, income and the importance of certain food groups such as animal products, fish and seafood to consumers' nutrition security have no influence on beans consumption.

Gender has no significant effect on bean consumption except for purple bean consumption. While having at least a secondary education influence mixed yellow bean consumption, this has no significant effect on purple and yellow bean consumption. A higher child dependency ratio is associated with increased odds of consuming mixed yellow beans, but it has no significant influence on consumers' decision to consume purple and yellow beans. Consumers with dual household income have lower odds of consuming yellow beans, however, having dual household income has no effect on mixed yellow and yellow beans consumption. While being employed decreases the odds of consuming purple beans, it increases the odds of consuming yellow beans and it has no effect on mixed yellow beans consumption.

Residential area is a major factor influencing beans consumption. Consumers living in low population density area have higher odds of consuming purple and yellow beans than consumers living in high population density area. Consumers living in

medium population density area have higher odds of consuming mixed yellow and yellow beans than consumers residing in high population density area. Consumers who ascribe cereal as critically important to household food security have higher odds of consuming purple and mixed yellow beans while those who assign roots and tubers as highly important to their household food security have higher odds of consuming yellow beans. Moreover, consumers who deemed fruits and vegetables to be critically important to their food security have higher odds of consuming purple beans.

4.9. Recommendations

The research provides some understanding on what motivates consumption of purple, mixed yellow and yellow beans. Our findings show that product attributes have a stronger influence on consumption of bean colors than consumer characteristics. Gravy quality, cooking time and price are important bean attributes motivating beans consumption. However, grain size attribute is a not an important attribute motivating beans consumption, which imply that consumers do not consider beans grain size when making beans consumption decision.

While the study reveals that consumers are motivated by these attributes, unfortunately it does not provide information on the attribute levels. For instance, while we know consumers are motivated to consume beans due to beans' cooking time attribute, we have no information on whether it is fast cooking attribute or slow cooking attribute that consumer are motivated by. Despite this limitation in the study, this result provides direction to breeders, producers and traders on which bean attributes are important to purple, mixed yellow and yellow beans consumers.

Drawing on the results of the study, breeders could focus on improving gravy quality and cooking time in breeding purple, yellow and mixed yellow beans while taking into consideration the price sensitivity expressed by purple and mixed yellow beans consumers. Yellow beans consumers are not as price sensitive as purple and mixed yellow beans consumers, hence, producers and traders could charge a premium for yellow beans. Although, few consumer characteristics have influence on bean consumption, these characteristics except consumers' residential area are unique to each bean color. Purple beans consumption is affected by gender, employment status and

importance of fruits, vegetables and cereals to consumers' nutritional security. Mixed yellow beans consumption is influence by education, child dependency ratio and the importance of cereal to consumers' nutritional security. Dual household income, monthly household income employment status and roots and tubers importance to consumers' nutritional security influence yellow beans consumption.

Findings show that consumers living in areas with medium and low population density consume yellow beans more than consumers who live in high population density area. This finding could help producers and traders to target consumers in specific locations based on the population density of the area.

Chapter 5 - Summary and Conclusions

Common beans are affordable source of essential micronutrients, protein and fiber. Thus, they provide an avenue to alleviate nutritional insecurity in Zambia especially among the low-income population segment. Despite its nutritional attributes, bean consumption in Zambia is very low. This study examined the consumption profile of beans in terms of beans consumption frequency and evaluated the probability of consumers choosing a beans variety given the bean attributes and consumer characteristics. Recommendations are then made to stakeholders in Zambia's bean supply chain based on findings from the study. Data used in this study was obtained from a household survey conducted in Lusaka, Zambia. A logit model was used to estimate factors affecting purple, mixed yellow and yellow beans consumption.

Findings from this study indicates that beans attributes except grain size motivate beans consumption. This is surprising since past studies reported grain size having significant influence on consumers' beans preference. Cooking time, gravy quality and price are found to be important beans attributes motivating consumption. Most consumer characteristics influencing bean consumption are unique to each beans color.

From the result obtained from the logit analysis, it was concluded that the consumer characteristics influencing purple bean consumption are gender, employment status, importance of fruits, vegetables and cereals to consumers' nutrition security. Education, child dependency ratio and the importance of cereals to consumers' food security have effect on mixed yellow bean consumption while dual household income, employment status and cereal importance to consumers' nutrition security influence yellow bean consumption. Purple, mixed yellow and yellow beans consumption are influenced by consumers' residential area.

While this research provides understanding on bean attributes influencing beans consumption, further work needs to be done to assess the effect of specific attribute levels on beans consumption. Moreover, the data used in this study is a stated preference data. Due to its hypothetical nature, consumers response is unconstrained (by income, price of beans, price of substitute or complement goods etc.). Further research could explore

beans attributes and consumers' characteristics influencing bean consumption using data that capture consumers' actual choices in the market setting.

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Appendix A - Pairwise Correlation

Figure 2: Pairwise correlation for purple beans

	Price motivation	Grain size motivation	Cooking time motivation	Gravy quality motivation	Age	Gender	Education	Child Dependency Ratio	Marital Status
Price motivation	1.000								
Grain size motivation	0.278	1.000							
	0.000								
Cooking time motivation	0.248	0.393	1.000						
	0.000	0.000							
Gravy quality motivation	0.053	0.420	0.451	1.000					
	0.118	0.000	0.000						
Age	-0.034	-0.010	0.030	0.006	1.000				
	0.322	0.767	0.369	0.860					
Gender	-0.026	0.002	0.002	0.102	-0.023	1.000			
	0.450	0.958	0.950	0.003	0.494				
Education	-0.006	-0.012	-0.058	-0.080	-0.058	-0.153	1.000		
	0.850	0.728	0.090	0.019	0.087	0.000			
Child Dependency Ratio	-0.030	-0.074	-0.020	0.006	0.122	0.150	-0.143	1.000	
	0.383	0.028	0.560	0.851	0.000	0.000	0.000		
Marital Status	0.002	0.044	0.053	0.058	0.296	0.264	-0.134	0.190	1.000
	0.956	0.196	0.117	0.089	0.000	0.000	0.000	0.000	
Legume budget share	0.208	0.171	0.205	0.118	-0.008	-0.058	-0.118	0.004	0.018
	0.000	0.000	0.000	0.001	0.825	0.090	0.001	0.914	0.601
Dual Household Income	0.009	-0.007	-0.012	-0.036	0.080	-0.035	0.094	0.012	0.092
	0.781	0.842	0.735	0.282	0.018	0.308	0.006	0.718	0.007
Monthly Household Incon	-0.090	-0.040	-0.026	0.050	0.057	-0.060	0.194	0.112	-0.047
	0.010	0.257	0.457	0.158	0.106	0.090	0.000	0.001	0.177
Employment	0.010	0.033	-0.025	-0.037	0.097	-0.043	-0.033	-0.001	0.035
	0.770	0.330	0.466	0.269	0.004	0.213	0.329	0.989	0.297
Residential area	-0.059	-0.069	-0.054	-0.051	0.039	-0.100	0.214	-0.072	-0.169
	0.083	0.043	0.114	0.133	0.258	0.004	0.000	0.037	0.000
Fish and seafood	-0.070	0.017	-0.005	0.060	0.034	0.075	0.125	-0.015	0.056
	0.038	0.621	0.874	0.077	0.325	0.029	0.000	0.661	0.102
Fruits and vegetables	-0.012	0.019	0.030	0.085	-0.006	0.069	0.019	0.029	0.063
	0.727	0.569	0.376	0.012	0.864	0.044	0.584	0.397	0.064
Cereal	-0.052	-0.058	0.057	0.020	0.042	-0.015	0.085	0.005	0.002
	0.125	0.091	0.096	0.555	0.221	0.663	0.012	0.873	0.954
Roots and tubers	0.027	0.075	-0.033	0.039	0.010	0.048	0.119	-0.002	-0.013
	0.433	0.028	0.330	0.251	0.774	0.160	0.001	0.962	0.713
Animal products	-0.017	-0.014	0.027	0.047	0.002	-0.067	0.174	-0.041	-0.045
	0.627	0.685	0.437	0.166	0.951	0.051	0.000	0.230	0.186

	Legume budget share	Dual Household Income	Monthly Household Income	Employment	Residential area	Fish and seafood	Fruits and vegetables	Cereal	Roots and tubers	Animal products
Legume budget share	1.000									
Dual Household Income	-0.041	1.000								
	0.230									
Monthly Household Incon	-0.102	0.089	1.000							
	0.004	0.011								
Employment	0.052	0.622	-0.013	1.000						
	0.126	0.000	0.706							
Residential area	-0.054	0.034	0.098	-0.075	1.000					
	0.118	0.323	0.006	0.029						
Fish and seafood	-0.253	0.094	0.100	0.005	0.029	1.000				
	0.000	0.006	0.004	0.879	0.397					
Fruits and vegetables	-0.117	0.030	0.094	0.001	-0.056	0.205	1.000			
	0.001	0.383	0.007	0.984	0.105	0.000				
Cereal	-0.141	0.020	0.039	-0.053	0.161	0.252	0.393	1.000		
	0.000	0.555	0.264	0.120	0.000	0.000	0.000			
Roots and tubers	-0.144	0.045	0.153	-0.005	0.020	0.272	0.255	0.280	1.000	
	0.000	0.182	0.000	0.888	0.569	0.000	0.000	0.000		
Animal products	-0.191	0.000	0.144	-0.036	0.170	0.331	0.169	0.329	0.231	1.000
	0.000	0.999	0.000	0.299	0.000	0.000	0.000	0.000	0.000	

Figure 3: Pairwise correlation for mixed yellow beans

	Price motivation	Grain size motivation	Cooking time motivation	Gravy quality motivation	Age	Gender	Education	Child Dependency Ratio	Marital Status
Price motivation	1.000								
Grain size motivation	0.474	1.000							
	0.000								
Cooking time motivation	0.464	0.453	1.000						
	0.000	0.000							
Gravy quality motivation	0.507	0.544	0.581	1.000					
	0.000	0.000	0.000						
Age	0.033	0.003	0.004	0.016	1.000				
	0.324	0.939	0.913	0.644					
Gender	0.053	0.044	0.051	0.103	-0.023	1.000			
	0.124	0.197	0.134	0.002	0.494				
Education	0.022	0.027	0.042	-0.031	-0.058	-0.153	1.000		
	0.521	0.435	0.216	0.361	0.087	0.000			
Child Dependency Ratio	0.052	-0.029	0.056	0.022	0.122	0.150	-0.143	1.000	
	0.125	0.390	0.098	0.520	0.000	0.000	0.000		
Marital Status	0.065	0.052	0.035	0.112	0.296	0.264	-0.134	0.190	1.000
	0.055	0.123	0.304	0.001	0.000	0.000	0.000	0.000	
Legume budget share	0.088	0.086	0.041	0.053	-0.008	-0.058	-0.118	0.004	0.018
	0.010	0.012	0.231	0.119	0.825	0.090	0.001	0.914	0.601
Dual Household Income	0.030	0.009	0.022	0.054	0.080	-0.035	0.094	0.012	0.092
	0.369	0.800	0.522	0.111	0.018	0.308	0.006	0.718	0.007
Monthly Household Incon	-0.009	-0.012	0.053	0.033	0.057	-0.060	0.194	0.112	-0.047
	0.808	0.736	0.129	0.345	0.106	0.090	0.000	0.001	0.177
Employment	0.015	-0.002	0.025	0.040	0.097	-0.043	-0.033	-0.001	0.035
	0.664	0.953	0.457	0.240	0.004	0.213	0.329	0.989	0.297
Residential area	0.001	0.049	0.004	-0.080	0.039	-0.100	0.214	-0.072	-0.169
	0.976	0.150	0.902	0.019	0.258	0.004	0.000	0.037	0.000
Fish and seafood	0.022	0.064	0.005	0.094	0.034	0.075	0.125	-0.015	0.056
	0.523	0.058	0.878	0.006	0.325	0.029	0.000	0.661	0.102
Fruits and vegetables	0.015	0.078	0.053	0.078	-0.006	0.069	0.019	0.029	0.063
	0.657	0.022	0.118	0.021	0.864	0.044	0.584	0.397	0.064
Cereal	0.024	0.054	0.023	0.089	0.042	-0.015	0.085	0.005	0.002
	0.478	0.112	0.508	0.009	0.221	0.663	0.012	0.873	0.954
Roots and tubers	0.074	0.087	0.025	0.096	0.010	0.048	0.119	-0.002	-0.013
	0.030	0.010	0.464	0.005	0.774	0.160	0.001	0.962	0.713
Animal products	-0.006	0.044	0.035	0.070	0.002	-0.067	0.174	-0.041	-0.045
	0.872	0.193	0.310	0.041	0.951	0.051	0.000	0.230	0.186

	Legume budget share	Dual Household Income	Monthly Household Income	Employment	Residential area	Fish and seafood	Fruits and vegetables	Cereal	Roots and tubers	Animal products
Legume budget share	1.000									
Dual Household Income	-0.041	1.000								
	0.230									
Monthly Household Incon	-0.102	0.089	1.000							
	0.004	0.011								
Employment	0.052	0.622	-0.013	1.000						
	0.126	0.000	0.706							
Residential area	-0.054	0.034	0.098	-0.075	1.000					
	0.118	0.323	0.006	0.029						
Fish and seafood	-0.253	0.094	0.100	0.005	0.029	1.000				
	0.000	0.006	0.004	0.879	0.397					
Fruits and vegetables	-0.117	0.030	0.094	0.001	-0.056	0.205	1.000			
	0.001	0.383	0.007	0.984	0.105	0.000				
Cereal	-0.141	0.020	0.039	-0.053	0.161	0.252	0.393	1.000		
	0.000	0.555	0.264	0.120	0.000	0.000	0.000			
Roots and tubers	-0.144	0.045	0.153	-0.005	0.020	0.272	0.255	0.280	1.000	
	0.000	0.182	0.000	0.888	0.569	0.000	0.000	0.000		
Animal products	-0.191	0.000	0.144	-0.036	0.170	0.331	0.169	0.329	0.231	1.000
	0.000	0.999	0.000	0.299	0.000	0.000	0.000	0.000	0.000	

Figure 4: Pairwise correlation for yellow beans

	Price motivation	Grain size motivation	Cooking time motivation	Gravy quality motivation	Age	Gender	Education	Child Dependency Ratio	Marital Status
Price motivation	1.000								
Grain size motivation	0.469	1.000							
	0.000								
Cooking time motivation	0.420	0.474	1.000						
	0.000	0.000							
Gravy quality motivation	0.404	0.534	0.631	1.000					
	0.000	0.000	0.000						
Age	0.042	0.025	0.028	0.028	1.000				
	0.219	0.470	0.417	0.414					
Gender	0.003	-0.006	-0.007	-0.030	-0.023	1.000			
	0.924	0.873	0.849	0.385	0.494				
Education	0.028	0.043	0.027	0.025	-0.058	-0.153	1.000		
	0.411	0.204	0.419	0.470	0.087	0.000			
Child Dependency Ratio	0.104	-0.042	0.079	-0.009	0.122	0.150	-0.143	1.000	
	0.002	0.217	0.020	0.795	0.000	0.000	0.000		
Marital Status	-0.018	-0.011	-0.023	-0.017	0.296	0.264	-0.134	0.190	1.000
	0.595	0.749	0.506	0.623	0.000	0.000	0.000	0.000	
Legume budget share	0.129	0.099	0.081	0.069	-0.008	-0.058	-0.118	0.004	0.018
	0.000	0.004	0.017	0.043	0.825	0.090	0.001	0.914	0.601
Dual Household Income	0.072	0.053	0.021	0.017	0.080	-0.035	0.094	0.012	0.092
	0.033	0.120	0.537	0.608	0.018	0.308	0.006	0.718	0.007
Monthly Household Incor	0.018	0.010	0.047	0.020	0.057	-0.060	0.194	0.112	-0.047
	0.605	0.780	0.178	0.562	0.106	0.090	0.000	0.001	0.177
Employment	0.020	-0.015	-0.017	-0.022	0.097	-0.043	-0.033	-0.001	0.035
	0.555	0.659	0.625	0.520	0.004	0.213	0.329	0.989	0.297
Residential area	0.056	0.056	-0.002	0.005	0.039	-0.100	0.214	-0.072	-0.169
	0.102	0.104	0.946	0.884	0.258	0.004	0.000	0.037	0.000
Fish and seafood	-0.054	-0.008	-0.015	0.026	0.034	0.075	0.125	-0.015	0.056
	0.114	0.817	0.667	0.453	0.325	0.029	0.000	0.661	0.102
Fruits and vegetables	-0.091	-0.077	-0.016	-0.011	-0.006	0.069	0.019	0.029	0.063
	0.007	0.024	0.646	0.749	0.864	0.044	0.584	0.397	0.064
Cereal	-0.063	-0.045	-0.015	0.013	0.042	-0.015	0.085	0.005	0.002
	0.064	0.189	0.655	0.704	0.221	0.663	0.012	0.873	0.954
Roots and tubers	0.002	-0.006	-0.039	0.054	0.010	0.048	0.119	-0.002	-0.013
	0.955	0.870	0.253	0.115	0.774	0.160	0.001	0.962	0.713
Animal products	-0.066	-0.023	0.031	0.004	0.002	-0.067	0.174	-0.041	-0.045
	0.051	0.496	0.358	0.917	0.951	0.051	0.000	0.230	0.186

	Legume budget share	Dual Household Income	Monthly Household Income	Employment	Residential area	Fish and seafood	Fruits and vegetables	Cereal	Roots and tubers	Animal products
Legume budget share	1.000									
Dual Household Income	-0.041	1.000								
	0.230									
Monthly Household Incor	-0.102	0.089	1.000							
	0.004	0.011								
Employment	0.052	0.622	-0.013	1.000						
	0.126	0.000	0.706							
Residential area	-0.054	0.034	0.098	-0.075	1.000					
	0.118	0.323	0.006	0.029						
Fish and seafood	-0.253	0.094	0.100	0.005	0.029	1.000				
	0.000	0.006	0.004	0.879	0.397					
Fruits and vegetables	-0.117	0.030	0.094	0.001	-0.056	0.205	1.000			
	0.001	0.383	0.007	0.984	0.105	0.000				
Cereal	-0.141	0.020	0.039	-0.053	0.161	0.252	0.393	1.000		
	0.000	0.555	0.264	0.120	0.000	0.000	0.000			
Roots and tubers	-0.144	0.045	0.153	-0.005	0.020	0.272	0.255	0.280	1.000	
	0.000	0.182	0.000	0.888	0.569	0.000	0.000	0.000		
Animal products	-0.191	0.000	0.144	-0.036	0.170	0.331	0.169	0.329	0.231	1.000
	0.000	0.999	0.000	0.299	0.000	0.000	0.000	0.000	0.000	