EVALUATION OF CONSUMERS ACCEPTANCE AND PRICING OF EDIBLE WINGED TERMITES (*Macrotermes Subhylanus*) IN KIMILILI SUB- COUNTY, KENYA

KISAKA NAFULA CAROLYNE

A thesis submitted to the Graduate School in partial fulfilment for the requirements of the Master of Science Degree in Agribusiness Management of Egerton University

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DECLARATION AND RECOMMENDATION

Declaration

I hereby do declare that this thesis is wholly my original work and to the best of my knowledge, has not, wholly or in part, been submitted for the award of any degree in this or any other university.

Signature…….. Date: ……

Kisaka Nafula Carolyne

KM19/13518/14

Recommendation

This thesis has been submitted to the Graduate school of Egerton University for examination with our recommendation and approval as University supervisors.

Signature…… Date ……..

Dr. Oscar Ingasia Ayuya, PhD

Department of Agricultural Economics and Agribusiness Management,

Egerton University.

Signature…….. Date……

Prof. George Owuor, PhD

Department of Agricultural Economics and Agribusiness Management,

Egerton University.

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DEDICATION

This thesis is dedicated to God.

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ABSTRACT

The food poverty rate stands at 42 percent in Bungoma County; Kimilili Sub-County included. The available animal-based protein sources are insufficient, unsustainable and expensive for the unemployed poor locals. Commercializing the edible insects' particularly edible winged termite value chain has the potential of improving this situation. The termite value chain is transforming from subsistent to commercial. However, important information to support its commercialization is scanty. The general objective of this study was to contribute to enhanced commercialization of edible winged termite value chain as a way of diversifying food systems for improved livelihood. Specific objectives of the study were to; determine the consumers' perception of edible winged termites; consumers socioeconomic, institutional and edible winged termite characteristics significantly influencing its acceptance and quantity consumed and finally to evaluate the significant market price determinants of edible winged termites. The study followed an exploratory research design. Multistage sampling procedure was used to select 384 consumers who were interviewed using a pre-tested semi-structured questionnaire. Data were analyzed using Exploratory Factor Analysis, Double Hurdle and Hedonic Pricing models. Results indicate that consumers perceived edible winged termites as food with important attributes, convenient, and culturally appropriate with explained variances of 56%, 5% and 5%respectively. Acceptance and quantity of edible winged termites consumed were influenced by: gender, education, children below 5 years, income, native, termite attributes and convenience in rural and urban households; members over 5 years and culture in the rural; and age in the urban. Consumers' participation in off-farm activities and location of residence had positive effects on market prices of raw, fried, sun-dried and blanched termites. This study concludes that: consumers perceived edible winged termites positively; perceived edible winged termite attributes is the major acceptance and quantity consumed determinant and residence is the major market price determinant for raw, fried, sun-dried, and blanched with positive coefficients of 0.55, 0.57, 0.56 and 0.45 respectively. This study recommends that edible insect commercialization can start with edible winged termites; formal education officials can be used to engender edible insects in to the food chain through the school feeding programmes; marketers should target consumers residing in urban areas and those participating in off-farm income generating activities for higher profits.

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AM	After Midnight
APE	Average Partial Effect
CAPE	Conditional Average Partial Effect
CIDP	County Integrated Development Plan
CV	Contingent Valuation
DH	Double Hurdle
EFA	Exploratory Factor Analysis
EWT	Edible Winged Termites
FAO	Food and Agriculture Organisation of the United Nations
GoK	Government of Kenya
GoN	Government of Nepal
HIV	Human Immunodeficiency Virus
HP	Hedonic Price
KG	Kilogram
NFNSP	National Food and Nutrition Security Policy
NNAP	National Nutrition Action Plan
PCA	Principal Component Analysis
PM	Past Midday
SDG	Sustainable Development Goals
UAE	Unconditional Average Effect
VIF	Variance Inflation Factor
WHO	World Health Organization
WTP	Willingness to Pay
WUR	Wageningen University and Research Centre

CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter gives the background of the study, statement of the problem and the objectives in sections 2, 3, and 4 respectively. The research questions and justification of the study are presented in sections 5 and 6 respectively. Section 7 gives the scope and limitation of the study and operational definition of terms are presented in the last section.

1.2 Background of the Study

Developing countries Kenya included are faced with increased population growth and urbanization resulting in high demand for food, especially animal-based protein (FAO, 2013). The dilemma is how to sustainably meet the rising demand for animal-based protein in the face of climate change, environmental degradation as well as land and water scarcity (Lensvelt and Steenbekkers, 2014). The popular current animal-based protein sources are milk, meat and eggs whose supply is insufficient, unsustainable and relatively expensive (GoK, 2013). Entomophagy, the collection and consumption of insects as food could be a possible solution for developing economies Kenya included with several advantages (Alemu *et al*., 2015). Edible insects are nutritious, always available and have a lesser ecological footprint (FAO, 2013). Edible winged termites (EWT) are one of the edible insects commonly consumed in Western Kenya (Ayieko, 2013). The edible insect value chain has long been subsistent but it is transforming to commercial among consumers in Western Kenya particularly in Kimilili Sub-County.

The collection and consumption of insects by humans has long been known and dates back to prehistory (Van Itterbeeck and Van Huis, 2012; Anankware *et al*., 2013) and according to Yi *et al*. (2010), insects were consumed in China 3,200 years ago. Attitudes towards entomophagy are determined by cultural and health issues (Van Huis *et al*., 2013). People eat insects out of choice, because of their palatability and established place in local food cultures in many regional and national diets (FAO/WUR, 2012). Currently, over 2,000 insect species are consumed (Jongema, 2014). Van Huis *et al*. (2013) noted that different insect species are consumed at different stages of their life cycle. Anankware *et al*. (2013) reported a number of edible insect species in Africa, Asia, America and Australia, with South Africa, Southeast

Asia and North America having the highest registers. In Africa, insects are collected in the wild to feed pigs and poultry on farm (Kenis and Hein, 2014; Riggi *et al*., 2014).

The most commonly consumed insects are beetles (*Coleoptera*) (31%), caterpillars (*Lepidoptera*) (18%), bees, wasps and ants (*Hymenoptera)* (14%), grasshoppers, locusts and crickets (*Orthoptera)* (13%), cicadas, leafhoppers, plant hoppers, scale insects and true bugs (*Hemiptera*) (10%), termites (*Isoptera*) (3%), dragonflies (*Odonata*) (3%), flies (*Diptera*) (2 %) and other orders (5%) (FAO, 2013; Van Huis *et al*., 2013). More than 2.5 billion people in Africa and Asia eat insects as a common dietary habit and their collection and sale is an income generating activity for many women and youth in rural areas (FAO, 2010).

Insects comprise 70-95% of all animal species (Chapman, 2009), over one million species have been described and there could be a total of more than six million (Hamilton *et al*., 2010). Insects reproduce quickly, are less water and land dependent, emit less greenhouse gases (Van Huis *et al*., 2013) and can feed on bio wastes which are easily converted to high quality protein used for animal feed (Yen, 2012; FAO, 2013). They provide proteins (amino acids such as methionine, lysine, and threonine), carbohydrate, fats, minerals (calcium, iron, zinc, phosphorous), some essential vitamins vitamin A, B complex, and C (Johnson, 2010; Xiaoming *et al*., 2010). Insects are rich in proteins, fibre, micronutrients and fatty acids thus an important food supplement for undernourished children and people living with HIV/AIDS (Kinyuru *et al*., 2009; Ayieko *et al* ., 2010). They pose a low risk of transmitting zoonotic diseases, their harvesting provide entrepreneurship opportunities (Ayieko *et al*., 2011) and worldwide, insect gathering and rearing is an important livelihood diversification strategy for developed, transitional and developing economies (FAO, 2013).

In Kenya, winged termites, grasshoppers, locusts, lake flies and crickets have been embraced as part of traditional diet among rural communities (Ayieko *et al*., 2010). These edible insects have received a major boost after the Food and Agricultural Organization (FAO) recommended them as a way of addressing food insecurity in developing nations (Ayieko *et al*., 2011). The most seasonally collected edible insect in Western Kenya is the winged termite and like other insects, it is a good source of protein with high fat content (and thus energy) and many important minerals and vitamins (Pambo *et al*., 2016). The most commonly eaten termite species are the large termites (*Macrotermes subhylanus*) known as

Agoro in Luo and *Chiswa* in Luhya that emerge after the first rains fall at the end of the dry season, from holes near termite nests (Ayieko *et al*., 2010).

Termites are consumed raw, blanched, fried in own fat or sun-dried and surplus sold in any of the fore mentioned forms for cash (Ayieko *et al*., 2010). Even the landless can collect and sell the termites to increase their household income as collections from other peoples land are not prohibited (Ayieko *et al*., 2011). Furthermore, the nuptial flights can be collected very much far away from where they emerge using a light source and an open bucket half filled with water. Generally, the termite business has the potential of improving food security and household income of vulnerable groups specifically women, children, the poor, the landless and people living with HIV/AIDS.

1.3 Statement of the Problem

The food poverty rate stands at 42 percent in Bungoma County; Kimilili Sub-County included (GOK, 2013). The Sub-County residents mainly depend on milk and eggs for animal-based protein supply. However, these sources are insufficient, unsustainable and expensive for the unemployed poor locals who are the majority in Kimilili Sub-County. These reasons have made access to sufficient and sustainable animal-based proteins by most households difficult leading to malnutrition. Promoting the use of edible insects as an animal-based protein source is a sustainable solution (FAO, 2013). Edible winged termites are harvested and consumed by residents of Kimilili Sub-County. Commercializing the edible winged termite value chain has the potential of improving this situation. The termite value chain is transforming from subsistent to commercial. However, information on the consumers' perception of it, the factors influencing its acceptance and quantity consumed is scanty. Furthermore, the significant determinants of its market prices are unexplored. This information is important for commercialization of the termite value chain.

1.4Objectives

1.4.1General Objective

To contribute to enhanced commercialization of edible winged termite value chain as a way of diversifying food systems for improved livelihood.

1.4.2 Specific Objectives

i. To determine the consumers' perception of edible winged termites in Kimilili Sub-County.
ii. To determine the socioeconomic, institutional factors and termite characteristics significantly influencing consumers' acceptance and quantity consumed of edible winged termites in Kimilili Sub-County.
iii. To evaluate the significant market price determinants of edible winged termites in Kimilili Sub-County.

1.5 Research Questions

i. How do consumers in Kimilili Sub-County perceive edible winged termites?
ii. What are the socioeconomic, institutional factors and termites' characteristics that significantly influence acceptance and quantity consumed of edible winged termites by Kimilili Sub-County consumers?
iii. What are the significant market price determinants of edible winged termites Kimilili Sub-County?

1.6 Justification of the Study

The food poverty rate in Bungoma County stands at 42 percent, due to overdependence on rain fed agriculture that has been adversely affected by climate change (GOK, 2013). Among the development strategies put forward to address the problem are: food crop diversification, on-farm value addition, expansion of small livestock commercialization projects to enhance food security and increase farmers' incomes. Termite commercialization could be one way of diversifying food systems in Bungoma County. Termites harvesting is done during dry and rainy months; their value addition techniques are simple mainly on farm and an income generating activity.

Termites' commercialization could contribute to the achievement of National Food and Nutritional Security Policy (NFNSP) objective of achieving good nutrition for optimum health through; increasing the quantity and quality of food available that is affordable to consumers (GoK, 2011). Commercialization of termites will also help the country achieve the Sustainable Development Goal (SDG) number two that by 2030, it should end hunger and ensure access by all people, in particular the poor and people in vulnerable situations,

including infants, to safe, nutritious and sufficient food (GoK, 2007). Furthermore, while assessing the potential of edible insects as food and feed, Van Huis (2013) and Rumpold and Schlüter (2013) emphasized the necessity of consumers' acceptance and willingness to pay studies regarding edible insects as food.

The findings from this study contribute to knowledge about consumers that is important for intense commercialization of the termite value chain and agribusiness development. The study provides important information on increasing entomophagy thus responding to FAO and WHO call of increasing entomophagy as a way of addressing food insecurity challenge. It has made recommendations that when implemented will make the business more attractive and paying to the actors who are the vulnerable in society. Furthermore, findings from this study inform policy makers on designing and implementing policies on insect commercialization as food and feed in the Country.

1.7 Scope and Limitation of the Study

This study was carried out in Kimilili Township and Nabikoto sub-locations of Kimilili and Kamukuywa wards respectively both from Kimilili Sub-County, Bungoma County, Kenya. The study focused on edible winged termites. It aimed at finding out the consumers' perception of the edible winged termites, factors significantly influencing acceptance and quantity consumed of edible winged termites and the significant market price determinants of edible winged termites. The limitation encountered was lack of standard measurement units for edible winged termite quantity. However, this was solved by weighing the different units used in the rural and urban areas, taking the average weight and converting it to the international standard (SI) units that is Kilograms which are reported.

1.8 Operational Definition of Terms

Entomophagy –The collection and consumption of insects by human beings as food.

Food poverty- The inability of an individual or household to obtain healthy, nutritious food or to access the food they would like to eat.

Food security-situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Hedonic price- The change in edible winged termites' price resulting from the marginal change in one of its attributes or characteristics.

Household-A social unit composed of people living together in the same compound and have same cooking arrangements, and are answerable to the same household head.

Insect-a class of invertebrates within the arthropod phylum that have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae.

Livelihood diversification-The process by which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living.

Perception-It is one's own special way of seeing or viewing things (products).

Urban- Households within market centres in the peri-urban area (Kimilili Township Sub-Location).

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter gives literature reviewed on previous related studies. The literature has been presented in the following order; entomophagy in Kenya, Consumers' perception of food products, determinants of consumer product acceptability, Factors influencing pricing of food products and finally the theoretical and conception frameworks of the study.

2.2 Entomophagy in Kenya

The edible insects within the Lake Victoria region are; termites, both green and brown grasshoppers, locusts and a collection of edible lake flies (Ayieko *et al*., 2010). According to Kinyuru *et al*. (2010), winged termites, grasshoppers, locusts, and crickets have been embraced as part of traditional diet among rural communities in Kenya. Lake Flies, *Agoro* termites, Black ants, locusts and Grasshoppers have traditionally been consumed in some local areas (Ayieko *et al*., 2010; Kinyuru *et al*., 2010; Alemu *et al*., 2015). Termites are part of the traditional diet in Western and Lake Victoria region of Kenya thus relatively popular even among non insect eating communities (Kinyuru *et al*., 2013). The major limiting factor in the use of edible insects is that they are seasonal and highly perishable (Ayieko *et al*., 2010).

Insects being protein and micronutrients rich have been used in enriching low protein foods such as maize and sorghum with protein to help reduce nutritional deficiency (Ayieko *et al.,* 2010; Nyukuri *et al*., 2014). Termites, *dagaa* and grain amaranth have been used in formulation of protein rich complementary food for children and mothers in Mumias Sub-County Western Kenya (Konyole *et al*., 2012). Termites can be eaten in three different forms; as whole insects, in powder or paste form, and as protein extract (FAO, 2013). Alemu *et al*. (2015), observed that residents of Western Kenya (mainly in rural areas) traditionally eat whole termites after boiling or sun-drying or roasting them with a pinch of salt, served on the side of ugali.

Lake flies are sensitive to dirty waters and emerge only from clean lakeshores without contamination making them fairly hygienic aquatic products relative to several lake and ocean fishes (Ayieko *et al*., 2010). Contamination is only possible at the point of harvesting

and processing and this can be improved with due care as necessary. According to Ayieko *et al*. (2010), termites are sensitive to harmful chemicals in the ground and burrow low in the grounds to form their nests. Furthermore, mounts treated by insecticides do not realize the sexual winged termites that are harvested for human consumption. The basic rules for insect consumption are that the insects must be caught alive, from healthy environments and should be processed immediately to avoid deterioration (Ayieko *et al*., 2010).

The nature of the insect wings is such that tiny pieces often stick around the throat and cause unpleasant cough (Ayieko, 2013). Parts of insects such as the spiny legs, wings or hairy skins found in crickets, caterpillars and large grasshoppers, must be treated with caution to avoid stomach upsets (Ayieko *et al*., 2010). They further pointed that; Consumption of certain insects may cause bodily harm during certain physiological conditions such as famine when a severely malnourished body may not be able to tolerate foods rich in thiamine. This setback could be overcome by processing the insects by mixing with other ingredients such as flour, sugar, eggs or bread crumbs (Ayieko *et al*., 2010). Termite crackers, lake fly crackers, Termite muffins, lake fly muffins, lake fly meat loaf, and lake fly sausages have been processed, consumed and liked by users within the Lake Victoria region (Ayieko *et al*., 2010). Western Kenya has focused on other insects such as grasshoppers (Kinyuru *et al.,* 2010) and black ants (Ayieko *et al*., 2012). As such, entomophagy will no longer be a survival tactic for the poor in Kenya but a food habit for the health conscious individuals and food for the future.

At the onset of the rainy season, the winged reproductive termites fly off from their nests in large numbers during which they are collected for domestic consumption (Ayieko *et al*., 2013). It is during this flight, known as the nuptial (wedding) flight that virgin queens pair up with males in the air for mating and then land to start a new colony (Ayieko *et al*., 2011). Termites are known to have large and elaborate nests; some species have nests as tall as eight metres, and a single nest may house as many as one million individuals consisting of workers, soldiers, a queen and a king. The global biomass of termite individuals is believed to exceed that of all human beings combined (FAO, 2013). In Kimilili Sub-County, termites are consumed both as main and side dishes, or simply eaten as snack foods after they have been de-winged fried and sun-dried (Kinyuru *et al.,* 2009).

Early in the morning women and children collect three shot sticks which are used to invite the termites. Sticks are beaten, this is to sound like rain and because termites emerge when it begins to rain, they all come trooping out during the day (Makokha, 2016). Normally, women erect small tents *siswa*, which are covered with blankets leaving an opening that leads to a special hole dug at the opening, where termites will slide into, for collection. The special hole is called *efubo*, which is smoothly lined with banana leaves inside and at the entrance where termites slide and fall into (Makokha, 2016). Continuous beating and drumming on the ground (resembling rain) around termite hills triggers the termites to emerge (Ayieko *et al*., 2011).

In Western Kenya, different methods are employed in harvesting termites and these depend on the season and type of species (Ayieko *et al*., 2010). In urban areas, they are trapped in receptacles with water near light sources, to which they are attracted (Chung, 2010). In rural areas, winged termites are typically caught at the termite mound itself (Ayieko *et al*., 2011). When they emerge attracted by the light from a bundle of dry grass set on fire-they are swept into a hole dug for the purpose (Kinyuru, 2009). Tent-like structures made of sticks or elephant grass covered with banana leaves or a blanket is used to cover the holes. All holes outside the structure are closed so that termites only emerge from holes within the structure. The emerging sexuals, unable at first to use their wings, crawl toward the light on one side of the structure and fall into the pit, from which they are unable to escape because of the smooth leaf lining. They are then collected from the pit for consumption and processing (Kinyuru, 2012).

In Kimilili Sub-County, edible winged termites are collected mostly by women and children depending on the time of their emergency. Nuptial flights, *kamaresi* in luhya, mostly collected by children emerge around 2 am from April to June. Climate change has affected emergence of termites due to causing unpredictability of rains (Ayieko *et al*., 2010). A typical termite mound yields up to a quarter sack of termites, equivalent to 20 kg of fresh termites in one collection and several collections are made in one season (Ayieko *et al*., 2010). Between September and December edible winged termites emerge from 2 pm to around 5pm, mostly collected by women, at most 10kg collections, and referred to as *chiswa chisisi* in luhya. *Chiswa chinunda* and *Kamabuli* in luhya emerge from 5 pm and 6pm, to 6pm and 7pm

respectively from December to February. These are collected by children; the least collected at most a half kg and a quarter kg per collection, respectively (Makokha, 2016).

2.3 Consumers' Perception of Food Products

Perception is the process of selecting, organizing and interpreting sensations into meaningful whole. This process involves; exposure to stimulus which is the deliberately or accidentally coming into contact with environmental stimuli; attention ,the allocation of an individual's mental capacity to a stimulus or task and sensation which are responses to a person's sensory receptors to environmental stimuli and transmission of this information to the brain via the nervous system (Hanna, 2013). Consumer perception underlies the success or failure of products in the market place. According to Šarčević *et al*. (2009), all stakeholders (consumers, producers, authorities) should fulfil their expected contribution in integrated manner and all efforts should be put in preventive control and consumption of safe and quality food.

A two-way communication among stakeholders is required in order to provide all information of the hazards and the risks associated with food handling from the time of purchase and onwards (Šarčević *et al*., 2009). All stakeholders should be socially responsible in the process of getting safe and quality food (Šarčević *et al*., 2011). Non-cognitive mechanisms such as conditioning and imitation are predominant in the early formation of food habits (Troy and Kerry, 2010). Consumer perceptions are very dynamic, and there are often differences between what consumers' perceive and their behaviour.

The viability of the food industry depends on consumers demanding and paying for products and for them to willingly purchase and consume a particular food type, their perception has to be positive towards it (Šarčević *et al*., 2011). Quality cues contribute to the function of believes and therefore purchase choice (Troy and Kerry, 2010). In their study of meat and meat products Troy and Kerry (2010), found out that consumers' perception of meat relates to its quality. Understanding the most important factors influencing food consumption is imperative in order to produce consistent products, in line with consumers' expectations (Troy, 2011). Food habits, attitudes, beliefs and opinions on food choice and purchase influences the acceptance or rejection of food (Šarčević *et al*., 2011). Packaging is a visual

factor that influences the consumers' purchase of food products, presentation of the product to the consumers will make them purchase or not purchase it (Troy and Kerry, 2010).

Based on the study by Chaniotakis *et al*. (2010), factors influencing consumers' purchase intention are consumers' attitudes, extrinsic and intrinsic factors of the products. Consumers' attitude includes trust, familiarity and perceived economic situation (Aertsens *et al*., 2009). The way of thinking influence consumers purchase intention as well as perceived economic situation (Chaniotakis *et al*., 2010). When a product is familiar to consumers; they will define the product in such a good way (Conroy, 2010). Therefore, in order to build up trust on any product, retailers should let consumers feel confident with their product (Chaniotakis *et al*., 2010). Perceived price-quality affects consumers' attitude; negative experience toward a product will give a negative impact for future purchase while when the quality matched the price, a positive impact is shown. Furthermore, such experiences are shared with others and thus influence their decision-making (Conroy, 2010). Extrinsic factors of the product include 'perceived price, packaging, store image, and advertisement. Intrinsic factor is related to physical product characteristics where it includes perceived quality, risk and value (Liljander *et al*., 2009; Jaafar *et al*., 2011).

2.4 Determinants of Consumer Product Acceptability

Sensory appeal; smell, colour, texture and taste are the most important factors influencing food choice (Costell *et al*., 2010; Lunde *et al*., 2012). According to Costell *et al*. (2010), consumers' responses to food products are determined by four different components. First, consumers perceive the sensory characteristics of a product. Second, the consumer has a general response to a product, which is an affective component. Third, the consumer applies a cognitive component which is related to the information the consumer has about the product and to the consumers' attitudes and beliefs. Fourth, the response is affected by a behavioural component which involves the persons' intentions or actions for future behaviour (Costell *et al*., 2010). Sensory qualities and taste in particular are critical determinants of food choice and preferences (Garcia-Bailo *et al*., 2009). Understanding how consumers perceive senses such as taste and olfaction are thus useful in understanding food preferences (Lawless and Heymann, 2010).

The interaction between taste and odour jointly constitutes the flavour reflecting a central neural process based on associations between taste and smell (Costell *et al*., 2010). Oral perception of the foods texture is included in what people perceive as the "taste" of a food product. Thus, the sensory factors affecting consumers food preferences are particularly how they perceive the basic tastes: sweet, sour, bitter, or salty which, together with odour and texture, constitutes the vast array of flavours found in foods (Garcia-Bailo *et al*., 2009).

According to Köster (2009), people learn about food throughout their lives with most food related learning occurring during the first 5 years of life. Flavour-consequence learning is through experiencing the negative or positive consequences of eating a particular food (Köster, 2009). Repeated exposure to novel foods might increase liking for that particular food (Hausner *et al*., 2012). The medicine effect is the effect that occurs when food associated with recovery from illness becomes preferred. Flavour-flavour learning occurs when a new flavour is paired with an already liked flavour like sweetness and is long lasting. The food continues to be liked unless another learning experience counteracts the initial experience. Flavour-nutrient learning occurs when a food is associated with ingested nutrients or calories. Consumers prefer food with the highest energy density, such as food high in sugars or fat (Köster, 2009).

Habits develop through repeated behaviours and are automatic acts since individuals rarely think consciously about them (Franchi, 2012). According to Costell *et al*. (2010), habitual consumption of a food might increase consumers' liking or preference for that particular food. Expectations towards sensory or hedonic characteristics influence food selection (Costell *et al*., 2010). Information received before tasting a food product influences hedonic ratings more than information received after tasting (Siegrist and Cousin, 2009), thus consumers tend to search for the taste experience they initially received information on.

Expectations or experiences related to a certain brand and brand loyalty affects consumers' preferences (Lawless and Heymann, 2010). The brands consumers are loyal to, produce positive associations for the consumers which determine whether the consumer will repeatedly buy the product (Jansson, 2010).Culture is a sort of collective memory that influences individual behaviours (Franchi, 2012), and its influence is rooted in a combination of several factors environment included. Culture determines what kind of foods we are

exposed to as children, thereby influencing our preferences later in life (Ludy and Mattes, 2012). According to Barthomeuf *et al*. (2009), the presence of other people affects the desire to eat food thus affecting our food preferences to some degree. Different gender and age groups have different preference patterns for functional food concepts as well as different healthy food habits (Johansen *et al*., 2011).

Kuhnlein *et al*. (2009), in their study of food systems noted that, food choices are frequent, multifaceted, situational, dynamic and complex. After purchase the consumer has a quality experience, and the relationship between quality expectations and quality experience determines whether or not the consumer will be satisfied with the product (Chrea *et al*., 2011).The ultimate goal of product development depends on consumers' judgment (Van Trijp and Fischer, 2011). The acceptance of functional food ingredients is influenced by the way consumers obtain their information and knowledge (Del Giudice and Pascucci, 2010). Also the intensity of information searching depends on the level of personal involvement (Kroeber-Riel, and Gröppel-Klein 2009). Consumers' product acceptance depends on several influence factors divided into three main aspects: consumer characteristics, purchasing situation and product characteristics (Bröring 2010; Bröring and Faber 2011).Successful product launch needs an efficient and structured product development process (Man, and Lai, 2010). Consumer perception towards a food product as containing important nutrients is a strong predictor of purchase intention (Krutulyte *et al*., 2011).

2.5 Factors Influencing Pricing of Food Products

Willingness to pay (WTP) is the maximum amount an individual is willing to sacrifice to procure a good or avoid something undesirable (Alemu *et al*., 2015). The price of any goods transaction will thus be any point between a buyer's willingness to pay and a seller's willingness to accept. Aryal *et al*. (2009), revealed that the consumers' knowledge and awareness about agricultural organic products affected the market prices. Consumers' perception about nutritive value, taste, freshness, food safety and environmental friendliness are important determinants of pricing of food products (Pouratashi, 2012). Aryal e*t al*. (2009), consider gender, age, income, education, price of product, experience and attitude as the most important factors influencing food products pricing.

Michel *et al*. (2011), in their study on value added chicken realised that most consumers are willing to pay premium prices for value added products than those not value added. This was also revealed by Gebrezgabher *et al*. (2015), when they observed that consumers paid more for smoked fish than fresh fish in Ghana. The government of Nepal (2009), on organic food consumption noted that; consumers' knowledge and awareness about the products affected their attitude and perception towards market prices charged on the food. According to Becker *et al*. (2016), most organic products consumers perceive quality that is food safety and nutritive value as more important than the prices. Janssen and Hamm (2012), revealed that organic products that were well packaged, labelled with cooking instruction, and with consistent supply fetched premium prices. Trust, external appeal, supply and information about food products influence market prices to acquire them (GON, 2009).

A product does not provide utility; it is the characteristics of the product that give rise to utility (Lancaster, 1966). The total amount of utility a consumer receives from the consumption of a good is subject to the total amount of the characteristics contained in a product purchased. The hedonic price can be interpreted as the additional cost of purchasing a product that is marginally 'better' in terms of a particular characteristic(Rosen,1974).

2.6 Theoretical and Conceptual Framework

2.6.1 Theoretical Framework

The study was based on utility maximization theory, where consumer utility provides the basis for measuring willingness to pay (WTP) in terms of change in welfare. Consumers are willing to make and pay for preferences that maximize their utility. The preference utility function for an individual may be written as $u(x,q)$ where $x = x_1 \ldots\ldots\ldots x_m$ is a vector of private goods and $q = q_1 \ldots\ldots\ldots q_m$ is a vector of public goods. Private goods are chosen by individuals and public goods are considered exogenous. An individual maximizes utility subject to income *y*. The indirect utility function $v(p,q,y)$ is given by:

$$V(p,q,y) = \max \{u(x.p) \mid p.x \leq y\} \quad (1)$$

The properties of both the indirect utility and expenditure function are well known (Deaton and Muellbauer, 1980). The derivative of the expenditure function yields the Hicksian or utility constant (compensated) demand function with the subscript indicating the Marshallian or ordinary demand curve:

$$u_i(p,q,u) = mp_i(p,q,u) \quad (2)$$

WTP measures the maximum amount of income the individual will be willing to pay for an improvement in their circumstances (utility maximization) or maximum amount an individual is willing to pay to avoid a decline in circumstances. Willingness to pay is defined using the indirect utility function as;

$$v(p, q^*, y - WTP) = v(p, q, y) \quad (3)$$

Where $q^* \geq q_i$ and increases in q are advantageous, that is $\frac{\partial v}{\partial q} > 0$ implying that higher consumption level of q leads to higher utility).

2.6.2 Conceptual Framework

In Figure 1, it is conceptualised that consumers acceptance and pricing of edible winged termites is directly influenced by; consumers' socioeconomic, institutional and termites characteristics. The Edible Winged Termites pricing is also affected by acceptance. Consumers' socioeconomic characteristics include; age, gender, education, household members above 5years, number of children below 5 years, off farm activities, being a native of the area and income. Institutional characteristics include; the type of retail out let; kiosk and producers ; source of nutritional and food security information that are extension officers and nutritional officers, group membership, time taken walking to the nearest market, and location of the consumers' residence. Termite characteristics/perception include; cleanliness, healthiness, taste, smell, colour, size, raw, fried, sun-dried, blanched, relative price, availability, naturalness, nutritional value, texture and ethical concern. Termite characteristics/perception have been measured on a Likert five point continuum scale of strongly disagree, disagree, undecided, agree and strongly agree. Consumers' acceptance and pricing of Edible Winged Termites result in improved termites value addition and agribusiness development leading to improved producer revenue and welfare resulting from sale of edible winged termites.

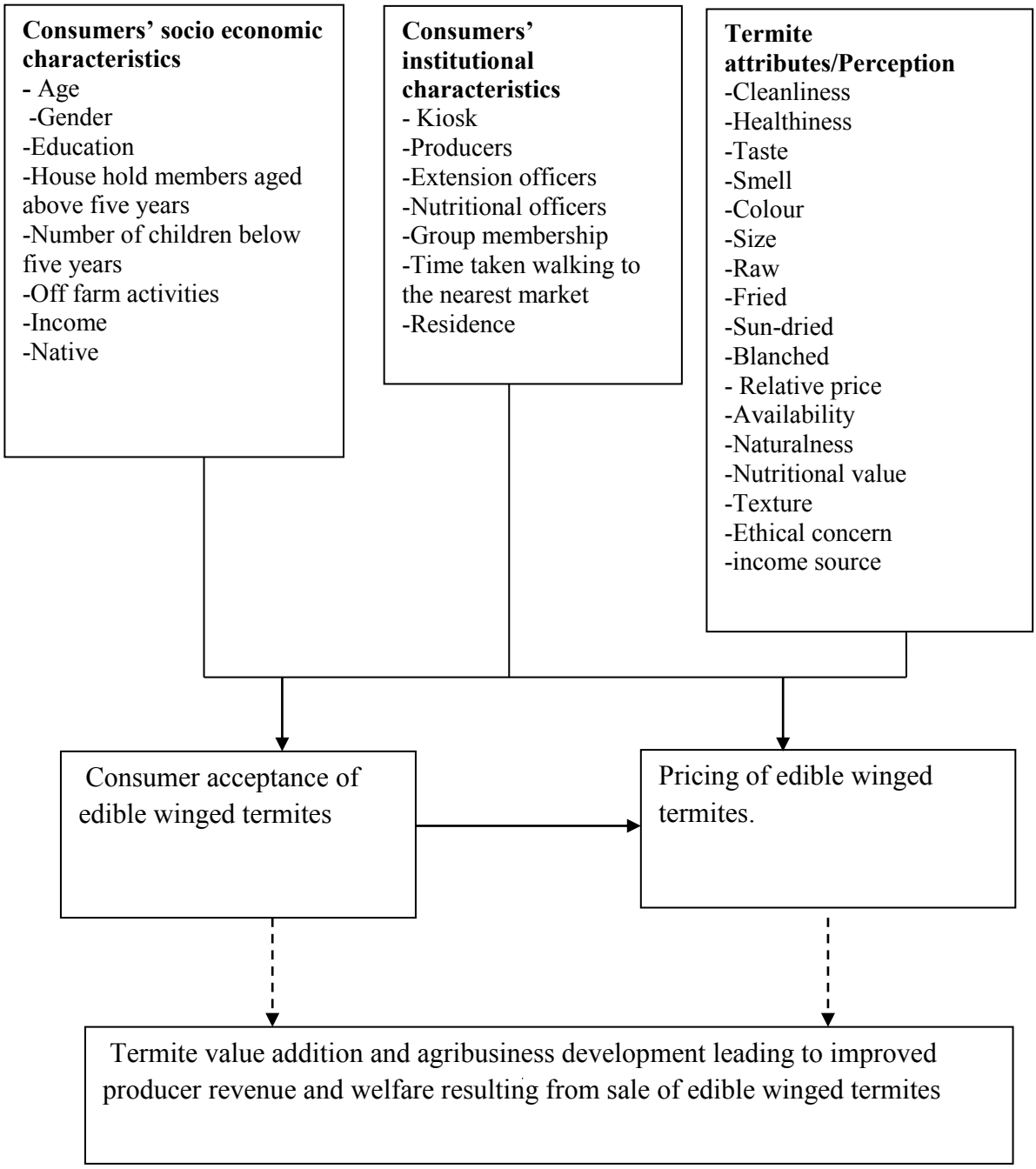

Figure 1: Conceptual Framework

Source: Own Conceptualization

CHAPTER THREE
METHODOLOGY

3.1 Introduction

The chapter gives information on the Research design, study area, sampling procedure and Sample size determination in sections2, 3, 4 and 5 respectively. The last three sections give Data collection methods and sources, Analytical framework and priori assumptions of the study.

3.2 Research Design

This study used an exploratory survey research design. Exploratory survey design is used to gather, summarize, present and interpret information on topics that have not been researched (Mutai, 2014). This research design was appropriate since the study aimed at exploring in to the economic aspects of entomophagy that had not been done by many researchers.

3.3 Study Area

The study was conducted in Kimilili Sub-County, which is one of the nine Sub-Counties of Bungoma County. The study area was purposively selected for its high population density, cosmopolitan population and emergence of edible winged termite commercialization. Therefore using an exploratory research design, the study area would provide insights into aspects of marketing the termites. Kimilili Sub-County borders Mount Elgon Sub-County to the North, Tongaren Sub-County to the East, Webuye East and Webuye West Sub-Counties on the South and to the West it borders Kabuchai Sub-County. Kimilili Sub-County geographical coordinates are 0° 45' 0" North, 34° 43' 0" East. The Sub-County covers an area of 181.20 Km^2 divided into two divisions that are Kimilili 94.00 Km^2 and Kamukuywa 87.20 Km^2 each having two wards. Kimilili division has Kibingei 51.90 Km^2 and Kimilili 42.10 Km^2 wards, while Kamukuywa has Maeni 41.00 Km^2 and Kamukuywa 46.20 Km^2 wards (GoK, 2010).

According to GOK (2013), Kimilili Sub-County is the most densely populated in the county with a population of 150,074 persons (Males 73,011 and females 77,063) thus a density of 828 persons per Km^2.The population was projected to be 169,567 persons with a density of 936 persons per Km^2 by the year 2017 with a male population of 82,494 and females 87,073.

It is further pointed in GOK (2013) that, high unemployment level, food insecurity due to dependency on rain fed agriculture and high poverty and inequality levels are a challenge in Kimilili Sub-County. GOK (2013) proposed that, diversification of food production and encouraging self employment should be promoted to enhance food security and poverty alleviation.

The Sub-County is rural with headquarters at Kimilili town with one of the largest open air markets in Western region, the Kimilili old market. Other busy markets are new Kimilili-Makwata, Kamukuywa, Sosio, Matili, Chebukwabi, Kapkateny, Chesamisi, Maeni and Kibingei markets. Agriculture is the main economic activity in the area with cereals farming dominating. Cereals commonly produced are; maize, beans, sorghum, millet, groundnuts and soy bean. Dairy farming is done on small-scale and indigenous poultry keeping is done majorly on free range. Main cash crops are sunflower, coffee and sugarcane (GoK, 2013).

Termites are harvested, consumed and sold year round in the Sub-County. Most collections are in rural areas by women and children. Termites are sold in both rural and urban markets in different forms that are raw, fried and sun-dried. GOK (2013) identifies agribusiness as an investment opportunity to be explored in Kimilili Sub-County. The termites' value chain enhancement could be of great importance to the Sub-County residents.
The map of the study area is presented in Figure 2.

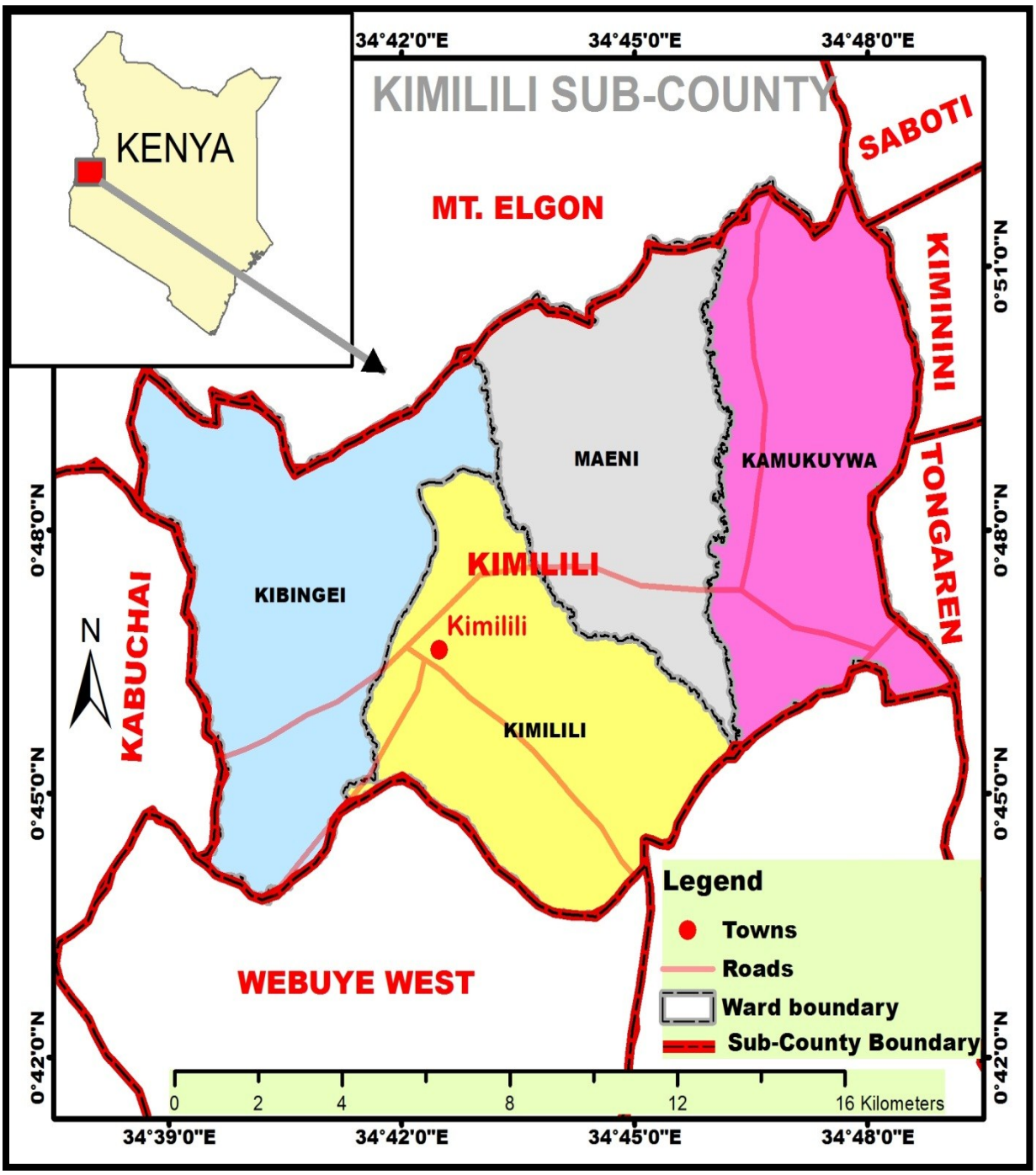

Figure 2: Map of the Study Area.

Source: World Resource Centre (2016).

3.4 Sampling Procedure

The target population of this study was the residents of Kimilili Sub-County where multistage sampling procedure was followed. In the first stage, Kimilili Sub-County was purposively selected because it is among the Sub-Counties in Western Kenya where agribusiness on termites is developing. In the second stage, two of the four County Assembly wards were selected purposively. Kimilili ward residents represented urban consumers while Kamukuywa ward residents represented rural consumers. Based on information from the ward Ministry of agriculture offices, Kimilili Township Sub-Location from Kimilili ward and Nabikoto sub-location from Kamukuywa ward were selected. Simple random sampling technique was used to select 192 respondents from each Sub-Location leading to a total of 384.

3.5 Sample Size Determination

The required sample size was determined by proportionate to the number of households sampling methodology adapted from Anderson *et al*. (2007).

$$n = \frac{pqZ^{2}}{E^{2}} \qquad (4)$$

Where; n= desired sample size; Z= standard normal deviate at the desired confidence level (95%); p= proportion of the target population containing the major interest; q= 1-p; E= allowable error. Since the proportion of the population was not known, p=0.5, q=1-0.5=0.5, Z=1.96 and E=0.05 (Fisher *et al*., 1991)

The sample size, therefore, was;

$$n = \frac{(0.5)(0.5)(1.96^{2})}{(0.05)^{2}} = 384 \quad \text{Consumers}$$

3.6 Data Collection Methods and Sources

Primary data was collected from the respondents by use of a semi structured questionnaire. The questionnaire containing information on consumers' characteristics, institutional and termite characteristics was administered through face to face interviews. The data collected from the questionnaires was cleaned and entered in STATA for analysis.

3.7 Analytical Framework

Objective one: To determine the consumers' perception of the edible winged termites in Kimilili Sub-County was analysed using descriptive statistics. A Likert type five-point continuum scale was used to measure perception. The respondents were asked to indicate the extent of their agreement on each perception statement (indicator) using the Likert type five-point continuum scale of strongly disagree, disagree, undecided, agree, and strongly agree. Since data pertaining to consumers' perception of edible winged termites consists of possibly correlated variables, factor analysis was used to reorient the data and to create a few numbers of orthogonal variables which account for as much of the available information as possible (Jollife, 2002). The basic idea underlying factor analysis is that, p observed random variables, $X = [x1, x2, ..., xp]$ can be expressed as linear functions of $m (< p)$ latent factors, $F = [f1, f2, ..., fm]$:

$$X_j = \sum_{k=1}^{m} \lambda jkfk + ej \qquad (5)$$

Where λjk, $j = 1,2, ... p$; $k = 1,2, ... m$ denote factor loadings, and ej, $j = 1,2, ..., p$ are error terms or specific factors. The factors obtained from this analysis have the property that each factor is uncorrelated with all others and thus can be included as explanatory variables in the Double Hurdle model in the second objective.

Objective two: To determine the socioeconomic, institutional factors and termites characteristics significantly influencing consumers' acceptance and quantity consumed of edible winged termites in Kimilili Sub-County ,was analysed using the Double Hurdle model. Double Hurdle models the households' demand for edible winged termites as a two-tier decision. In the first tier, households decide whether or not to consume EWT. Conditional on that decision being positive, they decide about the quantity of EWT to consume in the second tier. The first tier is a binary decision, which is expressed as:

$$d_i^* = \alpha x_i + \mu_i; \quad \mu_i \sim N(0,1) \text{ and } d_i = \begin{cases} 1 if\ d_i^* > 0 \\ 0 otherwise \end{cases} \qquad (6)$$

Where the subscript *i* refers to the respondent of the *i*th household. d_i^* is a latent variable for d_i. When $d_i = 1$, the respondent consumes EWT in his or her household, while $d_i = 0$

indicates no EWT are consumed by the respondent. The decision on the quantity of EWT to consume is represented as:

$$Y_i^* = \beta z_i + V_i; \quad v_i \sim N(0, \sigma^2) \text{ and } Y_i = \begin{cases} Y_i^* if\, Y_i^* > 0 and\, d_i = 1 \\ 0 otherwise \end{cases} \tag{7}$$

Where Y_i^* is a latent variable for Y_i which represents the observed quantity of EWT consumed by the household *i*. In the above equations, χ_i and Z_i are vectors of explanatory variables, which may or may not contain the same variables. α and β are vectors of parameters to be estimated, while μ_i and V_i are random error terms.

A Heckman selection approach may seem appropriate, because a certain proportion of all households report zero consumption of EWT. However, the Heckman approach is designed for incidental truncation where the zeros are unobserved values (Jones, 1989; Wooldridge, 2002). In this case, a corner solution model seems more appropriate than a selection model, because the zero values are actually observed. It can be assumed that households that decide not to consume EWT do so deliberately, so that the observed values represent rational choices (deliberate zeros) rather than censored zeros. The Tobit estimator is a common approach to estimate corner solution models. However, the Tobit estimator is restrictive, as it assumes that the decisions to accept to consume and how much EWT to consume are determined by the same process. A more flexible approach is the double-hurdle (DH) model proposed by Cragg (1971), which accounts for the possibility that the two decisions (hurdles) are determined by different processes. Following the specification in equations (6) and (7) and assuming independent error terms, the likelihood function for the DH model can be expressed as follows (Jones, 1989):

$$L(\mathrm{Y}_i | \mathrm{X}_i, \theta) = \{\prod_{\mathrm{Y}_i=0} [1 - \Phi(\mathrm{X}_i\alpha / \sigma_u)]\Phi(\mathrm{Z}_i\beta / \sigma_v)\} \times \{\prod_{\mathrm{Y}_i>0} \Phi(\mathrm{X}_i\alpha / \sigma_u)\Phi(\mathrm{Z}_i\beta / \sigma_v)\} \times$$

$$\{\frac{\phi[\mathrm{Y}_i - \mathrm{Z}_i\beta / \sigma_v]}{\sigma_v \Phi(\mathrm{Z}_i\beta / \sigma_v)}\} \tag{8}$$

Where ϕ and Φ denote the standard normal probability and cumulative distribution functions, respectively. Similarly, σ_u and σ_v are the standard deviations of u_i and v_i, respectively. Equation (8) can be solved for α, β, and σ^2 through maximum likelihood

estimation. It should be noted that the Tobit is nested in the DH model. Hence, a likelihood ratio (LR) test can be used to establish whether the more flexible DH specification is actually preferable. The log-likelihood of the DH model comprises the summation of the log-likelihood values estimated in the first and second hurdles (tiers) by probit and truncated normal regression techniques.

Using the DH model, marginal effects of the explanatory variables on the probability of accepting EWT consumption and on the quantity EWT consumed were estimated. At first, the probability of accepting EWT consumption for each individual observation i was estimated as:

$$\mathrm{P}\left(d_i^* > 0 \mid \mathrm{X}_i\right) = \Phi\left(\mathrm{X}_i\alpha\right) \tag{9}$$

The conditional expected quantity of EWT consumed was estimated as:

$$\mathrm{E}\left(\mathrm{Y}_i \mid \mathrm{Y}_i > 0, \mathrm{Z}_i\right) = \mathrm{Z}_i\beta + \sigma \times \lambda\left(\mathrm{Z}_i\beta / \sigma\right) \tag{10}$$

Similarly, the unconditional expected quantity of edible winged termites consumed was estimated as:

$$\mathrm{E}\left(\mathrm{Y}_i \mid \mathrm{X}_i, \mathrm{Z}_i\right) = \Phi\left(\mathrm{X}_i\alpha\right)\left[\mathrm{Z}_i\beta + \sigma \times \lambda\left(\mathrm{Z}_i\beta / \sigma\right)\right] \tag{11}$$

The term $\lambda(\mathrm{Z}_i\beta / \sigma)$ in equations (10) and (11) is the inverse Mills ratio:

$$\lambda\left(\mathrm{Z}_i\beta / \sigma\right) = \phi\left(\mathrm{Z}_i\beta / \sigma\right) / \Phi\left(\mathrm{Z}_i\beta / \sigma\right) \tag{12}$$

The marginal effect of each independent variable was estimated following procedures outlined in Burke (2009). The average effects were obtained by averaging over all i observations. In addition to the first stage marginal effects, which were based on the first hurdle estimates, it was differentiated between the conditional average partial effect (CAPE) and the unconditional average partial effect (UAE). While the CAPE expresses the second hurdle effect, conditional on the first hurdle being passed, the UAE expresses the combined effect of both hurdles.

Objective three: To evaluate the significant market price determinants of edible winged termites in Kimilili Sub-County was analysed using hedonic regression analysis model. This analysis adopts hedonic pricing and regression analysis to estimate the value of specific attributes of edible winged termites from within the bundled price. The regression analysis treats the price as a function of various attributes. The general implicit function is expressed as:

$$P_i(X) = Q^i(X_1, X_2, \ldots X_n, Z) + \varepsilon_i \quad (13)$$

Where; P_i is the price of the product *i* in the market (EWT), X_1, $X_2 \ldots X_n$ are product attributes, and Z are the buyer or seller characteristics. The variable Z can be omitted from the function if there are no existing differences between the buyers or sellers (Rosen, 1974).

The above function then takes the following empirical multiple regression models' derived short form:

$$InP_i = \alpha + \sum_{j-1} \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_n X_n + nZ + \varepsilon_i \quad (14)$$

Where; *In* P_i is the market value or price for EWT which is log transformed, *Xs* are the product attributes β_S and are elasticities that measure the proportional change in prices caused by proportional changes in characteristics. Z are characteristics of the sellers or buyers including other relevant market characteristics, while *a* is the constant effect and ε_i the homoskedastic error term with zero mean. The variables used in the model are presented in Table 1. To obtain the parameters the model was estimated using STATA.

The second step of the hedonic regression analysis estimates the willingness to pay of households which additionally accounts for households having different socioeconomic characteristics. The willingness to pay function therefore becomes:

$$p_i = W(X_1, X_2, \ldots \ldots X_n, Z) \quad (15)$$

Where; p_i is the price of termites, W is the willingness to pay, $X_1 + X_2 \ldots \ldots X_n$ termites attributes and a vector (Z) which denotes consumer characteristics.

3.8 Priori Assumptions of the Study

These assumptions are based on prior similar studies findings about explanatory variables used in the current research. However, it should be noted that the current research findings presented in chapter four can either be in agreement with, or contrary to these assumptions. Consumers age, education, household members aged above five years, children below five years, income, being native of the area, residence, off-farm activity participation and group membership have been reported to have positive significant effects on novel food product acceptance, quantity consumed and willingness to pay (Alemu *et al*., 2015; Ayuya *et al*., 2015; Kajale and Becker, 2015; Pambo *et al*., 2016; Gido *et al*., 2017). However, gender and time taken walking to nearest market have been reported to have negative effects on acceptance, quantity consumed and willingness to pay premiums for novel foods in prior

studies (Kajale and Becker, 2015; Medigo *et al*., 2016; Alemu *et al*., 2016). Kiosk, producers, agricultural extension officers and nutritional officers have been reported to positively affect consumer acceptance, quantity consumed and pricing of novel foods (Alemu *et al*., 2015; Balogh *et al*., 2016; Pambo *et al*., 2016; Alemu *et al*., 2017a). Similar previous studies on novel food demand (Kikulwe *et al*., 2011; Akpoyomare *et al*., 2012; Mensah *et al*., 2013; Wollni and Fischer, 2015; House, 2016; Olsen *et al*., 2017) found out that, perceived product attributes, convenience and fitness into consumer culture increased acceptance and quantity consumed.

Table 1. Definition of Variables Used in Double Hurdle and Hedonic Price Models.

Variables	Definition	Measurement	Hypothe-sized sign
Dependent variable			
Conterm	Acceptance of EWT consumption.	1= Yes 0 = No	
Quacons3	Quantity of EWT consumed in a year.	Continuous, Kilo grams	
Inrawprice	Natural log of raw EWT price.	Continuous	
Infriedprice	Natural log of fried EWT price.	Continuous	
Insdrypri	Natural log of sundried EWT price.	Continuous	
Inblanprice	Natural log of blanched EWT price.	Continuous	
Explanatory Variables			
Age	Age of food purchase decision maker in years.	Continuous	+
Gender	Gender of food purchase decision maker.	Dummy1 = Male 0 = Female	+/-
Education	Number of years spent in formal education.	Continuous	+/-
Hmeover5	Total number of household members aged above 5 years.	Continuous	-
Chlbelow 5	Number of children below 5 years	Continuous	+
Income	Monthly income of the household	Continuous; Ksh	+/-
Inincome	Natural log of monthly income	Continuous	+/-
Off-farm activities	Participation in other activities that are not on-farm.	Dummy;1 = Yes 0 = No	+
Native	Born and grownup in the study area.	Dummy;1= Yes,0=No	+

Residence	Where consumer resides	Dummy;1= Urban,0=Rural	+/-
Groupmem	Participation in food security groups.	Dummy;1 = Yes 0 = No	+
Timarket	Time taken walking to the nearest market	Continuous; Number of minute	-
Kiosk	Having Kiosk as the most preferred retail outlet.	Dummy;1 = Yes 0 = No	+
Producers	Having collectors of EWT as the most preferred retail outlet.	Dummy;1 = Yes 0 = No	+/-
Agritens	Agricultural extension officers as frequent nutritional information source.	Dummy;1 = Yes 0 = No	+
Nutficer	Nutritional officers as frequent nutritional information source.	Dummy;1 = Yes 0 = No	+
Termite attributes	Important EWT characteristics to the consumer.	Continuous, score	+
Convenience	Availability and ease of access and use of EWT.	Continuous, score	+
Culture	Fitness of EWT into consumers' way of living.	Continuous, score	+/-

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter is divided into four major sections. The first section discusses the descriptive results comprising of households' socioeconomic and institutional characteristics. In the second section, exploratory factor analysis results are discussed. Empirical results of Double Hurdle and Hedonic regression models are discussed in sections three and four respectively.

4.2 Descriptive Results

This section presents descriptive statistics of variables used in the regression models. Table 2 presents results of the food purchase and consumption decision maker's gender, participation in off-farm income activity, native and termites consumption by category of residence. Among the rural respondents, 78.65% were female compared to urban that had 68.75% of the respondents as female. Probably, in most households the females are the ones concerned with food and nutritional maters. Rural and urban respondents were found to be statistically deferent in terms of gender of at 5% significance level. The gender of a food product purchaser influences the food choice thus male purchasers tend to choose more innovative foods while female purchasers are more heath conscious and responsible for children than male so they buy healthy and nutritious food products (Kajale and Becker, 2015).

Table 2. Consumers Gender, Off-Farm Activity Participation, Native and Termite Consumption (%).

Variable	Description	Rural	Urban	χ^2 Value
Gender	Female	78.65	68.75	4.85**
	Male	21.35	31.25	
Off-farm activity participation	No	25.52	2.08	44.33***
	Yes	74.48	97.92	
Native	No	44.79	45.31	0.01
	Yes	55.21	54.69	
Termite consumption	No	15.63	23.44	3.74**
	Yes	84.38	76.56	

Note: **, ***= significant at 5% and 1% level, respectively.

Most respondents participated in off-farm income activities with 74.48% from rural and 97.92% from urban. The rural and urban respondents were found to be statistically different in terms of their participation in off-farm income activities at 1%. This could be attributed to higher exposure to business opportunities by urban respondents compared to their counterparts in the rural area. Off-farm income comprised of income from employment, business and any other income apart from farm income (Kassie *et al.*, 2013). Off-farm income activity improves disposal income through the provision of supplementary income for increasing food purchase. It also improves access to information due to exposure of the household head; this could enhance informed food purchase decision making (Alemu *et al*., 2015).

Whether the food purchase decision maker consumes termites or not influences the decision to buy them or not. Higher numbers of those who consume edible winged termites were rural respondents 84.38% compared to 76.56% of urban respondents. There was a statistical difference between rural and urban respondents in terms of edible winged termite consumption at 5%.This could be associated with familiarity; most collections are within the rural areas by women and children thus the edible winged termites are common among rural respondents than urban. According to Hartman *et al.* (2015), the consumers' familiarity with novel food products influence acceptance.

Table 3 presents the mean of food purchase and consumption decision maker's age, education, members above 5years, children below 5 years and monthly income by category of residence. The mean age was 45.313 years and 42.771years for rural and urban respondents respectively. There was a statistical difference between rural and urban respondents in terms of age at 5%. This finding could be attributed to younger people moving from rural to urban areas in search of employment. Probably, most elderly decision makers do not see the point of relocating at old age and so prefer retaining their current rural residence even after they get employment in urban areas. Age is associated with experience and knowledge on entomophagy benefits that facilitate acceptance (Medigo *et al*., 2016).

Table 3. Mean Age, Education, Household Members Above 5 Years, Children Below 5 Years and Income.

Variable	Rural	Urban	*t* – value
Age	45.313	42.771	1.914*
	(14.804)	(10.927)	
Years spent in formal education	11.568	15.281	-9.199***
	(4.363)	(3.501)	
Household members above 5 years	4.453	5.104	-3.621***
	(1.649)	(1.867)	
Number of children below 5 years	1.922	0.781	6.584***
	(0.792)	(0.705)	
Monthly income in Kenyan shillings	19015.630	35604.170	-9.101***
	(14164.880)	(20909.420)	

Note: Figures in parenthesis represent standard deviation. *, ***= significant at 10% and 1% level, respectively.

In terms of education, the mean number of years spent in formal schooling was 11.568 years and 15.281years for rural and urban respondents respectively. These are averagely secondary school and tertiary levels for rural and urban respondents respectively. Education was significantly different between rural and urban households at 1%. The probable explanation for this result could be the shift from rural areas to urban areas of the highly educated consumers. Most highly educated consumers find the rural areas not fit for their residence and often move to urban areas as they get higher education. Education relate to the consumers knowledge and learning ability thus higher education increases access to nutritional information and enhances understanding of new ideas and concepts (Gido *et al*., 2017).

The mean number of household members aged above five years was 5 and 6 in rural and urban households respectively. Rural and urban respondent were found to be different in terms of household members aged above five years at 1% significance level. This finding could be attributed to rural urban migration. Most people are born in the rural areas and later on move to urban areas when they grow up for different reasons like employment thus making the urban areas to have more members above the age of five years than the rural. More members above five imply higher food and non food expenditure forcing the

households to try out new low cost initiatives that could have additional economic benefits to meet their basic needs (Ayuya *et al*., 2015).

Rural and urban household were statistically different in terms of the number of children below the age of five years at 1% significance level. On average, rural households had 2 children below five years while urban had 1. This finding could be linked to the rural respondents' negative attitude towards birth control measures that translates to more children below the age of five years in rural areas than in the urban. Presence of children below five years is a sensitive factor when it comes to food product choice. Young children require nutritious diets with all the necessary macro and micro elements for proper physical growth and mental development (FAO, 2013).

Rural respondents had a relatively lower monthly income of Kshs 19015.630 compared to Kshs 35604.170 for urban respondents. Rural and urban respondents were statistically different in terms of their monthly incomes at 1% significance level. This result could be attributed to most urban respondent participation in other income generating activities that increased their incomes. Additionally, the formally employed could be enjoying allowances like those associated to working and residing within the municipality. Consumers' income is important when studying food products demand it is from the income that the consumer allocates a portion for food purchase. Kajale and Becker (2015) reported that increase consumer income increases the purchasing power and improve the living standards.

The percentages of the retail outlets are presented in Table 4. Concerning the kiosk outlet, 44.27% of urban consumer bought EWT from kiosk as only 20.31% of rural consumers bought from kiosks. There was a significant statistical difference between rural and urban consumers in terms of the kiosk retail outlet at 1%. Kiosks could be many in the urban areas than rural so urban consumers found it easy to buy from them. According to Alemu *et al*. (2017a), urban consumers prefer kiosks for food products purchases due to their convenience and reliability.

Table 4. Frequently Used Retail Outlets by Consumers (%).

Variable	Description	Rural	Urban	χ^2Value
Kiosk	No	79.69	55.73	25.20***
	Yes	20.31	44.27	
Producer	No	40.63	79.69	61.12***
	Yes	59.38	20.31	

Note: ***= significant at 1% level.

Slightly over half of rural consumers 59.38% bought EWT from producers as 20.313% of urban consumers bought from producers. There was a significant difference at 1% between rural and urban consumer in terms of producer retail outlet. This finding could be expected as most producers are located in the rural areas thus closer to rural consumers than the urban. Balogh *et al*. (2016) noted that, consumers have trust and prefer local producers for speciality food products because of their quality consciousness and belief in promoting local producer outlets.

Table 5 presents results for information sources. Nutritional or health officer was significant at 1% level with 75.52% and 20.31% of urban and rural households getting food and nutritional information from nutritional or health officers respectively. This finding could be attributed to the distance between health facilities and urban households. Most of the health facilities are in the urban areas and therefore it is easier for urban consumers to access them for nutritional and health information than their rural counterparts. Urban consumers tend to trust nutritional information from official health workers than from friends and relatives (Alemu *et al*., 2017a).

Table 5. Frequently Used Nutritional and Food Security Information Sources and Group Membership (%).

Variable	Description	Rural	Urban	χ^2 Value
Nutritional/Health officer	No	79.69	24.48	117.25***
	Yes	20.31	75.52	
Agricultural extension officer	No	32.81	82.29	96.21***
	Yes	67.19	17.71	
Food security group membership	No	36.98	67.19	35.10***
	Yes	63.02	32.81	

Note: ***= significant at 1% level.

Majority of rural respondents 67.19% got nutritional information from agricultural extension officers as compared to urban 17.71%. Rural and urban respondent were found to be statistically different in terms of agricultural extension officers at 1% significance level. The rural respondents could be practicing farming more than their urban counterparts so agricultural extension officers visited them more frequently and not only gave them farming advice but also nutritional information. Higher number of extension visits increases farmers information and knowledge on new production technologies and adoption (Kassie *et al*., 2013).

In terms of food security group membership, rural and urban consumers were statistically different at 1% significant level with 63.02% and 32.81% participation by rural and urban consumers respectively. High demand for nutritional information and knowledge at affordable cost by rural consumers could explain this result. According to Zamasiya *et al*. (2017), group membership creates platforms for information exchange, reduces information dissemination costs and motivates acceptance of new technology.

Table 6 presents descriptive results of time taken walking to the market, quantity of edible winged termites consumed and prices of the different forms of EWT consumption. Rural respondents took longer 24.313 minutes than urban respondents 8.115 minutes walking to the nearest market. Rural and urban respondents were statistically different in terms of the time taken walking to the nearest market at 1% significance level. Time taken walking to the nearest market determines consumer ease of accessing food. Markets in the rural area could be distant with poor road network making rural consumers to take longer than their urban counterparts. Longer distance to market constrains access to food commodities due to high transportation costs. Consumers are less willing to shop from far distant markets that involve more time for travelling (Gido *et al*., 2016). Contrary to these findings, consumers were more likely to obtain complementary leafy African Indigenous Vegetables from distant retail outlets (Gido *et al*., 2017).

Table 6. Mean Time Taken to Nearest Market, Quantity Consumed and Price of Edible Winged Termites.

Variable	Rural	Urban	*t* – value
Time taken walking to market(Minutes)	24.313	8.115	27.205***
	(7.510)	(3.415)	
Quantity of EWT consumed (Kilograms)	10.309	4.785	9.426***
	(6.963)	(4.177)	
Price of raw EWT (Kenya shillings)	27.941	49.568	-42.774***
	(4.058)	(4.319)	
Price of fried EWT (Kenya shillings)	84.012	149.796	-37.001***
	(21.423)	(2.474)	
Price of sun-dried EWT (Kenya shillings)	84.321	150.000	-37.552***
	(21.202)	(0.000)	
Price of blanched EWT (Kenya shillings)	50.971	80.000	-30.862***
	(11.130)	(0.000)	

Note: Figure in parenthesis represent standard deviation and ***= significant at 1% level.

In terms of the quantity of EWT consumed in a year, rural households consumed a mean of 10.309 kilograms while the urban 4.785. There was statistical difference between rural and urban households in terms of quantity of EWT consumed at 1%. This finding could be attributed to EWT being collected from the rural areas. The supply is relatively high in rural areas thus after collections it is consumed and the surplus sold to urban areas with low supply and high demand. According to Pambo *et al*. (2016), most EWT collection and consumption is in the rural areas by women and children.

There was a significant statistical difference at 1% between rural and urban households in terms of prices of raw, fried, sun-dried, and blanched EWT. Rural households had a mean price of Kshs 27.941, 84.012, 84.321and 50.971 for raw, fried, sun-dried and blanched EWT respectively. Urban households had a mean price of Kshs 49.568, 149.796, 150.000 and 80.000 for raw, fried, sun-dried and blanched EWT respectively. The probable explanation of this finding is that EWT are mostly collected in rural areas then supplied to urban areas thus its supply is higher than demand in the rural as opposed to urban where the demand is higher than supply thus higher prices in urban areas. Price is an important factor when accessing

demand of any product in the market. Food consumers prefer products that have been fairly priced as they equate prices to true perceived value of the product (Hussain *et al*., 2016).

4.3 Consumers' Perception of Edible Winged Termites

To determine the consumers' perception of edible winged termites in Kimilili Sub-County was analysed using exploratory factor analysis (EFA). EFA identifies latent factors that reconstruct the complexity of observed data retaining all the important information available from the original data (Yong and Pearce, 2013). Principal component analysis (PCA) could be used. However, PCA summarises the observed data with as little loss of information as possible assuming perfect reliability that observed items have been assessed without any measurement error (Matsunaga, 2010). This is not the case in this study thus EFA that utilizes reliability estimates is more suitable (Yong and Pearce, 2013). A Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.948 which is above the required cut-off (0.50) showed that EFA was appropriate. Furthermore, the Bartlett's test of sphericity yielded a *p*-value<0.05 indicating a patterned relationships amongst the variables. A total explained variance of 66% points out the proportion of the original data explained, indicated by more than half of the proportion which is a good fit. Therefore, the three factors with Eigen values greater than 1 were vital in explaining variability in the dataset.

The EFA resulted in 3 factors that, henceforth, will be referred to as termite attributes, convenience and culture based on the factor loadings of the variables on the extracted factors. Table 7 presents the factor loadings of perception variables (in bold) on the extracted factors after orthogonal rotation. Examining the factor loadings provides information on the extent to which each of the perception variables contributed to the meaning of each of the factors. The total variance accounted for was 66% with factor 1 accounting for 56%, factor 2 for 5% and factor 3 for 5%. Cronbach's alpha coefficients were computed to examine the internal consistency of each factor. Values were 0.89, 0.58 and 0.77 for factor 1, 2 and 3 respectively indicating that the perception variables loading on each of the factors measured the same underlying construct.

Table 7. Factor Loadings for Perception Statements

Perception statements	Factor 1	Factor2	Factor3
Termites are the same as meat and fish	**0.453**	0.065	0.106
Termites are cheaper than meat and fish	**0.649**	0.306	0.074
I would buy termites no matter the price	**0.895**	0.249	0.234
I would buy raw termites	**0.769**	0.184	0.209
Termites are hygienic	**0.967**	0.464	0.673
Termites consumption is healthy	**0.905**	0.221	0.014
I would buy large termites	**0.945**	0.272	0.009
Termites contain no chemical residues	**0.589**	0.442	-0.051
I would buy termites that are fried	**0.957**	0.260	0.012
I would buy blanched termites	**0.794**	0.198	0.181
Termites look nice	**0.951**	0.263	0.006
Termites have a pleasant smell	**0.962**	0.164	-0.009
Termites have a good texture	**0.955**	0.175	-0.006
Termites have a good taste	**0.910**	0.226	-0.019
I would buy sun-dried termites	**0.960**	0.256	0.009
Termites consumption is environmental friendly	**0.742**	0.365	-0.056
Termites are rich in nutrients	**0.819**	0.390	-0.023
I have adequate knowledge on termites good preparation	**0.647**	0.205	0.521
Termites are always available	0.075	**0.518**	0.022
Termites take no time to prepare	0.217	**0.662**	0.009
Termites are a luxury	0.056	**0.992**	0.012
Termites are a source of income	0.223	**0.725**	0.053
I would buy termites only if recommended by health authorities	0.056	0.002	**0.992**
Termites are what I usually eat	0.008	0.079	**0.437**
I have been consuming termite since childhood	-0.229	0.037	**0.877**
Termites are food for the poor	0.056	0.005	**-0.992**
It is primitive behaviour to eat termites	-0.070	0.186	**-0.848**
Termites are food for famine periods only	-0.016	-0.128	**-0.509**

Termites are medicinal	0.037	-0.180	**0.468**
Termites are destructive pests	-0.080	-0.266	**-0.874**
Termites are a nuisance	-0.310	-0.265	**-0.852**
Variance Explained (%)	56.000	5.342	4.846
Cronbach alpha coefficients	**0.890**	**0.580**	**0.770**
Suggested interpretation	**Termite attributes**	**Convenience**	**Culture**

Factor 1, Termites attributes, loaded on statements related to the termite characteristics and forms of consumption. This factor captured consumers' tendency to accept to consume EWT based on both the EWT related and contextual attributes. In addition to these variables, other variables reflecting the perceived benefit of EWT such as it being always available, medicinal and source of income loaded positively on this factor.

The second factor, convenience, loaded on statements related to potential benefits of EWT. This factor captured the tendency of consumers to accept EWT based on its perceived potential benefits such as availability, income source and ease of preparation. The third factor, Culture, loaded on Statements that reflect the consumer's cultural beliefs about EWT. This factor loaded on statements that reflect the people's way of living (entomophagy culture or not). Most of these statements had negative loadings. However, when consumers believed that EWT are medicinal they tend to accept it thus a positive loading on the medicinal statement. The derived factors from exploratory factor analysis (Termite attributes, Convenience and Culture), were treated as explanatory variables in the Double Hurdle model to determine the factors influencing consumers' acceptance of EWT as food and the extent to which they affected the quantity consumed.

4.4 Factors Influencing Consumers' Acceptance and Quantity Consumed of Edible Winged Termites.

4.4.1 Preliminary Diagnostics of the Variables Used in the Regression Models.

Multicollinearity is the existence of linear relationship among explanatory variable (Gujarati, 2004). It is a serious problem both to the proper specification and to the effective estimation

of the type of structural relationships commonly sought through the use of regression techniques. Multicollinearity was tested using pair-wise correlation for categorical variables and variance inflation factor (VIF) for continuous variables. VIF measures the presence of multicollinearity among the independent variables in a regression model on the precision of estimation. It expresses the degree to which multicollinearity amongst the predictors degrades the precision of an estimate. It is a statistic used to measure possible multicollinearity amongst explanatory variables. By the rule of thumb, a value of VIF between 5 and 10 indicates high correlation amongst the explanatory variables in a regression model (Gujarati, 2004). If the VIF value goes above 10, it can be assumed that the regression coefficients are poorly estimated due to multicollinearity. The pair-wise correlation results presented in appendix 2 confirmed that there was no serious linear relationship amongst the categorical explanatory variables tested. Similarly, VIF result showed that there was no strong relationship amongst all the continuous explanatory variables since its values were less than 5 as shown in appendix 3. Therefore, all the proposed potential explanatory variables were used in regression analysis.

To determine the socioeconomic, institutional factors and termites characteristics significantly influencing consumers' acceptance and quantity consumed of edible winged termites in Kimilili Sub-County, was analysed by the Double Hurdle model using the 'craggit' command. The first hurdle was estimated by a Probit and the second hurdle a truncated regression (Burke, 2009). The dependent variables were consumers' acceptance to consume EWT and quantity of EWT consumed for the first and second hurdles respectively. The Tobit estimator could seem suitable. However, the Tobit estimator is restrictive, as it assumes that the decisions to accept to consume and how much EWT to consume are determined by the same process. A more flexible approach is the double-hurdle (DH) model proposed by Cragg (1971), which accounts for the possibility that the two decisions (hurdles) are determined by different processes. Table 8 presents the DH model results of factors that influenced the consumers' acceptance of EWT and their effect on quantity consumed by category of rural and urban.

Table 8. Maximum Likelihood Estimates from Double Hurdle Models for Rural and Urban Dwellers.

	Rural dwellers				Urban dwellers			
	Consumption acceptance		Quantity consumed		Consumption acceptance		Quantity consumed	
Variable	**Coef**	**Std. Err.**	**Coef**	**Std.Err**	**Coef**	**Std.Err.**	**Coef**	**Std.Err**
Consumers' socioeconomic characteristics								
Age	-0.018	0.018	0.000	0.001	0.119**	0.055	0.013***	0.004
		0.653		0.029		0.586	-	0.079
Gender	1.219**		-0.070**		-0.948		0.197**	
Education	0.216**	0.093	0.001	0.004	0.217**	0.109	0.005	0.015
Hmeover5	0.042	0.184	0.023***	0.008	-0.216	0.240	0.021	0.024
		0.277		0.015		0.526		0.054
Chlbelow5	0.329		0.038***		0.599		0.130**	
Inincome	-2.528***	0.833	-0.024	0.021	-1.928**	0.785	-0.039	0.092
Native	0.920**	0.557	0.008	0.026	-0.199	0.634	0.234***	0.086
Consumers' institutional characteristics								
Kiosk	-23.156	283.968	-0.028	0.050	0.678	0.999	-0.096	0.100
Producers	-23.664	283.972	0.013	0.045	-0.578	1.030	-0.050	0.129
Timarket	-0.064	0.040	0.001	0.002	-0.073	0.101	-0.002	0.013
Nutficer	-0.478	0.897	-0.000	0.039	-20.604	233.370	0.066	0.146

Agritens	-0.163	0.714	-0.001	0.031	-19.880	233.366	0.052	0.179
Groupmem	0.456	0.514	-0.027	0.025	-0.590	0.774	0.009	0.078
Edible winged termite characteristics								
		3.924		0.187		4.606		0.732
Termite attributes	15.449***		-0.415**		12.712***		0.793	
Convenience	1.853	1.141	-0.100*	0.060	4.737**	2.134	-0.020	0.437
Culture	0.775***	0.269	0.065***	0.014	0.330	0.357	0.025	0.048
Constant	42.192	284.100	2.912***	0.209	29.909	233.526	0.929	0.960
Sigma Cons			0.118***	0.007			0.398***	0.024
Number of observations	192				192			
Log Likelihood	68.848				-84.402			
Wald Chi2(16)	23.830				18.180			

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

The results of the average partial effects of the independent variables are presented on three different quantities of interest: the probability that a household consumes EWT (APE), the expected quantity of EWT consumed by a household given that the household consumes EWT (CAPE), and the expected quantity of EWT consumed by a household (UAE) for rural and urban dwellers separately in Tables 9 and 10 respectively.

Table 9. Average Partial Effects from Double Hurdle Model for Rural Consumers.

Variable	APE	Std. Err.	CAPE	Std. Err	UAE	Std. Err.
Consumers' socioeconomic characteristics						
Age	0.001	0.001	0.007	0.001	0.007	0.036
Gender	-0.003**	0.023	-0.149**	0.002	-0.113**	0.027
Education	0.012**	0.080	-0.001	0.007	0.029**	0.065
Hmeover5	0.010	0.154	-0.009***	0.002	0.018***	0.098
Chlbelow5	0.037	0.221	0.117***	0.009	0.176***	0.164
Inincome	-0.134***	0.526	0.153	0.009	0.442***	0.483
Native	0.018**	0.368	0.040	0.019	0.073**	0.382
Consumers' institutional characteristics						
Kiosk	0.014	280.223	0.000	0.012	0.034	277.158
Producers	-0.083	251.350	0.008	0.003	-0.199	234.272
Timarket	-0.006	0.012	0.022	0.001	0.002	0.009
Nutficer	-0.158	0.569	0.010	0.005	-0.383	0.099
Agritens	-0.098	0.496	0.070	0.003	-0.192	0.258
Groupmem	-0.017	0.150	0.078	0.009	0.014	0.098
Edible winged termite characteristics						
Termats	1.010***	2.557	-0.248**	0.060	2.322***	2.066
Convenience	0.192	1.029	-0.191*	0.008	0.339**	0.948
Culture	0.042***	0.247	0.064***	0.003	0.148***	0.198

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

Standard errors have been calculated by the delta method.

Table 10. Average Partial Effects from Double Hurdle Model for Urban Consumers.

Variable	APE	Std. Err	CAPE	Std.Err	UAE	Std. Err
Consumers' socioeconomic characteristics						
Age	0.001***	0.019	0.007***	0.001	0.006***	0.014
Gender	-0.002	0.274	-0.149**	0.004	-0.106**	0.150
Education	0.008**	0.088	-0.001	0.004	0.013**	0.157
Hmeover5	0.006	0.092	-0.009	0.002	0.005	0.095
Chlbelow5	0.024	0.204	0.117**	0.033	0.126**	0.396
lnincome	-0.086**	0.495	-0.153	0.008	-0.266***	0.248
Native	0.011	0.150	0.040***	0.001	0.049***	0.095
Consumers' institutional characteristics						
Kiosk	0.009	0.526	0.000	0.028	0.016	0.388
Producers	-0.053	0.782	0.008	0.058	-0.093	0.695
Timarket	-0.004	0.040	0.022	0.007	0.008	0.013
Nutficer	-0.101	219.086	0.010	0.002	-0.182	156.713
Agritens	-0.063	217.367	0.070	0.004	-0.068	132.985
Groupmem	-0.011	0.347	0.078	0.001	0.034	0.295
Edible winged termite characteristics						
Termats	0.650***	3.917	-0.248	0.396	1.035***	2.987
Convenience	0.124**	1.605	-0.191	0.098	0.098**	0.988
Culture	0.027	0.189	0.064	0.005	0.094	0.113

Note: ***, **Significant at 1%, and 5%, respectively.

Standard errors have been calculated by the delta method.

APE results for rural and urban dwellers are presented in Table 11. Results indicate that in urban dwellers, the probability of accepting EWT consumption increased with increase in the age of decision makers. Familiarity and knowledge about the nutritive and ecological benefits of using insects as food could have influenced the acceptance of EWT consumption among the urban elderly. This finding corroborates those reported by Becker *et al*. (2016); Pambo *et al*. (2016) where, the acceptance of edible insects as alternative to conventional meat significantly increased with advancement in the age of the decision maker. Similarly, consumers who had consumed edible insects before were willing to accept edible insects as

substitute to meat (Lensvelt and Steenbekkers, 2014; Verbeke, 2015). Contrary to this, previous studies (Ayuya *et al*., 2015; Kajale and Becker, 2015) reported that older consumers tend to be risk averse, thus unwilling to undertake new production techniques compared to younger consumers, who tend to be flexible and risk takers.

Table 11. Average Partial Effects from Double Hurdle Model for Rural and Urban Consumers.

	Rural consumers		Urban consumers	
Variable	**APE**	**Std. Err.**	**APE**	**Std. Err.**
Consumers' socioeconomic characteristics				
Age	0.001	0.001	0.001***	0.019
Gender	-0.003**	0.023	-0.002	0.274
Education	0.012**	0.080	0.008**	0.088
Hmeover5	0.010	0.154	0.006	0.092
Chlbelow5	0.037	0.221	0.024	0.204
Inincome	-0.134***	0.526	-0.086**	0.495
Native	0.018**	0.368	0.011	0.150
Consumers' institutional characteristics				
Kiosk	0.014	280.223	0.009	0.526
Producers	-0.083	251.350	-0.053	0.782
Timarket	-0.006	0.012	-0.004	0.040
Nutficer	-0.158	0.569	-0.101	219.086
Agritens	-0.098	0.496	-0.063	217.367
Groupmem	-0.017	0.150	-0.011	0.347
Edible winged termite characteristics				
Termats	1.010***	2.557	0.650***	3.911
Convenience	0.192	1.029	0.124**	1.605
Culture	0.042***	0.247	0.027	0.189

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

Standard errors have been calculated by the delta method.

Rural households with male decision makers have lower probability of accepting EWT consumption compared to female decision makers. Most EWT collections being in the rural

areas by females could have increased their familiarity with it hence acceptance. Probably, females in rural areas are more informed of the proper methods of collection, preparation and nutritive content of EWT than males thus readily accepting its consumption. Familiarity with the use of edible insects as food facilitates acceptance (House, 2016). Similarly, possession of adequate knowledge on preparation and proper use of edible insects as food enhances its acceptance (Medigo *et al*., 2016). Kajale and Becker (2015) found out that, female consumers are more health conscious and responsible for children nutrition in their food choices than males. Furthermore, females are more informed of safe and nutritious diets than males (Rossini *et al*., 2015). Contrary to this finding, consumers who are more sympathetic to the use of insects as food are male, adventurous, curious, and low in disgust sensitivity and food neophobia (Sogari, 2015; Verbeke, 2015).

In rural and urban households, more educated decision makers were likely to accept EWT consumption than the less educated. Formal education could have developed knowledge on the nutritive and ecological benefit of using insects as food among participants which influenced their attitudes and perceptions towards EWT consumption making the highly educated more likely to accept. Similar findings were reported by Ayuya *et al*. (2015) where, highly educated farmers readily accepted the adoption of certified organic farming technology. Education enhances the consumers' knowledge about food products which has a positive influence on acceptance (Kajale and Becker, 2015). According to Looy *et al*. (2014), traditional, ecological and nutritional knowledge of entomophagy increases consumers' acceptance of the use of insects as food.

The increase in income reduces the likelihood of accepting EWT as food in rural and urban households. Perhaps as income increases, the respondents have access to other animal protein sources or they view termites as food for the poor thus reducing its acceptance. Gido *et al*. (2017) found similar results, where an increase in household income reduced the acceptance of leafy African indigenous vegetables consumption. A perception of edible insects as food for the poor could reduce the likelihood of consumption acceptance as income increases (Looy *et al*., 2014).

Among rural dwellers, the probability of natives accepting EWT consumption was higher compared to non natives. Perhaps rural natives had developed an insect eating culture that

had been learned and passed from one generation to another thus increasing their likelihood of accepting EWT. Distinct cultural groups of people living in the same ecological region eat same food (Looy *et al*., 2014; Ayodele and Panama, 2016). FAO, (2013) complements this finding where they found out that caterpillars were gathered, preserved and sold in markets in the Democratic Republic of Congo that is not common practice to other parts of Africa.

Termite attributes (EWT attributes), had appositive and significant effect on acceptance for rural and urban households. This implies that, consumers' perception of EWT as nutritious, environmental friendly, natural, healthy, hygienic, having a good appearances, texture, taste and pleasant smell increased their probability of acceptance. The rural and urban consumers' optimism about the consequences of consuming EWT based on these attributes could have influenced acceptance. The most desirable food attributes are freshness, naturalness, and minimal processing (Roman *et al*., 2017). This finding corroborates those reported by (Alemu *et al*., 2016; Hartmann and Siegrist, 2017), where they found consumers positive perception of edible insects attributes as the major determinant of acceptance. Moreover, perceived real benefits of a food product increase the probability of acceptance (Kajale and Becker, 2015).

In urban households, the view of EWT as convenient increased the probability of acceptance. Probably urban respondents have limited time for food preparation so they tend to accept food types that take the shortest time to prepare and that are readily available when needed for consumption. Pambo *et al*. (2016) reported similar findings that convenience plays an important role when consumers have to decide whether to consume a certain food product or not. The product should, amongst other things, be easily accessible, easy to store, available for use when needed and be easy to cook (Wollni and Fischer, 2015). For consumers to accept a new food product, it should fit with their trends and needs (Hoek 2010).

Culture had a positive significant effect on EWT acceptance among the rural respondents, implying that entomophagy is well rooted in their culture. Probably rural respondents attached greater value to their culture that increased their acceptance likelihood of EWT when they viewed it as a cultural delicacy. According to Looy *et al*. (2014), "*people are what they eat*" and so make their food choices depending on how they define themselves as. Personal values and their general way of living like quality nutrition and care for the

environment play significant role in shaping consumer behaviour (Wollni and Fischer, 2015; Naidoo and Ramatsetse, 2016).

Table 12 presents the unconditional average effects (UAE) for rural and urban dwellers. The UAE are the most meaningful for interpretation, as they allow statements about the impact (if any) of acceptance on the quantity consumed of EWT taking into account both hurdles. UAE gives the significant dominant effects of the independent variables. Results indicate that, urban households with elderly decision makers are likely to consume more EWT than those with younger decision makers. Elderly urban consumers could have been in possession of adequate knowledge on the nutritional benefit of termites and role of nutritious diets in boosting the body immunity among the aged that enhanced quantity consumed. Probably, older consumers could have accumulated more resources than the young which could enhance their purchasing power. Pambo *et al*. (2016) reported similar results, where the demand for edible insects was higher in elderly consumers. However, Rossini *et al*. (2015) in their study on demand for cheese, reported lower demand among the older consumers.

Table 12. Unconditional Average Effects from Double Hurdle Model for Rural and Urban Consumers.

	Rural consumers		Urban consumers	
Variable	**UAE**	**Std. Err.**	**UAE**	**Std. Err.**
Consumers' socioeconomic characteristics				
Age	0.007	0.036	0.006***	0.014
Gender	-0.113**	0.027	-0.106**	0.150
Education	0.029**	0.065	0.013**	0.157
Hmeover5	0.018***	0.098	0.005	0.095
Chlbelow5	0.176***	0.164	0.126**	0.396
Inincome	0.442***	0.483	-0.266***	0.248
Native	0.073**	0.382	0.049***	0.095
Consumers' institutional characteristics				
Kiosk	0.034	277.158	0.016	0.388
Producers	-0.199	234.272	-0.093	0.695
Timarket	0.002	0.009	0.008	0.013
Nutficer	-0.383	0.099	-0.182	156.713
Agritens	-0.192	0.258	-0.068	132.985
Groupmem	0.014	0.098	0.034	0.295
Edible winged termite characteristics				
Termats	2.322***	2.066	1.035***	2.987
Convenience	0.339**	0.948	0.098**	0.988
Culture	0.148***	0.198	0.094	0.113

Note: ***, **Significant at 1%, and 5%, respectively. Standard errors have been calculated by the delta method.

The food purchase and consumption decision maker being male reduced the expected quantity of EWT consumed for both rural and urban dwellers. This finding could be expected as most collections are in the rural areas by females. Females could be in possession of adequate knowledge on EWT collection and preparation methods than males. This finding could also be attributed to the nature of EWT collection and preparation methods are sequential and require patience thus not appealing to most males. In most rural areas, females shoulder the heavy responsibility in terms of household nutrition and food preparation

decisions (Pambo *et al*., 2016). Similarly, Gido *et al*. (2017) found out that, female decision makers are more informed of healthier diets than men thus consume larger quantity of nutritious food products.

On average, an increase in the number of years spent in formal education of the household head increased the expected quantity of EWT consumed in rural and urban households. More educated household heads could have acquired supplementary knowledge about the nutritional, ecological and economic benefits of EWT consumption that developed positive perceptions and attitudes leading to higher demand of EWT. Wu *et al*. (2014), when analysing the demand for powdered milk in China found out that, higher education raised the consumers' living standards and increased their consciousness of nutritional aspect of health implications of food intake. Similarly, more educated consumers consumed more cheese than the less educated due to their awareness of its nutritional content importance (Rossini *et al*., 2015). Education is important in instilling ethics, understanding, transmitting knowledge and information among consumers (Ayuya *et al*., 2015).

As the number of household members aged above 5 years increased, the quantity of EWT consumed increased among rural respondents. This finding could be attributed to most collections being in the rural areas. Rural dwellers collect and consume thus households with more members are able to collect and consume more EWT. Similarly, households with more adult members consumed more cheese than those with only one adult or two adults and children (Rossini *et al*., 2015). Presence of elderly members in the household increased the demand for powdered milk (Wu *et al*., 2014).

On average, an increase in the number of children below 5 years in the household increased the quantity of EWT consumed in both rural and urban dwellers. Perhaps the respondents were aware of the termite nutritional benefits and importance of proper nutrition to their children. This finding corroborates that reported by Pambo *et al*. (2016) where households with young children consumed higher quantities of EWT than those without. Children require nutritious diets with all the necessary macro and micro elements for proper physical growth and mental development (FAO, 2013). Failure to get these elements at the required early life stage leads to deficiency physical and mental disorders that can never be corrected at later life stages (Stiles *et al*., 2011; Looy *et al*., 2014).

Among rural dwellers, an increase in monthly income increased the expected quantity of EWT consumed by a household. This finding is expected as higher income increases disposable income hence purchasing power of consumers. Similar finding was reported by (Kajale and Becker, 2015) where increase in income increased the consumers purchasing power of genetically modified food and improved their living standards. However, a higher monthly income will lower the expected quantity of EWT consumed by a household in urban dwellers. Perhaps as income increases, the urban dwellers get access to other animal protein sources or they view EWT as food for the poor thus reducing its consumption as income increases. Gido *et al*. (2017) found similar results, where an increase in household income reduced the consumption intensity of leafy African indigenous vegetables consumption. Similarly, perception of edible insects as food for the poor could reduce the likelihood of consumption (Looy *et al*., 2014).

The food purchase and consumption decision maker being a native of the area will increase the expected quantity of EWT consumed by a household in both rural and urban dwellers. Perhaps natives had developed an insect eating culture that had been learned and passed from one generation to another thus increasing the quantity of EWT consumed. Distinct cultural groups of people living in the same ecological region eat same food (Looy *et al*., 2014; Ayodele and Panama, 2016). FAO (2013) complements this finding where they found out that caterpillars were gathered, preserved and sold in markets in the Democratic Republic of Congo that was not common practice to other parts of Africa.

On average, the perceived EWT attributes increased the expected quantity of EWT consumed in rural and urban households. Perceived good appearance, texture, taste, pleasant smell, hygiene, healthiness, naturalness, environmental friendliness and nutritional value of EWT increases the expected quantity consumed. This finding is expected as consumers make their purchase and consumption decisions based on the tangible and intangible product attributes. Importance of these attributes to the consumers could have created a positive perception of EWT that increased the demand. According to Akpoyomare *et al*. (2012), consumers use product attributes as a basis for evaluating the product in relation to the benefits they seek when buying the product. Perceived taste, naturalness, freshness and nutritional value are considered the most important attributes of sea food by Norwegian consumers (Olsen *et al*.,

2017). With the increase in consumer consciousness about what they eat, food products perceive natural are consumed in large quantities as they are associated with freshness, good taste, higher safety and superior quality (Hemmerling *et al*., 2016). The entomophagy attributes related to ethical concerns; animal welfare or environmental impact and nutritional aspects offer important benefits towards consumer needs satisfaction that are major demand drivers (Medigo *et al*., 2016).

Perceived convenience of EWT increases the expected quantity of EWT consumed by a household among rural and urban dwellers. EWT could have fitted well into consumers' trends and needs of saving time and generating income for others. According to Pambo *et al*. (2016), convenience plays an important role when consumers have to decide whether to consume a certain food product or not. Moreover, food products perceived as easily accessible, easy to store, available for use when needed and easy to cook have a higher demand (Wollni and Fischer, 2015). Furthermore, consumers demand for edible insects increases when they know that other chain actors like farmers or producers are employed, earn higher incomes and have improved livelihood (Kikulwe *et al*., 2011).

Culture significantly and positively influenced the expected quantity of EWT consumed among rural respondents. This finding is not surprising as rural areas are the major source of EWT. Rural households could be relatively homogenous hence influencing each other culturally. Probably rural respondents perceive EWT consumption as more cultural appropriate practice so increased consumption as a way of promoting their culture. This finding corroborates that reported by (House, 2016) where fitness of novel food in to consumer norms, beliefs and customs facilitated preference and increased the willingness to consume more units of the food. Culture is a significant determinant and regulator of peoples way of life especially their food consumption related behaviours (Ayodele and Panama, 2016). According to Mensah *et al*. (2013), culture influences consumer satisfaction because it determines the value placed on a product by the consumer.

4.5 Determinants of Market Prices of Raw, Fried, Sundried and Blanched Edible Winged Termites

To determine the consumers socioeconomic, institutional and EWT characteristics that significantly affect the market prices of raw, Fried, sundried and blanched was done using

Hedonic price analysis model. The contingent valuation (CV) model could be used instead. However, CV requires joint consumption of goods within a group and models the whole system of demand and supply (Satimanon and Weatherspoon, 2010). For this study Hedonic price model has an advantage over contingent valuation: does not require joint consumption of EWT within a group thus inverse demand of specific form of EWT consumption can be estimated individually. Hedonic price model decomposes the price of a product into separate factors that determine it (Lancaster, 1966). According to Rosen (1974), the observed market price of a differentiated product is a composite of the coefficients of its embedded characteristics but the characteristics of buyers and sellers are excluded. However, most studies have found that product prices are as well related to the characteristics of buyers or sellers (Bett *et al*., 2011; Alemu *et al*., 2015; Pambo *et al*., 2015; Alemu *et al*., 2017a; Alemu *et al*., 2017b).This study therefore hypothesises that the consumers' socioeconomic, institutional and EWT characteristics explain the variations in market prices of EWT.

Table 13 presents hedonic price model results. The adjusted R-squared were 0.880, 0.826, 0.828 and 0.634 for raw, fried, sun-dried and blanched EWT models respectively indicating the percentage of market price variability explained by the empirical models. The F test values were significant at 1% for all models implying that the independent variables as a set significantly affect the dependent variable.

Results indicate that age of the consumer had a significant and negative effect on the market price of raw EWT at 10%. Generally the elderly were unlikely to pay higher prices for raw EWT in both rural and urban markets. Probably, the consumers view raw EWT consumption as a childhood practice and move away from it as they get older. The elderly could be in possession of knowledge on collection of raw EWT or might have seen no value added to raw EWT that warrantee the higher price. This finding corroborates that reported by Alemu *et al*. (2017a) where older consumers were less likely to pay higher prices for whole and processed termites than the young. However, elderly consumers were more willing to pay premium prices for local rice than younger consumers in Upper East Region, Ghana (Ehiakpor *et al*., 2017).

Table 13. Determinants of Raw, Fried, Sun-dried and Blanched Edible Winged Termites Prices.

EWT form	Raw		Fried		Sundried		Blanched	
Variable	**Coef.**	**S.E**	**Coef.**	**S.E**	**Coef.**	**S.E**	**Coef.**	**S.E**
Consumers' socioeconomic characteristics								
Age	-0.001*	0.001	0.000	0.001	0.000	0.001	0.001	0.001
Gender	0.025	0.016	0.023	0.019	0.021	0.019	0.028	0.027
Education	0.002	0.002	-0.006*	0.003	-0.005*	0.003	-0.001	0.004
Chlbelow5	-0.012	0.009	-0.017	0.011	-0.017	0.011	-0.023	0.016
Ofarmacts	0.064**	0.025	0.096***	0.030	0.084***	0.030	0.071*	0.042
Inicome	0.023	0.016	0.039**	0.019	0.035*	0.019	0.012	0.026
Native	0.014	0.016	-0.023	0.019	-0.022	0.019	-0.034	0.027
Residence	0.548***	0.025	0.569***	0.030	0.561***	0.030	0.450***	0.041
Consumers' institutional characteristics								
Groupmem	0.016	0.015	-0.039**	0.018	-0.040**	0.018	-0.034	0.025
Timarket	0.005	0.001	0.004***	0.002	0.004**	0.002	0.004*	0.002
Kiosk	0.063***	0.023	0.060**	0.028	0.047*	0.028	0.056	0.038
Producers	0.092***	0.024	-0.004	0.030	-0.014	0.029	-0.007	0.040
Agritens	-0.023	0.023	0.013	0.029	0.015	0.028	0.007	0.039
Nutficer	0.007	0.025	0.053*	0.031	0.049	0.031	0.040	0.042

Edible winged termite characteristics								
Termats	-0.130	0.121	0.204	0.126	0.220*	0.124	0.035	0.191
Convenience	-0.030	0.048	0.041	0.054	0.049	0.053	0.004	0.080
Culture	0.006	0.009	0.018*	0.010	0.017*	0.010	0.018	0.014
		0.147		0.179		0.177		0.243
Constant	3.070***		3.839***		3.906***		3.654***	
Number of obs	274		309		309		279	
F(17)	119.140		86.760		88.250		29.380	
Prob > F	0.000		0.000		0.000		0.000	
R-squared	0.888		0.835		0.838		0.657	
Adj R-squared	0.880		0.826		0.828		0.634	
Root MSE	0.110		0.141		0.138		0.184	

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

Education is significant at 10%. There is a negative and significant relationship between the variation in price of fried and sun-dried EWT and education of the consumer. These are the most common and available forms. Probably, as consumers advanced in education they adopted western eating habits and abandoned their traditional local diets like EWT making the more educated unwilling to pay high prices. Similar finding was reported by Ehiakpor *et al*. (2017) where, more educated consumers were unwilling to pay for local rice but paid higher prices for imported perfumed and polished rice. Moreover they could not wish their friends to see them consume the local rice. Furthermore, more educated consumers would less likely pay a premium price for fresh tilapia (Gebrezgabher *et al*., 2015). Contrary to this finding, Hussain *et al*. (2016) reported that, highly educated consumers understand and appreciate the health implications of their diets thus more willing to pay higher prices for healthy products than the less educated.

Consumer participation in off-farm income generating activities has a positive and significant effect at 5%, 1%, 1% and 10% for raw, fried, sundried and blanched EWT respectively. This implies that, consumer who participated in off-farm income generating activities were more willing to pay price premiums for raw, fried, sundried and blanched EWT than those who did not participate. Off-farm activities could have improved access to nutritional information on EWT and provided supplementary income which increased disposable income that made consumers more willing to pay higher prices for EWT. This finding is not surprising as in their study on willingness to pay Alemu *et al*. (2015), found formally employed consumers more willing to pay higher prices for whole and processed termites than those who only practiced farming or fishing.

Income was significant at 5% and 10% for fried and sun-dried EWT respectively. Consumers who earn higher incomes would pay higher prices for fried and sundried EWT than those who earn lower income. This finding could be expected because increase in income increases the consumers' purchasing power. The fried and sundried forms do not require any further on-farm processing before consumption they are ready to eat. The social class based on income could explain this purchase behaviour as high income earners could have associated the other forms that could require further processing with a lower income class. Similar finding was reported by Pambo *et al*. (2015) where, willingness to pay for fortified sugar increase with increase in consumer income. Moreover in their study on consumers'

willingness to pay for whole and processed termites Alemu *et al*. (2015) found out that, higher income earners were more willing to pay prices premiums than lower income earners. However, high income earners were less likely to pay higher prices for local rice in Ghana than low income earners (Ehiakpor *et al*., 2017).

There is a positive and significant variation in prices of raw, fried, sundried and blanched EWT and the consumers' location of residence at 1%. Urban consumers would pay higher prices for raw, fried, sundried and blanched EWT than rural consumers. This could be attributed to the transaction costs involved in moving EWT from rural to urban areas as most collections are majorly in rural areas. Moreover the supply is higher in rural markets than in urban markets where the demand is high. Prices in urban markets would therefore respond to supply rather than demand. Bett *et al*. (2011) found out that, urban consumers paid higher prices for indigenous chicken than rural consumers due to the higher transaction cost of moving live chicken from production areas in the rural to urban markets. Similarly, urban consumers were more likely to pay higher prices for whole and processed termites than rural consumers (Alemu *et al*., 2015). Furthermore, urban consumers were more willing to pay higher prices for buns fortified with cricket flour than rural consumers (Alemu *et al*., 2017b).

Group membership has a significant negative effect on the market prices of fried and sundried EWT at 5%. Consumers who were members of food security groups were unwilling to pay premium prices for fried and sundried EWT. Group membership allows consumers to learn from each other, share and exchange current nutritional information and knowledge at lower costs. Members could have acquired knowledge about a cheaper source of animal protein that was equivalent to or superior than EWT making them unwilling to pay higher prices for fried and sundried EWT. Probably from the group meetings the consumers learnt on how to do value addition to EWT thus could prefer collecting and value adding at a lower price than pay premiums for already fried and sundried EWT. Similar finding was reported by Balogh *et al*. (2016) where, consumers who were group members were less willing to pay price premiums for mangalitza salami but preferred to pay more for fresh pork.

Distance to the nearest market measured as time taken walking to the nearest market of the consumer positively and significantly influenced the market prices of fried, sundried and blanched EWT. Consumers who took long walking to the market could be more willing to

pay higher prices for fried, sundried and blanched EWT when they get to the market and reduce the number of times they go to the market to save on their time. Longer distance to markets constrains access to food commodities due to high transportation costs (Gido *et al*., 2016). Moreover, Bett *et al*. (2011) in their study on hedonic pricing of indigenous chicken reported that, transport and other transaction costs were included in market prices and passed to consumers making them pay higher prices.

Kiosk was significant at 1%, 5% and 10% for raw, fried and sun-dried EWT respectively. Consumers who had kiosks as their most preferred retail outlet would pay higher market prices for raw, fried and sundried EWT. Kiosks are many in number, found in rural and urban areas even some along the roadsides. These combined with their reliability, could have increased the consumers' willingness to pay for raw, fried and sun-dried EWT. Satimanon and Weatherspoon (2010) found a positive and significant relationship between price variation of eggs and kiosk retail outlet. Similarly, most consumers preferred to buy EWT from kiosks than supermarkets and paid premiums for them in kiosks but none of them could be willing to pay for them in supermarkets or open air markets (Alemu *et al*., 2015; Alemu *et al*., 2017a).

Producers had a significant positive effect at 1% on the market price of raw EWT. This implies that consumers who bought EWT from producers would pay higher market prices for raw EWT. This finding could be attributed to EWT collection by producers from rural areas and consumers' awareness of it hence reluctant to pay for the raw form in other retail outlets due to uncertainty about quality and freshness. Most consumers have confidence in producer retail outlet, associate them with quality assurances and are willing to pay premium prices there (Alemu *et a*l., 2017a). Furthermore, consumers tend to trust and prefer local producers for speciality food goods because of their quality consciousness and belief in promoting local producer outlets (Balogh *et al*., 2016).

Nutritional officer was significant at 10%. Having food and nutritional information provided by nutritional officers positively and significantly affected the market price of fried EWT. This finding could be attributed to consumer trust in the information source; food and nutritional information given by nutritional specialists. Based on the information about nutritional value of EWT consumers have they would pay higher prices for fried EWT. Insect

based food consumers prefer and respond quickly to official recommendation like health and nutritional officers (Alemu *et al*., 2017a). However, Alemu *et al*. (2015) found termite consumers trusting information from friends and relatives than from health officials and media.

Termite attributes was significant at 10%. Termite attributes had a positive and significant influence on the price of sundried EWT. The sun-dried EWT could be having most of the important attributes that consumers were seeking making them more willing to pay price premiums. This finding could be expected as most consumers are increasingly getting aware of the nutritional, ecological and economic importance of using edible insects as food. Perceived product attributes is an important factor for any food product purchase. According to Alemu *et al*. (2015), consumers pay higher prices for food with attributes they consider important like high nutritional value and naturalness. Furthermore, high nutritional value, perceived naturalness and ecological concern positively influenced prices of cricket flour buns (Alemu *et al*., 2017b). Satimanon and Weatherspoon (2010) in their study of hedonic pricing of eggs found desirable egg characteristics as most significant price variation determinant.

Culture was significant at 10%. Consumers with higher value for their culture would pay higher prices for fried and sundried EWT than those with lower value for their culture. Fried and sundried EWT are traditionally given as wedding prizes to signify long-term food security. Probably, the consumers associated EWT consumption with habits and heritages passed from one generation to another that generated the price premiums for fried and sun-dried EWT. This finding corroborates that reported by Balogh *et al*. (2016) where, consumers' culture positively influenced their willingness to pay for traditional food products. Sea caught shrimp was preferred to cultured shrimp because consumers believed that, sea caught shrimp was culturally appropriate, healthier, natural and of superior quality so paid premiums for it (Suthamathy, 2012).

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions of the study, policy recommendations and areas of further research.

5.2 Conclusions

i. Consumers perceive Edible Winged Termites positively as food with desirable attributes, convenient and culturally appropriate.

ii. Positive perception of edible winged termite characteristics is the major determinant of acceptance and quantity consumed in rural and urban consumers.

iii. Consumers' participation in off-farm income generating activities and location of residence are the major significant determinants of market prices for raw, fried, sun-dried and blanched edible winged termites.

5.3 Policy Recommendations

i. Commercialization of edible insects' value chain can start with edible winged termites as consumers already have a positive perception of it.

ii. Formal education sector officials can take an active role in engendering edible insects into the food chain through the school feeding programmes.

iii. Marketers should target consumers residing in urban areas and participating in off-farm income generating activities for higher profits.

5.4 Areas of Further Research

i. While this study used exploratory factor analysis to get the consumers perception of edible winged termites a further study can be done using the theory of reasoned action (TRA) where first, the consumers acceptance to consume edible winged termite is predicted, which is an important factor to measure the consumers attitude toward it. Second, subjective norm determinant should be used to measure the influence of family members' or friends' expectations on the consumer's reaction towards consumption of edible winged termites.

ii. Choice experiment can be used instead of hedonic regression model in a further study.

iii. This study focused on edible winged termites whose mass production methods are unknown. Therefore, further similar research can be conducted using crickets or grasshoppers that are easier to produce in commercial farms.

iv. This research was carried out in an area where consumers are familiar with edible winged termite consumption. Further research can be carried out in other areas where the consumption of edible insects like termites is not a common practice.

REFERENCES

Aertsens, J., Verbeke, W., Mondelaers, K. and Huylenbroeck, G.V. (2009). Personal Determinants of Organic Food Consumption: *A review. British Food Journal*, 111(10): 1140–1167.

Alemu, M.H., Olsen, S.B., Vedel, S.E., Pambo, K.O. and Owino, V.O. (2015). Consumer Acceptance and Willingness to Pay for Edible Insects as Food in Kenya: The Case of White Winged Termites. IFRO Working Paper 2015 / 10, Department of Food and Resource Economics (IFRO) University of Copenhagen, Denmark.

Alemu, M.H., Olsen, S.B., Vedel, S.E., Kinyuru, J. and Pambo, K.O. (2016). Integrating Sensory Evaluations in Incentivized Discrete Choice Experiments to Assess Consumer Demand or Cricket Flour Buns in Kenya. IFRO Working Paper 2016 / 02, Department of Food and Resource Economics (IFRO) University of Copenhagen, Denmark.

Alemu, M.H., Olsen, S.B., Vedel, S.E., Pambo, K.O., and Owino, V.O. (2017a). Combining Product Attributes with Recommendation and Shopping Location Attributes to Assess Consumer Preferences for Insect-Based Food Products. *Food Quality and Preference*, 55: 45–57.

Alemu, M.H., Olsen, S.B., Vedel, S.E., Kinyuru, J.N. and Pambo, K.O. (2017b). Can Insects Increase Food Security In Developing Countries? An Analysis of Kenyan Consumer Preferences and Demand for Cricket Flour Buns. *Food Security*, 9: 471-484.

Akpoyomare, O.B., Adeosun, L.P.K. and Rahim Ajao Ganiyu, R.A. (2012). The Influence of Product Attributes on Consumer Purchase Decision in the Nigerian Food and Beverages Industry: A Study of Lagos Metropolis. *American Journal of Business and Management*, 1,(4):196-201.

Anankware, P.J., Obeng-Ofori, D. and Osekre, E. (2013). Neglected and Underutilized Insect Species for Nutrition and Health. In: International Conference on Neglected and Underutilized Species for a Food-Secure Africa. Accra, Ghana, 27-29 September, 2013.

Anderson, D. R., Sweeny, J. D., Williams, T. A., Freeman, J. and Shoesmith, E. (2007). Statistics for Business and Economics. United Kingdom: Thomson Learning.

Aryal, K.P., Chaudhary, P., Pandit, S. and Sharma, G. (2009). Consumers' Willingness to Pay for Organic Products: A Case from Kathmandu Valley. *The Journal of Agriculture and Environment,* 10: 12-22.

Ayieko, M.A., Kinyuru, J.N., Ndong'a, M.F.O., Kenji, G. (2012). Nutritional Value and Consumption of Black Ants (*Carebara Vidua Smith*) from the Lake Victoria Region in Kenya. *Advanced Journal of Food Science and Technology*, 3: 39-45.

Ayieko, M.A., Ndong'a, M.F.O. and Tamale, A. (2010). Climate Change and the Abundance of Edible Insects in the Lake Victoria Region. *Journal of Cell and Animal Biology*, 4(7): 112–118.

Ayieko, M.A., Obonyo, G.O., Odhiambo, J.A., Ogweno, P.L., Achacha, J. and Anyango, J. (2011). Constructing and Using a Light Trap Harvester: Rural Technology for Mass Collection of *Agoro* Termites *(Macrotermes Subhylanus). Research Journal of Applied Sciences, Engineering and Technology*, 3(2): 105–109.

Ayieko, M.A. (2013). Review on Community Food Security and Edible Insects Resources: Biodiversity and Policy Implications for Safeguarding Human Consumption. *Journal of Agricultural Biotechnology and Sustainable Development*, 1(1):1–10.

Ayodele, A. A. and Panama, A.E. (2016). Predictors of Consumer Patronage of Street Food Vendors in a Typical Developing Economy Context. *Developing Country Studies*, 6(11):105-119.

Ayuya, I. O., Gido, O. E., Bett, K. H., Lagat, J. K., Kahi, A. K. and Bauer, B. (2015). Effect Of Certified Organic Production Systems on Poverty among Smallholder Farmers: Empirical Evidence from Kenya. *World Development*, 67: 27–37.

Balogh, P., Békési, D., Gorton, M., Popp, J. and Lengyel, P. (2016). Consumer Willingness to Pay for Traditional Food Products. *Food Policy*, 61:176–184.

Barthomeuf, L., Rousset, S. and Droit-Volet, S. (2009). Emotion and Food. Do the Emotions Expressed on Other People's Faces Affect the Desire to Eat Liked and Disliked Food Products? *Appetite*, 52: 27-38.

Becker, N., Tavor, T., Friedler, L. and Kutiel, P. B. (2016). Consumers' Preferences Towards Organic Tomatoes: A Combined Two-Phase Revealed Approach. *Journal of International Food And Agribusiness Marketing*, 28(1):1-17.

Bett, H. K., Peters, K.J. and Bokelmann, W. (2011). Hedonic Price Analysis to Guide in Breeding and Production of Indigenous Chicken in Kenya. *Livestock Research For Rural Development,* 23 (6) 2011.

Bröring, S. (2010). Consumer Awareness of Health Ingredients - Walking the Fine Line of Innovation Between Foods and Drugs. *Food-Chemical Manager Europe*, 5 (1):11-12.

Bröring, S. and Faber,M.(2011). Consumer Awareness of Health Ingredients Nutraceuticals, *Business and Technology*, 7 (1):26-27.

Burke, W.J. (2009) Fitting and Interpreting Cragg's Tobit Alternative Using Stata. *The Stata Journal*, 9(4), 584–592.

Chaniotakis, I.E., Lymperopoulos, C. and Soureli, M. (2010). Consumers' Intentions of Buying Own-Label Premium Food Products. *Journal of Product and Brand Management*, 19(5):327-334.

Chapman, A.D. (2009). *Numbers of Living Species in Australia and the World* (2nd Edition) A Report for the Australian Biological Resources Study. Australian Biodiversity Information Services, Toowoomba, Australia.

Chrea, C., Melo, L., Evans, G., Forde, C., Delahunty, C. and Cox, D.N. (2011). An Investigation Using Three Approaches to Understand the Influence of Extrinsic Product Cues on Consumer Behavior: An Example of Australian Wines. *Journal of Sensory Studie*s, 26: 13-24.

Chung, A.Y.C. 2010. Edible Insects and Entomophagy in Borneo. Edible Insects in Lao Market Economy. *In* P.B. Durst, D.V. Johnson, R.L. Leslie. and K. Shono. *Forest Insects as Food: Humans Bite Back, Proceedings of a Workshop on Asia-Pacific Resources and Their Potential for Development*, Pp. 131–140. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific.

Conroy, D.E. (2010). Implicit Attitudes and Explicit Motivation Prospectively Predict Physical Activity. *Annals of Behavioral Medicine*, 39: 112-118.

Costell, E., Tárrega, A., and Bayarri, S. (2010). Food Acceptance: The Role of Consumer Perception and Attitudes. *Chemosensory Perception*, 3(1): 42-50.

Cragg, J. G. 1971. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*, 39: 829–844.

Deaton, A. and Muellbauer J. (1980). An Almost Ideal Demand System, *American Economic Review,* 70: 312-326.

Del Giudice, T. and Pascucci, S. (2010). The Role of Consumer Acceptance in the Food Innovation Process: Young Consumer Perception of Functional Foods in Italy. *International Journal on Food System Dynamics*, 1 (2):111-122.

Ehiakpor, S.D., Apumbora, J., Danso-Abbeam, G. and Adzawla, W. (2017). Households' Preference for Local Rice in the Upper East Region, Ghana. Hindawi Advances in Agriculture Volume 2017, Article ID 1812975, 9 Pages.

FAO, (2010). *Forest Insects as Food: Humans Bite Back*. Bangkok. Rome, Italy.

FAO, (2013). Edible Insects: Future Prospects for Food and Feed Security. FAO Forestry Paper 171, Rome, Italy.

FAO/WUR, (2012). *Experts Consultation Meeting: Assessing the Potential of Insects as Food and Feed in Assuring Food Security*. P. Vantomme, E. Mertens, Van Huis, A. And H. Klunder Eds. Summary Report, 23–25 January 2012, Rome, Italy.

Fisher A.A., Laing J.E., Stoeckel J.E and Townsend J.W (1991). Handbook for Family Planning Operations Research Design 2nd Ed. P43. Population Council. New York, USA Available On: Www.Popcouncil.Org.

Franchi, M. (2012). Food Choice: Beyond the Chemical Content. *International Journal of Food Sciences and Nutrition*, 63(S1): 17-28.

Garcia-Bailo, B., Toguri, C., Eny, K.M. and El-Sohemy, A. (2009).Genetic Variation in Taste and its Influence on Food Selection. *A Journal of Integrative Biology*, 13(1): 69-80.

Gebrezgabher, S.A., Amewu, A. and Amoah, A. (2015). Consumer Preference and Willingness to Pay for Fish Farmed in Treated Wastewater in Ghana. International Water Management Institute, PMB CT 112, Cantonments, Accra, Ghana.

Gido, O.E., Ayuya, I.O., Owuor, G. and Bokelmann, W. (2016). Consumer's Choice of Retail Outlets for African Indigenous Vegetables: Empirical Evidence Among Rural and Urban Households in Kenya. *Cogent Food and Agriculture*, 2(1):1-14.

Gido, O.E., Ayuya, I.O., Owuor, G. and Bokelmann, W. (2017). Consumption Intensity of Leafy African Indigenous Vegetables: Towards Enhancing Nutritional Security in Rural and Urban Dwellers in Kenya. *Agricultural and Food Economics*, 5:14.

Government Of Kenya, (2007). Ministry Of Planning and National Development. Kenya Vision 2030.

Government of Kenya, (2010). 2009 Kenya National Population and Housing Census Volume 1A, Kenya National Bureau of Statistics, Nairobi.

Government of Kenya, (2011) Kenya National Food and Nutrition Security Policy, Nairobi.

Government of Kenya, (2013). First Bungoma County Integrated Development Plan 2013 - 2017.

Government of Nepal, Ministry of Agriculture and Cooperatives. (2009). Your Planet Needs You - Unite to Combat Climate Change. *The Journal of Agriculture and Environment*, 10:18-29.

Gujarati, N. (2004). *Basic Econometrics(4th Edition)*.New Delhi Mc-Graw Hill Publishing Company.

Grisolía, J.M., López, M. and Dios Ortúzar, J. (2012). Sea Urchin: From Plague to Market Opportunity. *Food Quality and Preference*, 25: 46-56.

Hamilton, A.J., Basset, Y., Benke, K.K., Grimbacher, P.S., Miller, S.E., Novotny, V., Samuelson, G.A., Stork, N.E., Weiblen, G.D. and Yen, J.D.L. (2010). Quantifying Uncertainty in Tropical Arthropod Species Richness Estimation. *American Naturalist*, 176: 90-95.

Hanna,(2013). *Consumer Behavior: An Applied Approach*. (*4th Edition*). Kendall Hunt Publishing.

Hartmann, C., Shi, J., Giusto, A. and Siegrist, M. (2015). The Psychology of Eating Insects: A Cross-Cultural Comparison Between Germany and China. *Food Quality and Preference*,44; 148–156.

Hartmann, C. and Siegrist, M. (2017). Insects as Food: Perception and Acceptance. Findings From Current Research. *Ernahrungs Umschau*,64(3): 44–50.

Hausner, H., Hartvig, D. L., Reinbach, H. C., Wendin, K., and Bredie, W.L.P. (2012). Effects of Repeated Exposure on Acceptance of Initially Disliked and Liked Nordic Snack Bars in 9–11 Year-Old Children. *Clinical Nutrition*, 31(1): 137-143.

Hemmerling, S., Canavari, M. and Spiller, A. (2016). Preference for Naturalness Of European Organic Consumers: First Evidence of an Attitude-Liking-Gap. *British Food Journal*, 118: 2287-2307.

Hoek, A. (2010). Will Novel Protein Foods Beat Meat? Consumer Acceptance of Meat Substitutes: A Multidisciplinary Research Approach. Phd Dissertation, Wageningen University, the Netherlands.

House, J. (2016). Consumer Acceptance of Insect-Based FoodsiIn the Netherlands: Academic and Commercial Implication. *Appetite*, 107: 47-58.

Hussain, I., Rahman, S., Zaheer. A. and Saleem, S. (2016). Integrating Factors Influencing Consumers Halal Products Purchase: Application of Theory of Reasoned Action. *Journal of International Food and Agribusiness Marketing*, 28(1): 35-58.

Jaafar, S.N., Lalp, P.E. and Nabal, M.M. (2011). Consumers' Perceptions, Attitudes and Purchase Intention Towards Private Label Food Products in Malaysia. *Asian Journal of Business and Management Sciences*, 2(8): 73-90.

Janssen, M., and Hamm, U. (2012). Product Labelling in the Market for Organic Food: Consumer Preferences and Willingness-to-Pay for Different Organic Certification Logos. *Food Quality and Preference*, 25: 9–22.

Jansson-Boyd, C. V. (2010). *Consumer Psychology*, New York, USA: Open University Press.

Johansen, S.B., Næs, T. and Hersleth, M. (2011). Motivation for Choice and Healthiness Perception of Calorie-Reduced Dairy Products. A Cross-Cultural Study. *Appetite*, 56: 15-24.

Johnson, D. V.(2010). The Contribution of Forest Edible Insects to Human Nutrition and to Forest Management. *in* P.B. Durst ,D. V. Johnson, R. L. Leslie and Shono, K. *Forest Insects as Food: Humans Bite Back, Proceedings of a Workshop on Forest Resources and Their Potential for Development*, Pp. 5–22. Bangkok, FAO Regional Office for Asia And The Pacific.

Jollife, I.T. (2002). *Principal Component Analysis*, Springer, New York.

Jones, A.M., 1989. A Double Hurdle Model of Cigarette Consumption. *Journal of Applied Econometrics*, 4 (1): 23–39.

Jongema, Y. (2014). *List of Edible Insects of the World*. Wageningen University, Wageningen, the Netherlands.

Kajale, D. and Becker, T. (2015). Factors Influencing Young Consumers' Acceptance of Genetically Modified Food in India. *Journal of Food Products Marketing*, 21:461–481.

Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F. and Mekuria, M. (2013). Adoption of Interrelated Sustainable Agricultural Practices in Smallholder Systems: Evidence From Rural Tanzania. *Technological Forecasting and Social Change*, 80: 525–540.

Kenis, M. and Hien, K. (2014). Prospects and Constraints for the Use of Insects as Human Food and Animal Feed in West Africa. Book of Abstracts of Conference on Insects to Feed the World, the Netherlands 14-17 May, 2014.

Kikulwe, E., Birol, E., Wesseler, J. and Falck-Zepedad, J. (2011). A Latent Class Approach to Investigating Demand for Genetically Modified Banana in Uganda. *Agricultural Economics*, 42(1): 547-560.

Kinyuru, J. N. (2012). Development and Evaluation of Complementary Foods Based on Traditional Foodstuffs in Western Kenya. A Phd Thesis Jomo Kenyatta University of Agriculture and Technology, Kenya.

Kinyuru, J.N., Kenji, G.M. and Njoroge, M.S. (2009). Process Development ,Nutrition and Sensory Qualities of Wheat Buns Enriched With Edible Termites (*Macrotermes Subhylanus*) from Lake Victoria Region, Kenya. *African Journal of Food, Agriculture, Nutrition and Development*, 9(8): 1739-1750.

Kinyuru, J.N., Kenji, G.M. and Muhoho, S.N. (2010). Nutritional Potential of Longhorn Grasshopper (*Ruspolia Differens*) Consumed in Siaya District, Kenya. *Journal of Agriculture, Science and Technology*, 12(1): 1–24.

Kinyuru, J., Konyole, S., Roos, N., Onyango, C., Owino, V., Owuor, B., Estambale, B., Friis, H., Aagaard-Hansen, J. and Kenji, G. (2013). Nutrient Composition of Four Species of Winged Termites Consumed in Western Kenya. *Journal of Food Composition and Analysis*, 30 (2), 120–124.

Konyole, S.O., Kinyuru, J. N., Owuor, B.O., Kenji, G.M., Onyango, C.A., Estambale, B .B., Friis, H., Roos, N. and Owino, V.O. (2012). Acceptability of Amaranth Grain-Based Nutritious Complementary Foods With *Dagaa* Fish (*Rastrineobola Argentea*) and Edible Termites (*Macrotermes Subhylanus*) Compared to Corn Soy Blend Plus Among Young Children and Mothers in Western Kenya. *Journal of Food Research*, 1(3): 11-120.

Köster, E.P. (2009). Diversity in the Determinants of Food Choice: A Psychological Perspective. *Food Quality and Preference*, 20: 70-82.

Krutulyte, R. K., Grunert, G., Scholderer, J., Lähteenmäki, L., Hagemann, K., Elgaard, H., Nielsen, B. and Graverholt, J. P. (2011). Perceived Fit of Different Combinations of Carriers and Functional Ingredients and its Effect on Purchase Intention. *Food Quality and Preference* , 22 (1):11-17.

Kuhnlein, H.V., Erasmus, B. and Spigelski, D. (2009). *Indigenous Peoples' Food Systems: The Many Dimensions of Culture, Diversity and Environment for Nutrition and Health*. FAO and Centre for Indigenous Peoples' Nutrition and Environment, Rome, Italy.

Lancaster, K. J. (1966). A New Approach to Consumer Theory. *The Journal of Political Economy*.74: 132-157.

Lawless, H.T. and Heymann, H. (2010). *Sensory Evaluation of Food: Principles and Practices*. New York, USA.

Lensvelt, E. and Steenbekkers, L. (2014). Exploring Consumer Acceptance of Entomophagy: A Survey and Experiment in Australia and The Netherlands. *Ecology of Food and Nutrition*, 53: 543-561.

Liljander, V., Polsa, P. and Riel, A. (2009). Modeling Consumer Responses to an Apparel Store Brand: Store Image as a Risk Reducer. *Journal of Retailing and Consumer Service*, 16(4): 281-290.

Looy, H., Dunkel, F. and Wood, J. (2014). How then Shall we Eat? Insect-Eating Attitudes and Sustainable Foodways. *Agriculture and Human Values,* 31(1): 131–141.

Ludy, M. and Mattes, R.D. (2012). Comparison of Sensory, Physiological, Personality, and Cultural Attributes in Regular Spicy Food Users and Non-Users. *Appetite*, 58: 19-27.

Lunde, K., Egelandsdal, B., Skuterud, E., Mainl J.D. and Lea, T. (2012). Genetic Variation of an Odorant Receptor OR7D4 And Sensory Perception of Cooked Meat Containing Androstenone. 7,(5).

Makokha, E.(2016). *Kumbekumbe Harvesting in Western Kenya*. Kenya Indigeneuos Knowledge Online.

Man, M. C. and Lai, J. (2010). New Product Development for a Food and Beverage Company: a Showcase of Evidence-Based Management. *Knowledge and Process Management*, 17 (2):74-81.

Matsunaga, M., (2010). How to Factor-Analyze Your Data Right: Do's, Don'ts, and How-To's. *International Journal of Psychological Research*, 3 (1): 98-111.

Megido, C. R., Sablon, L., Geuens, M., Brostaux, Y., Alabi, T., Blecker, C., Francis, F. (2016). Edible Insects Acceptance by Belgian Consumers: Promising Attitude for Entomophagy Development. *Journal of Sensory Studies*, 29 (1): 14–20.

Mensah, J.O., Adioo, R. and Teye, A.N. (2013). Analysis of Street Food Consumption Across Various Income Groups in The Kumasi Metropolis of Ghana. *International Review of Management and Business Research*, 2(4).

Michel, L. M., Anders, S. and Wismer, W. V. (2011). Consumer Preferences and Willingness to Pay for Value-Added Chicken Product Attributes. *Journal of Food Science*, 76(8): 469–477.

Mutai, B. K. (2014). *How to Write a Quality Proposal: A Complete Simplified Recipe*. Second Revised Edition. Dream Web Solutions Pune, Maharashtra, India.

Nyukuri, R.W., Mwale, R.E., Kirui, S.C., Cheramgoi, E. and Koskei, G.C. (2014). Food Value of Termites (Isoptera: Termitidae)iIn Western Kenya: Comparison With Tilapia Fish and Red Meat. *International Journal of Scholarly Research Gate*, 2: 176-181.

Naidoo, V. and Ramatsetse, M. H. (2016). Assessment of the Consumer Purchase Intentions of Organic Food at the Hazel Food Market In Pretoria, South Africa. *Journal of Environmental Economics*, 7(3).

Olsen, S. O., Tuu, H. H. and Grunert, K.G. (2017). Attribute Importance Segmentation of Norwegian Seafood Consumers: The Inclusion of Salient Packaging Attributes. *Appetite*, 117: 214-223.

Pambo, O. K., Otieno, J. D. and Okello, J. J. (2015). Willingness-to-Pay for Sugar Fortification in Western Kenya. Selected Paper Prepared For Presentation at The 2015 Agricultural And Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28 ,2016.

Pambo, O. K., Okello, J. J., Mbeche, R. and Kinuyru, N. J. (2016). Consumer Acceptance of Edible Insects for Non-Meat Protein in Western Kenya. Paper Prepared For Presentation At The 5th African Association of Agricultural Economists (AAAE) Conference At The United Nations Conference Centre, Addis Ababa, Ethiopia: Sept 23-26, 2016.

Pouratashi, M. (2012). Factors Influencing Consumers' Willingness to Pay for Agricultural Organic Products. *International Conference on Applied Life Sciences*, Turkey, Sept 10-12, 2012 ;PP 371-376.

Riggi, L. G., Verspoor, R. L., Veronesi, M., Macfarlane, C. and Tchibozo, S. (2014). *Exploring Entomophagy in Northen Benin: Practices, Perceptions and Possibilities*. Book of Abstracts of Conference on Insects to Feed the World, The Netherlands 2014 May 14-17.

Rom`an, S., S`Anchez-Siles, L.M. and Siegrist, M. (2017). The Importance of Food Naturalness for Consumers: Results of a Systematic Review. *Trends in Food Science and Technology*, 67:44-57.

Rosen .S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *The Journal of Political Economy*, 82: 34-55.

Rossini, G., Vicentin, J. and Depetris, E. (2015). Household Cheese Consumption in Argentina: a Double-Hurdle Model Estimation. Paper Prepared For Presentation at:

The EAAE-AAEA Joint Seminar 'Consumer Behaviour in a Changing World: Food, Culture, Society" 2015 March 25 -27: Naples, Italy.

Rumpold, B.A. and Schlüter, O.K. (2013). Potential And Challenges of Insects as an Innovative Source of Food and Feed Production. *Innovation Food Science And Emergency Technology*, 17: 1-11.

Šarčević, D., Janičić, R. And Turubatović, L. (2009). Importance of Corporative Social Responsability In Meat Industry,55th International Meat Industry Conference, Book Of Abstracts.

Šarčević, D., Slobodan, L.,Vesna, D., Dragan, M., Danijela, V., Brankica, L. and Milan, M.(2011). The Role of Consumers' Perception and Attitude in Purchasing of Meat and Meat Products. Insitute of Meat Hygiene and Technology, Kaćanskog 13, 11 000 Belgrade, Republic of Serbia, Pp283-290.

Satimanon, T. and Weatherspoon, D. (2010). Hedonic Analysis of Sustainable Food Products. *International Food and Agribusiness Management Review*, 13(4): 57-74.

Siegrist, M. and Cousin, M. (2009). Expectations Influence Sensory Experience in a Wine Tasting. *Appetite*, 52: 762-765.

Sogari, G. (2015).Entomophagy and Italian Consumers: An Exploratory Analysis. *Progress in Nutrition*, 17(4): 311-316.

Stiles, K., Altıok, O. and Bell, M.M. (2011). The Ghosts of Taste: Food and the Cultural Politics of Authenticity. *Agriculture and Human Values*, 28: 225–236.

Suthamathy, N.(2012). Hedonic Price Analysis of Shrimp: Quality Factors Influencing Market Price of Shrimp In Nha Trang, Vietnam. Master Thesis In Fisheries And Aquaculture Management and Economics (30 ECTS). The Norwegian College of Fishery Science University of Tromso, Norway and Nha Trang University, Vietnam.

Troy, D. (2011). Modern Approaches to Enhancing Beef Quality. *Meat Technology*, 52(1): 15–21.

Troy, D. J. and Kerry, J.P. (2010). Consumer Perception and the Role of Science in Meat Industry. *Meat Science*, 86: 214–226.

Van Itterbeeck, J. and Van Huis, A. (2012). Environmental Manipulation for Edible Insect Procurement: A Historical Perspective. *Journal of Ethnobiology and Ethnomedicine*, 8(3): 1–19.

Van Huis, A. (2013). Potential of Insects as Food and Feed in Assuring Food Security. *Annual Review of Entomology*, 58(1): 563–583.

Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. And Vantomme, P. (2013). Edible Insects Future Prospects for Food and Feed Security. FAO Forestry, Paper 171.

Van Trijp, H.M. and Fischer, A.H. (2011). Mobilizing Consumer Demand for Sustainable Development. The Transforum Model: Transforming Agro Innovation Toward Sustainable Development. H. Van Latesteijn And K. Andeweg, Springer Netherlands: 73-96.

Verbeke, W. (2015). Profiling Consumers Who Are Ready to Adopt Insects as a Meat Substitute in a Western Society. *Food Quality and Preference*, 39: 147-155.

Wollni, M. And Fischer, E. (2015). Member Deliveries in Collective Marketing Relationships: Evidence From Coffee Cooperatives in Costa Rica. *European Review of Agricultural Economics*, 42(2): 287-314.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

Wu, Chen, Y., Si, W. and Chien, H. (2014). A Double-Hurdle Analysis of Demand for Powdered Milk: Evidence From Household Survey Data in an Urban Chinese Province. *Agribusiness*, 30 (3): 331–344.

Xiaoming, C., Ying, F., Hong, Z. and Zhiyong, C. (2010). Review of The Nutritive Value of Edible Insects. *In* P.B. Durst, D. V. Johnson, R. L. Leslie And Shono, K. *Forest Insects As Food: Humans Bite Back, Proceedings of A Workshop on Resources and Their Potential for Development*. Bangkok, FAO Regional Office for Asia and The Pacific.

Yen, A.L. (2012). Edible Insects and Management of Country. *Ecological Management and Restoration*, 13(1): 97–99.

Yi, C., He, Q., Wang, L. and Kuang, R. (2010). The Utilization of Insect Resources in Chinese Rural Area. *Journal of Agricultural Science*, 2(3): 146-154.

Yong, A. G. and Pearce, S. (2013). A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. *Tutorials In Quantitative Methods for Psychology* , 9(2): 79-94.

Zamasiya, B., Nyikahadzoi, K. and Mukamuri, B.B. (2017). Factors Influencing Smallholder Farmers' Behavioral Intention Towards Adaptation to Climate Change in Transitional Climatic Zones: A Case Study of Hwedza in Zimbabwe. *Journal of Environmental Management*, 198: 233-239.

APPENDICES

Appendix 1: Consumer Survey Questionnaire

Questionnaire No…….

Dear sir/ madam,

HALLO, my name is _____and I am part of a team from Egerton University, who are studying aspects to do with termite consumption with emphasis on consumers' perception, factors influencing acceptability of termites and willingness to pay for their attributes. Your participation in answering these questions is highly appreciated. Your responses will be **COMPLETELY CONFIDENTIAL** and used solely for research purposes together with other 383 households. If you indicate your voluntary consent by participating in this interview, may we begin? If you have any questions or comments about this survey, you may contact survey supervisor through the following address: **Carolyne Nafula Kisaka Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536, Egerton. Cell phone: 0725901431.** Email address: kisaka_carolyne@yahoo.com.

Ward:_____ Location:_____
Sub location:_____ Date:_____

1. Name of enumerator …….Date……..
   Mobile No…….
2. Name of respondent ……Mobile No……

SECTION A: SOCIOECONOMIC CHARACTERRISTICS OF THE CHIEF FOOD PURCHASE AND CONSUMPTION DECISION MAKER.

Please tick (√) the appropriate choice

1. How old are you (in years)? …….
2. Gender: 1=Male [ ] 0= Female [ ]
3. How many years have you spent in formal schooling? .....
4. What is the size of your household? ……..
5. How many of the children in your household are below 5years? .....
6. Are you involved in any other activities that are not on-farm? 1=Yes[ ], 0=No [ ]
7. What is your monthly income? Ksh.....

8. Are you a native of this place? 1=Yes[ ],0=No[ ]
9. Do you consume termite?1=Yes[ ],0=No[ ]
10. For how long have you been consuming termites? .....

SECTION B: CONSUMER'S PERCEPTION.

How do you view or see edible winged termites? To show your views , tick only once against each statement where 1=strongly disagree=(SD) ;2=disagree=(D); 3=undecided=(UD); agree 4=(A) and 5=(strongly agree SA); to show the extent of your agreement with the statement.

S/N	PERCEPTION STATEMENT	SD	D	UD	A	SA
1	Termites are the same as meat and fish					
2	Termites are cheaper than meat and fish					
3	I would buy termites no matter the price					
4	I would buy raw termites					
5	Termites are hygienic					
6	Termites consumption is healthy					
7	I would buy termites only if recommended by health authorities					
8	I would buy large termites					
9	Termites are always available					
10	Termites contain no chemical residues					
11	I would buy termites that are fried					
12	I would buy blanched termites					
13	Termites are what I usually eat					
14	Termites look nice					
15	Termites have a pleasant smell					
16	Termites have a good texture					
17	Termites have a good taste					
18	Termites take no time to prepare					
19	I have been consuming termites since childhood					
20	I would buy sun-dried termites					
21	Termites consumption is environmental friendly					
22	Termites are rich in nutrients					
23	Termites are food for the poor					
24	I have adequate knowledge on termites good preparation					
25	It is primitive behaviour to eat termites					
26	Termite are food for famine periods only					
27	Termites are medicinal					
28	Termites are a luxury					
29	Termites are destructive pests					
30	Termites are a nuisance					
31	Termites are a source of income					

SECTION C: INSTITUTIONAL CHARACTERISTICS.

1. Where do you buy termites?1= Hawkers [ ]2= kiosk [ ] 3=producer [ ]
2. How long does it take you walking to the nearest market? Minutes.....
3. From whom do you get information on the nutritional and food security? 1=Nutritional / Health officer [ ], 2=Friends and Relatives [ ], 3=Media [ ], 4=Agricultural extension officer [ ],5=Relative [ ],6=Others(specify)…… ……
4. Where do you stay? 1= Urban area [ ] ,0= Rural area [ ]
5. Do you belong to any group that is concerned with food security matters?1=Yes[ ],0=No[ ]

SECTION D: WILLINGNESS TO PAY FOR RAW EDIBLE WINGED TERMITES' ATTRIBUTES.

1. At how much do you buy a cup of raw edible winged termites?
Kshs……

2. How many cups of raw edible winged termite do you consume in a year?.....

3. When buying raw edible winged termites do you consider their freshness?

1=Yes [ ], 0=No [ ]

4. Do you consider cleanliness when buying raw edible winged termites?

1=Yes [ ], 0=No [ ]

5. When buying raw edible winged termites do you consider their smell?

1=Yes [ ], 0=No [ ]

6. Do you consider the colour when buying raw edible winged termites?

1=Yes [ ],0=No [ ]

7. When buying raw edible winged termites do you consider their size?

1=Yes [ ], 0=No [ ]

8. What else do you consider when buying raw edible termites?.....

SECTION E: WILLINGNESS TO PAY FOR FRIED EDIBLE WINGED TERMITES' ATTRIBUTES.

1. At how much do you buy a cup of fried edible winged termites? Kshs…….

2. How many cups of fried edible winged termite do you consume in a year?.....

3. When buying fried edible winged termites do you consider their freshness?

1=Yes [ ], 0=No [ ]

4. Do you consider cleanliness when buying fried edible winged termites?

1=Yes [ ], 0=No [ ]

5. When buying fried edible winged termites do you consider their smell?

1=Yes [ ], 0=No [ ]

6. Do you consider the colour when buying fried edible winged termites?

1=Yes [ ], 0=No [ ]

7. When buying fried edible winged termites do you consider their size?

1=Yes [ ], 0=No [ ]

8. What else do you consider when buying fried edible winged termites?.....

SECTION F: WILLINGNESS TO PAY FOR SUN-DRIED EDIBLE WINGED TERMITES' ATTRIBUTES.

1. At how much do you buy a cup of sun-dried edible winged termites? Kshs……

2. How many cups of sun-dried edible winged termite do you consume in a year?.....

3. When buying sun-dried edible winged termites do you consider their freshness?

1=Yes [ ], 0=No [ ]

4. Do you consider cleanliness when buying sun-dried edible winged termites?

1=Yes [ ], 0=No [ ]

5. When buying sun-dried edible winged termites do you consider their smell?

1=Yes [ ], 0=No [ ]

6. Do you consider the colour when buying sun-dried edible winged termites?

1=Yes [ ], 0=No [ ]

7. When buying sun-dried edible winged termites do you consider their size?

1=Yes [ ], 0=No [ ]

8. What else do you consider when buying sun-dried edible winged termites?.....

SECTION G: WILLINGNESS TO PAY FOR BLANCHED EDIBLE WINGED TERMITES' ATTRIBUTES.

1. At how much do you buy a cup of blanched edible winged termites?
Kshs……

2. How many cups of blanched edible winged termite do you consume in a year?.....

3. When buying blanched edible winged termites do you consider their freshness?

1=Yes [ ], 0=No [ ]

4. Do you consider cleanliness when buying blanched edible winged termites?

1=Yes [ ], 0=No [ ]

5. When buying blanched edible winged termites do you consider their smell?

1=Yes [ ], 0=No [ ]

6. Do you consider the colour when buying blanched edible winged termites?

1=Yes [ ], 0=No [ ]

7. When buying blanched edible winged termites do you consider their size?

1=Yes [ ], 0=No [ ]

8. What else do you consider when buying blanched edible winged termites?.....

SECTION I: TERMITES ATTRIBUTES RANKING.

Rank the termites' attributes (from **1-6**) according to what you consider being important.

	Termites consumption forms			
Attribute	Raw	Fried	Sun-dried	Blanched
Freshness				
Cleanliness				
Smell				
Colour				
Size				
Others				

THANKS FOR YOUR COOPERATION

Appendix 2: Pair Wise Correlation Stata Output

```
. pwcorr GENDER OFARMACTS NATIVE CONTERM RESIDEN GROUPMEM KIOSK PRODUCERS NUTFICER
```

	GENDER	OFARMA~S	NATIVE	CONTERM	RESIDEN	GROUPMEM	KIOSK
GENDER	1.0000						
OFARMACTS	0.0504	1.0000					
NATIVE	-0.0059	-0.2409	1.0000				
CONTERM	-0.0041	-0.0067	0.1480	1.0000			
RESIDEN	0.1124	0.3398	-0.0052	-0.0985	1.0000		
GROUPMEM	-0.1468	-0.1754	0.2399	0.1964	-0.3023	1.0000	
KIOSK	0.0049	0.2118	-0.0911	0.3402	0.2562	-0.0604	1.0000
PRODUCERS	-0.0271	-0.2449	0.1810	0.3875	-0.3989	0.2416	-0.5620
NUTFICER	0.0900	0.2025	-0.0220	-0.1060	0.5526	-0.1791	0.3187

	PRODUC~S	NUTFICER
PRODUCERS	1.0000	
NUTFICER	-0.4505	1.0000

Appendix 3: Variance Inflation Factor Stata Output

```
. reg AGE EDUCATION HMEOVER5 CHLBELOW5 TIMARKET TERMATS CONVENIENCE CULTURE logINCOME  QUACON
> S3 inRAWPRICE inFRIEDPRICE  inBLANPRICE
```

Source	SS	df	MS		
Model	18435.7071	12	1536.30893	Number of obs	= 274
Residual	25213.9717	261	96.6052555	F(12, 261)	= 15.90
				Prob > F	= 0.0000
Total	43649.6788	273	159.888933	R-squared	= 0.4224
				Adj R-squared	= 0.3958
				Root MSE	= 9.8288

AGE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
EDUCATION	-.8996283	.2063969	-4.36	0.000	-1.306043	-.4932133
HMEOVER5	3.691077	.3624468	10.18	0.000	2.977385	4.404769
CHLBELOW5	-2.170022	.8442037	-2.57	0.011	-3.832339	-.5077052
TIMARKET	.084156	.0934582	0.90	0.369	-.099872	.2681841
TERMATS	1.83883	10.60972	0.17	0.863	-19.05272	22.73038
CONVENIENCE	4.576507	4.227817	1.08	0.280	-3.748465	12.90148
CULTURE	-.0791951	.7217684	-0.11	0.913	-1.500425	1.342035
logINCOME	5.613785	1.218274	4.61	0.000	3.214888	8.012682
QUACONS3	2.913855	1.40838	2.07	0.040	.1406208	5.68709
inRAWPRICE	-7.567569	4.021826	-1.88	0.061	-15.48692	.3517878
inFRIEDPRICE	-.8415422	4.843649	-0.17	0.862	-10.37915	8.696062
inBLANPRICE	5.108312	3.952073	1.29	0.197	-2.673693	12.89032
_cons	-14.86655	19.05402	-0.78	0.436	-52.38571	22.65261

```
. estat vif
```

Variable	VIF	1/VIF
inFRIEDPRICE	4.93	0.202701
inRAWPRICE	4.65	0.215099
inBLANPRICE	4.10	0.244195
TIMARKET	2.39	0.418079
logINCOME	2.38	0.420782
QUACONS3	2.11	0.473567
EDUCATION	1.99	0.502361
TERMATS	1.46	0.683235
CONVENIENCE	1.43	0.699096
CHLBELOW5	1.27	0.784813
CULTURE	1.24	0.804426
HMEOVER5	1.17	0.854963
Mean VIF	2.43	

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.
```

Appendix 4: Craggit Model Stata Output

```
. craggit  CONTERM  AGE GENDER EDUCATION HMEOVER5 CHLBELOW5 logINCOME NATIVE KIOSK PRODUCERS
> TIMARKET NUTFICER  AGRITENS GROUPMEM TERMATS CONVENIENCE CULTURE, second ( QUACONS3  AGE GE
> NDER EDUCATION HMEOVER5 CHLBELOW5 logINCOME NATIVE KIOSK PRODUCERS TIMARKET  NUTFICER AGRIT
> ENS GROUPMEM TERMATS CONVENIENCE CULTURE )

Estimating Cragg's tobit alternative
Assumes conditional independence

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -2055.0012
rescale:       log likelihood = -708.15578
rescale eq:    log likelihood = -492.59228
Iteration 0:   log likelihood = -492.59228  (not concave)
Iteration 1:   log likelihood = -293.37858
Iteration 2:   log likelihood = -229.87923
Iteration 3:   log likelihood = -196.66108
Iteration 4:   log likelihood = -192.89455
Iteration 5:   log likelihood = -187.64293
Iteration 6:   log likelihood = -183.34927
Iteration 7:   log likelihood = -182.56278
Iteration 8:   log likelihood = -182.55914
Iteration 9:   log likelihood = -182.55914

                                                Number of obs   =        384
                                                Wald chi2(16)   =      54.92
Log likelihood = -182.55914                     Prob > chi2     =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Tier1						
AGE	.0067805	.0121608	0.56	0.577	-.0170541	.0306152
GENDER	-.0264987	.2948534	-0.09	0.928	-.6044009	.5514034
EDUCATION	.1127667	.0470448	2.40	0.017	.0205605	.2049728
HMEOVER5	.0910704	.1030062	0.88	0.377	-.110818	.2929588
CHLBELOW5	.3503218	.1866659	1.88	0.061	-.0155366	.7161801
logINCOME	-1.262291	.3452917	-3.66	0.000	-1.93905	-.5855313
NATIVE	-.1672887	.2998916	-0.56	0.577	-.7550655	.4204881
KIOSK	.1280712	.5537872	0.23	0.817	-.9573318	1.213474
PRODUCERS	-.7770246	.5286752	-1.47	0.142	-1.813209	.2591597
TIMARKET	-.0535826	.021581	-2.48	0.013	-.0958806	-.0112846
NUTFICER	-1.481647	.666225	-2.22	0.026	-2.787423	-.1758696
AGRITENS	-.9191843	.6112825	-1.50	0.133	-2.117276	.2789075
GROUPMEM	-.1618655	.3057997	-0.53	0.597	-.7612218	.4374908
TERMATS	9.498782	1.798684	5.28	0.000	5.973427	13.02414
CONVENIENCE	1.805415	.7384895	2.44	0.014	.3580021	3.252828
CULTURE	.3908117	.1408144	2.78	0.006	.1148205	.6668028
_cons	9.661884	3.200476	3.02	0.003	3.389066	15.9347
Tier2						
AGE	.0066919	.0023642	2.83	0.005	.0020582	.0113256
GENDER	-.1485768	.0563193	-2.64	0.008	-.2589606	-.038193
EDUCATION	-.0012954	.0084717	-0.15	0.878	-.0178996	.0153087
HMEOVER5	-.0088845	.016548	-0.54	0.591	-.0413181	.023549
CHLBELOW5	.1170019	.0325729	3.59	0.000	.0531602	.1808437
logINCOME	-.153033	.0494917	-3.09	0.002	-.2500349	-.0560312
NATIVE	-.0398698	.0535518	-0.74	0.457	-.1448294	.0650898
KIOSK	.000171	.0787856	0.00	0.998	-.1542459	.154588
PRODUCERS	.0077221	.083318	0.09	0.926	-.1555782	.1710224
TIMARKET	.0217719	.0035619	6.11	0.000	.0147907	.0287531
NUTFICER	.0095139	.0865701	0.11	0.912	-.1601603	.1791882
AGRITENS	.0700052	.0804957	0.87	0.384	-.0877635	.2277738
GROUPMEM	.0783903	.0517086	1.52	0.130	-.0229566	.1797373
TERMATS	-.2476161	.4150365	-0.60	0.551	-1.061073	.5658405
CONVENIENCE	-.1906024	.1678507	-1.14	0.256	-.5195837	.138379
CULTURE	.0634876	.0294475	2.16	0.031	.0057717	.1212036
_cons	3.158402	.4966821	6.36	0.000	2.184923	4.131881
sigma						
_cons	.3785028	.0162903	23.23	0.000	.3465745	.4104311

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Appendix 5: Hedonic Price Model Stata Output for Raw Edible Winged Termites.

```
. regres       inRAWPRICE  AGE GENDER EDUCATION  CHLBELOW5 OFARMACTS  inCOME NATIVE RESIDEN G
> ROUPMEM TIMARKET KIOSK PRODUCERS AGRITENS NUTFICER TERMATS  CONVENIENCE CULTURE
```

Source	SS	df	MS		
Model	24.6505277	17	1.45003104	Number of obs =	274
Residual	3.11566441	256	.012170564	F(17, 256) =	119.14
				Prob > F =	0.0000
Total	27.7661921	273	.101707663	R-squared =	0.8878
				Adj R-squared =	0.8803
				Root MSE =	.11032

inRAWPRICE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	-.0010283	.0006135	-1.68	0.095	-.0022364	.0001798
GENDER	.0248322	.0162082	1.53	0.127	-.0070863	.0567506
EDUCATION	.0020906	.0024197	0.86	0.388	-.0026744	.0068555
CHLBELOW5	-.0123388	.009323	-1.32	0.187	-.0306984	.0060208
OFARMACTS	.064149	.0252636	2.54	0.012	.014398	.1139
inCOME	.0228574	.0156853	1.46	0.146	-.0080313	.0537461
NATIVE	.0141117	.0161344	0.87	0.383	-.0176614	.0458848
RESIDEN	.5480295	.0250367	21.89	0.000	.4987253	.5973336
GROUPMEM	.0161564	.0152298	1.06	0.290	-.0138352	.046148
TIMARKET	.000046	.001271	0.04	0.971	-.0024568	.0025489
KIOSK	.0634198	.0227862	2.78	0.006	.0185476	.108292
PRODUCERS	.0923902	.0238179	3.88	0.000	.0454862	.1392942
AGRITENS	-.0231757	.0233974	-0.99	0.323	-.0692516	.0229002
NUTFICER	.0073544	.0252215	0.29	0.771	-.0423135	.0570224
TERMATS	-.1304234	.1207944	-1.08	0.281	-.3683006	.1074539
CONVENIENCE	-.0299003	.0480326	-0.62	0.534	-.1244896	.0646891
CULTURE	.0061705	.0085764	0.72	0.473	-.0107188	.0230597
_cons	3.069898	.146709	20.93	0.000	2.780987	3.358808

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Appendix 6: Hedonic Price Model Stata Output for Fried Edible Winged Termites.

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. regres        inFRIEDPRICE  AGE GENDER EDUCATION  CHLBELOW5 OFARMACTS  inCOME NATIVE RESIDE
> N GROUPMEM TIMARKET KIOSK PRODUCERS AGRITENS NUTFICER TERMATS  CONVENIENCE CULTURE
```

Source	SS	df	MS		
Model	29.1644306	17	1.71555474	Number of obs =	309
Residual	5.75409272	291	.019773514	F(17, 291) =	86.76
				Prob > F =	0.0000
Total	34.9185233	308	.113371829	R-squared =	0.8352
				Adj R-squared =	0.8256
				Root MSE =	.14062

inFRIEDPRICE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	.0001453	.0007275	0.20	0.842	-.0012864	.0015771
GENDER	.0224939	.019075	1.18	0.239	-.0150485	.0600362
EDUCATION	-.0054886	.0028463	-1.93	0.055	-.0110905	.0001133
CHLBELOW5	-.0168363	.0110006	-1.53	0.127	-.038487	.0048145
OFARMACTS	.0955924	.0301187	3.17	0.002	.0363142	.1548706
inCOME	.0389793	.0191315	2.04	0.043	.0013257	.0766329
NATIVE	-.0232778	.0192151	-1.21	0.227	-.061096	.0145404
RESIDEN	.5692373	.0303222	18.77	0.000	.5095587	.6289159
GROUPMEM	-.0388007	.0183575	-2.11	0.035	-.074931	-.0026703
TIMARKET	.0044458	.0015287	2.91	0.004	.0014371	.0074545
KIOSK	.0600464	.0283625	2.12	0.035	.0042247	.115868
PRODUCERS	-.0035468	.0298256	-0.12	0.905	-.0622481	.0551544
AGRITENS	.013292	.0288395	0.46	0.645	-.0434685	.0700525
NUTFICER	.0529241	.0310762	1.70	0.090	-.0082386	.1140868
TERMATS	.2036814	.1257032	1.62	0.106	-.0437214	.4510841
CONVENIENCE	.040999	.0543135	0.75	0.451	-.0658981	.147896
CULTURE	.0179625	.01002	1.79	0.074	-.0017583	.0376834
_cons	3.839264	.179432	21.40	0.000	3.486115	4.192413

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Appendix 7: Hedonic Price Model Stata Output for Sun-Dried Edible Winged Termites.

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. regres         inSDRYPRI  AGE GENDER EDUCATION  CHLBELOW5 OFARMACTS  inCOME NATIVE RESIDEN
> GROUPMEM TIMARKET KIOSK PRODUCERS AGRITENS NUTFICER TERMATS  CONVENIENCE CULTURE
```

Source	SS	df	MS		
Model	28.7208033	17	1.68945902	Number of obs =	309
Residual	5.57121355	291	.019145064	F(17, 291) =	88.25
				Prob > F =	0.0000
Total	34.2920168	308	.111337717	R-squared =	0.8375
				Adj R-squared =	0.8280
				Root MSE =	.13837

inSDRYPRI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	.0002208	.0007158	0.31	0.758	-.001188	.0016296
GENDER	.0208048	.0187694	1.11	0.269	-.0161362	.0577457
EDUCATION	-.0050103	.0028007	-1.79	0.075	-.0105225	.0005018
CHLBELOW5	-.0170446	.0108243	-1.57	0.116	-.0383485	.0042593
OFARMACTS	.0836575	.0296363	2.82	0.005	.0253289	.1419861
inCOME	.0346737	.018825	1.84	0.067	-.0023768	.0717241
NATIVE	-.021576	.0189073	-1.14	0.255	-.0587884	.0156364
RESIDEN	.561449	.0298364	18.82	0.000	.5027265	.6201716
GROUPMEM	-.0397648	.0180635	-2.20	0.028	-.0753163	-.0042132
TIMARKET	.0036515	.0015042	2.43	0.016	.000691	.0066121
KIOSK	.0467699	.0279081	1.68	0.095	-.0081575	.1016973
PRODUCERS	-.0135011	.0293478	-0.46	0.646	-.071262	.0442598
AGRITENS	.0149124	.0283775	0.53	0.600	-.0409388	.0707636
NUTFICER	.048493	.0305784	1.59	0.114	-.0116899	.1086759
TERMATS	.2195846	.1236895	1.78	0.077	-.0238549	.463024
CONVENIENCE	.0488706	.0534434	0.91	0.361	-.0563141	.1540552
CULTURE	.0171421	.0098595	1.74	0.083	-.0022629	.0365471
_cons	3.905691	.1765576	22.12	0.000	3.558199	4.253183

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Appendix 8: Hedonic Price Model Stata Output for Blanched Edible Winged Termites.

```
. regres          inBLANPRICE  AGE GENDER EDUCATION  CHLBELOW5 OFARMACTS  inCOME NATIVE RESID
> EN GROUPMEM TIMARKET KIOSK PRODUCERS AGRITENS NUTFICER TERMATS  CONVENIENCE CULTURE
```

Source	SS	df	MS		
Model	16.8152411	17	.989131828	Number of obs	= 279
Residual	8.78842511	261	.033672127	F(17, 261)	= 29.38
				Prob > F	= 0.0000
				R-squared	= 0.6568
				Adj R-squared	= 0.6344
Total	25.6036662	278	.092099519	Root MSE	= .1835

inBLANPRICE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	.0007893	.0010088	0.78	0.435	-.001197	.0027756
GENDER	.0282221	.0266386	1.06	0.290	-.0242319	.080676
EDUCATION	-.0011508	.0039647	-0.29	0.772	-.0089577	.0066562
CHLBELOW5	-.0233571	.0154662	-1.51	0.132	-.0538116	.0070973
OFARMACTS	.0712762	.0417293	1.71	0.089	-.0108928	.1534452
inCOME	.0121673	.025908	0.47	0.639	-.0388481	.0631827
NATIVE	-.0337037	.0265921	-1.27	0.206	-.0860659	.0186586
RESIDEN	.4494662	.0408643	11.00	0.000	.3690006	.5299318
GROUPMEM	-.0338748	.025056	-1.35	0.178	-.0832125	.015463
TIMARKET	.0037685	.0020771	1.81	0.071	-.0003214	.0078585
KIOSK	.0559325	.037745	1.48	0.140	-.018391	.130256
PRODUCERS	-.0074304	.0395844	-0.19	0.851	-.0853758	.070515
AGRITENS	.006839	.0388556	0.18	0.860	-.0696713	.0833492
NUTFICER	.0398948	.0418385	0.95	0.341	-.0424891	.1222787
TERMATS	.0353334	.1906988	0.19	0.853	-.3401706	.4108374
CONVENIENCE	.0042582	.0798659	0.05	0.958	-.1530053	.1615217
CULTURE	.0178115	.0142029	1.25	0.211	-.0101554	.0457783
_cons	3.653623	.2424903	15.07	0.000	3.176136	4.131109

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Appendix 9: Publications

i. Kisaka. N.C., Ayuya I.O. and Owuor .G. (2018). Insects for Food! Factors Influencing Consumer Acceptance and Quantity Consumed of Edible Winged Termites. Poster presented at: Tropentag 2018 International Conference on Research on Food Security, Natural Resource Management and Rural Development; 2018 Sep 17-19; Ghent University, Belgium.

ii. Kisaka. N.C., Ayuya I.O. and Owuor .G. (2018). Insects for Food! Factors Influencing Consumer Acceptance and Quantity Consumed of Edible Winged Termites. Tropentag 2018 International Conference on Research on Food Security, Natural Resource Management and Rural Development Ghent University, Belgium. September 17-19, 2018.

iii. Kisaka. N.C., Ayuya I.O. and Owuor .G. (2018). Hedonic Analysis of Edible Winged Termites Prices in Kenya. *Journal of Marketing and Consumer Research,* 49:51-58.