UNIVERSITY FOR DEVELOPMENT STUDIES

CONSUMERS' KNOWLEDGE, PERCEPTIONS AND WILLINGNESS TO PAY (WTP) FOR FRESH SAFER VEGETABLES IN TAMALE, GHANA

BY

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(UDS/MEC/0055/15)

THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS, FACULTY OF AGRIBUSINESS AND COMMUNICATION SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS

SEPTEMBER, 2017

DECLARATION

I, the undersigned hereby declare that apart from the references to the literature and other sources of information used for the study, which have been cited and duly acknowledged, this thesis is the result of my own original work for an M.Phil. Degree in Agricultural Economics and that no part of it has been presented for any degree in this University or elsewhere.

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We hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines on supervision of thesis writing laid down by this University.

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ABSTRACT

In recent years, consumers have become more concerned about the safety of foods they consume because of the increased awareness of inappropriate practices employed in the production of conventional foods and the health repercussions vis-à-vis the consumption of insalubrious foods. This study therefore examines consumers' knowledge, perceptions and willingness to pay (WTP) for fresh safer vegetables. Three hundred and thirty-one (331) observations used for the study were collected from consumers in Tamale (Ghana) through face-to-face interviews using structured questionnaires. A double-bounded dichotomous choice contingent valuation data was estimated to obtain the mean WTP and the factors influencing consumers' WTP using the ordered logit model. Results show that consumers have high knowledge in agrochemical residues and microbial pathogens as common food hazards. Also, results reveal that consumers' knowledge in food-borne diseases and deaths as resultant repercussions of consuming insalubrious foods was high. Results also show that consumer perception that safer foods are healthier was the highest, as a factor influencing consumption. Results further reveal that on average, consumers were willing to pay GH₵ 8.00 (equivalent 128.6% price premium), GH₵ 3.27 (equivalent to 197.3% price premium) and GH₵ 2.89 (equivalent to 189.0% price premium) for safer cabbage, *ayoyo* and okra respectively. The differences in WTP price premiums were influenced by socio-economic factors, vegetable shopping habit, choice of quality and credence cues, trust, consumer perceptions of food safety and use of farm-gate markets. The study recommends that farmers preserve unblemished attributes and nutritional values of vegetables while using synthetic pesticides prudently and clean water for irrigation since these factors influence consumers' WTP.

ACKNOWLEDGEMENTS

I thank Jehovah God for granting me bodily strength and spiritual support to complete this thesis in time.

I am pleased with the uncountable inspirational words, tireless efforts, patience and above all, intellectual support given to me by my two supervisors. In fact, this thesis could not have been materialized without the encouragement and ideas of my supervisors Dr. Samuel A. Donkoh and Isaac Gershon Kodwo Ansah, who have always been my most ideal lecturers in my undergraduate and postgraduate studies. Their supervision and engagement with the theoretical and analytical constructs underpinning this thesis has been meticulous, exciting and proactive. I say may the Almighty God richly bless you two for being very instrumental in the development of this thesis and my academic life.

I am also highly indebted to Urban Food plus (UFP), a German-African project for their generous financial support that has assisted in the timely completion of this thesis. I say your efforts shall not be in vain.

I thank my family for helping me financially and spiritually to pursue this programme.

I owe appreciation to my enumerators, Mohammed, Rahaman and Ayi for a successful data collection for my study.

DEDICATION

To my family and my role model Mr. Isaac Gershon Kodwo Ansah.

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LIST OF ACRONYMS

BECE Basic Education Certificate Examination

CE	Choice Experiment
CV	Compensation Variation
CVM	Contingent Valuation Method
DBDC	Double-Bounded Dichotomous Choice
DC	Discrete Choice
EFNs	Eco-friendly Nets
EFSA	European Food Safety Authority
EU	European Union
EV	Equivalent Valuation
FAO	Food and Agriculture Organization
FSK	Food Safety Knowledge
FSP	Food Safety Perceptions
GAPs	Good Agricultural Practices
GMOs	Genetically Modified Organisms
GNA	Ghana News Agency
GPS	Global Positioning System
GSS	Ghana Statistical Service
IARC	International Agency for Research on Cancer
IFPRI	International Food Policy and Research Institute
MoFA	Ministry of Food and Agriculture
MSLC	Middle School Learning Certificate
NOAA	National Oceanic and Atmospheric Administration
OE	Open-ended
OFS	Objective Food Safety
OK	Objective Knowledge
OLS	Ordinary Least Squares
PC	Payment Card
PE	Prior Experience
PHC	Population and Housing Census
RP	Revealed Preferences
RUT	Random Utility Theory
SBDC	Single-Bounded Dichotomous Choice
SDGs	Sustainable Development Goals
SFS	Subjective Food Safety
SK	Subjective Knowledge
SP	Stated Preferences
SSA	Sub-Saharan Africa
TaMA	Tamale Metropolitan Assembly
UPA	Urban and Peri-urban Agriculture
US	United States
USD	United States Dollar
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE

INTRODUCTION

1.0 Background

Vegetables are typically used in the preparation of soups to enhance their thickness or stews (sauces) to increase their bulkiness, and in most households, especially in Africa, they are preferentially eaten as a main dish or a side dish with rice or other starchy foods (Smith & Eyzaguirre, 2007). Drechsel & Seidu (2011) and Gonzalez *et al*. (2016) add that of late, the use of vegetables like cabbage and lettuce in the preparation of some western delicacies like salads has become popular among urban households in most traditional societies like Ghana. In West Africa, vegetables are the second major food group consumed after cereal and grain products (Stadlmayr *et al*., 2013). In terms of cash expenditure, vegetables are the third most important food consumption subgroup after bread and cereals and fish and sea-foods in Ghana, occupying 11.4% and 5.4% of total annual household food budget share and total annual household cash expenditure of all items respectively (GSS, 2014).

There is a higher demand for vegetable products worldwide due to the increased awareness of their acknowledged and understood role in optimizing health, and reducing the incidence of diabetes, cancer, heart diseases and aneamia by the public (Verma *et al*. 2015; Griep *et al*., 2011; Lambert, 2001). Also, higher demand for vegetables has been fueled by society's development, including population growth, urbanization, consumer affluence and changes in consumer lifestyles and preferences (Satterthwaite *et al*., 2010; Parrot *et al*., 2008). In Ghana, urbanization is rapidly increasing, and the growing population favours urban communities. Over the last three decades, Ghana's population has more than tripled with a little over half (54.04%) of

the population currently residing in urban areas (World Bank (WB), 2015). However, people in urban areas are more likely to change their consumption patterns towards fresh produce like vegetables, which is expected to increase the demand for vegetables along with the rising consumer affluence. Akoto *et al*. (2015) believe that increased vegetable production to meet the rising urban population and consumer affluence is important to enhancing food, nutrition and income security of urban households in Ghana. To meet this rising demand, especially for unblemished attributes (e.g., color and no insect bite or hole) and freshness of vegetables as revealed by Okello *et al*. (2010) coupled with poor transportation systems and lack of refrigeration, vegetables require close proximity of production inputs (including land and water) (Osei-Mensah *et al*., 2014; Acheampong *et al*., 2012).

The continuous rise in demand has caused a shift in vegetable production from a subsistence level (mainly in a form of backyard gardens) to encouraging more commercial or highly profitable farms (Nchanji *et al*., 2017). However, because of profit maximization, farmers would always opt to produce at the lowest cost, without paying key attention to GAPs, and may not also be well-audited or sanctioned by government, which is a public failure. Instead of moving to peri-urban fringes to farm due to shrinking land size and clean water scarcity because of urbanization and population pressure (Nchanji *et al*., 2017), many urban farmers turn to intensify their production all year-round by using poor practices. Consequently, most irrigated farmers produce vegetables using untreated wastewater, and this raises serious public health concerns concerning microbial pathogen contamination (Nchanji *et al*., 2017). In addition, the persistent influx of pests that potentially reduces vegetable crop quality and yields (Degri & Zainab, 2013), tempts farmers to apply more chemical pesticides

during vegetable cultivation to meet consumer expectations and demands (Acheampong *et al*., 2012; Ntow *et al*., 2006). However, reports show that in controlling pests, most farmers either apply chemical pesticides of no authorization or authorized ones in unselective manners (both in dosages and pre-harvest intervals) (Nchanji *et al*., 2017; Afari-Sefah *et al*., 2015; Darko & Akoto, 2008), and this also raises food safety concerns concerning chemical contamination.

In Ghana today, most consumers have become more concerned about the safety of vegetables they consume because of the increased awareness of inappropriate practices employed in the production of conventional food and the health repercussions vis-à-vis the consumption of their products (Acheampong *et al*., 2012). In fact, most urban consumers are aware that unsafe vegetables could be found on the market following the high levels of chemical and microbial pathogen contamination that have been recorded on most vegetables marketed on urban markets, and this has been identified as potential concerns of consumers as far as purchase decisions are concerned (Obuobie *et al*., 2014). To some extent this reflects expert views that most people in urban areas are more likely to grow their own vegetables (especially in backyard gardens) as a yardstick for food safety consciousness rather than for food and income security strategies as revealed by Obuobie *et al*. (2014) following the high prevalence of vegetable contamination in recent years.

Food safety remains a significant task of economies today because of globalization in food trade (Aung & Chang, 2014). Besides, the food supply has repeatedly been exposed to frequent incidents of food-borne diseases, and this questions the credibility or tarnishes the good image of the food supply. In reality, food-borne diseases no matter if on a local, regional or global scale not only significantly affect people's health

and life, but they also have significant economic repercussions for individuals, households, communities and countries (Aung & Chang, 2014). The cause may be intentional or unintentional but the outcomes are always negative. As a major cross-cutting issue of economies, outbreaks of food-borne diseases impose a considerable burden on state health-care systems and noticeably reduce economic productivity (Aung & Chang, 2014). These outbreaks also upset domestic and international food supply and tourism, and lead to loss of revenues, unemployment and litigations (Ortega *et al*., 2011; Aung & Chang, 2014). Often outcomes of the outbreaks are at the same time thrown back to the cause or source, and domestic producers or retailers may suffer lower sales and revenues due to lower demand nationally and internationally because of loss of confidence in the products' safety, which then can affect agricultural production. Recently, there has been a government effort to negotiate with the EU market to lift a ban on vegetables following traces of contamination. This has also raised the concern of consumers about food safety issues in Ghana.

In fact, the impact of food contamination on human health varies from various common acute symptoms to serious long-term health repercussions and even death, and these repercussions impose enormous financial burden on individual consumers or their families in forms such as costs of medical care for the sick and funeral expenses for the dead. Therefore, food safety cannot be negotiable, and not only that, it remains at the core of post-2015 agenda (especially, SDG 2) of the UN, which both developed and developing countries share similar concerns over. Food safety- identified as the most important link between food and health, intersect firmly with food and nutrition security, economic growth and environmental sustainability (WHO, 2015). Food safety is a shared responsibility of all the stakeholders of the food chain, including food

cultivars, sellers, processors, regulatory bodies and inspectors, governments and consumers. While consumers are expected to act as militias over their foods, government on the other hand is also expected to provide some level of control and intervention over food supply to ensure safety. This is because in relation to consumers' perception of produce safety, Tobin *et al*. (2012) found that consumers are less concerned about of the safety of produce when the government had inspected the products.

Food safety refers to the degree of confidence that a prepared-to-eat food will not cause both acute and chronic illnesses or even immediate death to the consumer (WHO, 2003), which means that the different kinds of food hazards like pathogenic microorganisms, chemical or physical toxins that make food injurious to the consumer are prevented or reduced to a permissible level (Haghiri, 2016). From a consumer perspective, food safety is subjectively assumed unless proven otherwise by an external body or where the consumer detects poor practices during production, handling or marketing of the product, or when the consumer suffers a deleterious (negative) health effect (Campbell Research & Consulting, 2005 cited in Aban *et al*., 2009; Viegas, 2013). Vis-à-vis the consumer, food safety has to do with the concerns consumers have about the repercussions of consuming certain foods on their health (Barrena *et al*., 2003). While Aung & Chang (2014) regard food safety as the consequence of control, origin, best before date and quality, while resulting in health and a feeling of calm, Viegas (2013) define food safety is an implicit (hidden) credibility of the merchandized product, and this is because its quality is related to attributes (such as application of pesticides and untreated wastewater) that are not detectable or avoidable by the

consumers before or after purchase (Alphonce & Alfnes, 2012; Torjusen *et al*., 2001; Grunert *et al*., 2004).

In other words, the consumer cannot foreknow the consequences of their purchase decisions, at least in the short term while long-term impacts can fairly be observed, and this remains a typical source of food safety concerns among some consumers. Among the ways to relieve consumers from anxieties due to the impossibility of them to self-detect safety coupled with the unlikeliness of producers and sellers to provide credible information about food products (Obuobie *et al*., 2014; Alphonce & Alfnes, 2012), attributes of product name, origin, information, labelling, certification and quality assurance are typically required to guarantee or facilitate the purchase of products during periods of consumer concerns (McKendree *et al*., 2013; Wirth *et al*., 2011; Yeung *et al*., 2010; Ortega *et al*., 2011). Alphonce & Alfnes (2012) work also suggests that concerned consumers address their concerns about food safety by relying on credence attributes like food being inspected to meet certain standards or organically produced, or having a geographical identity associated with good agricultural practices. To address the increasing consumer concerns and demand for fresh safer vegetables, it is necessary to investigate consumers' knowledge level and perceptions as well as their willingness to pay for fresh safer vegetables.

1.1 Problem Statement

In many developing countries, chemical deposits and microbial pathogen contamination levels in most fresh vegetables marketed on urban markets have been shown to exceed safety limits (Mandal & Singh, 2010; Chen *et al*., 2011; Amoah *et al*., 2006; Obuobie *et al*., 2006). A recent work by Abass *et al*. (2016) indicates that faecal bacteria in most fresh vegetables produced in Ghana exceed safety limits by almost

100%. The non-compliance to pesticide applications and irrigation standards has been attributed to limited knowledge to read labels and ignorance of most farmers to toxic effects of pesticide overdose as well as lack of finance to purchase clean water for irrigation farming (Ngowi *et al*., 2007; Mathews, 2008; Horna *et al*., 2008). However, in terms of purchase decisions, consumers may not question producers or sellers if the pesticide applications, irrigation water type and storage of vegetables fulfill standard conditions. Ensuring safer vegetable supply in a large informal farming or marketing environment would therefore require behaviour change, which may depend on cost and benefit analysis, and knowledge and perceptions about food safety of producers and consumers.

To help ensure effective supply of fresh safer vegetables to consumers would require regulation in the form of production methods, especially for pests and diseases control and irrigation. Currently, there is a research focus on the use of biochar to reduce microbial pathogen loads in wastewater to WHO safety limits for vegetable irrigation by farmers funded by the Urban Food plus in Tamale, but this requires extra investment if farmers are to operationalize. Regarding pests control, Vidogbena *et al*. (2015a) also promotes the use of deploy nets (Eco-Friendly Nets (EFNs)) as an effective physical measure in controlling pests. Citing Vidogbena *et al*. (2015a), most earlier studies have shown that EFNs can reduce pesticide use by 70-100%, and has promising results in terms of increasing productivity (Martin *et al*., 2006; Licciardi *et al*., 2008; Simon *et al*., 2014; Sauphanor *et al*., 2012). Nevertheless, Vidogbena *et al*. (2015b) estimate the cost of using EFNs to be 10% additional above normal production cost.

Also, it is understood that contamination of vegetables is more likely to occur at the market or retail level due to careless (unsafe) handling by vendors (Kutto *et al*., 2011),

and this leads to increasing health risks (Osei-Mensah *et al*., 2014); so, in line with safety measures under post-production practices of vegetables, postharvest regulations such as product certification and labelling are very necessary but this also involves extra costs. This means that while the use of safer methods ensures that vegetables are wholesomely produced for consumption, local producers who want to produce safer vegetables will incur extra costs, which would increase the prices of fresh safer vegetables in economic terms, and this requires that consumers bear part or all the additional cost. However, it is not known whether consumers in the Tamale Metropolis are willing to pay more for fresh safer vegetables. In the meantime, producers who would want to take advantage and create market niches in Tamale might also want to know which segment (or characteristics) of the consuming population are most likely to pay extra or premium price and by how much before potential investment is made by producers.

Analyzing consumers' knowledge, perceptions and willingness to pay (WTP) for food safety is very vital since it can help in the provision of the desired level of society's demand for safer foods. Consumers' knowledge and perceptions about food safety are important in prior and postpurchase evaluation of a product, especially in informal markets where information is largely asymmetric (Wilcock *et al*., 2004; Latvala, 2010; Sundström & Andersson, 2009). In particular, WTP is critical to understanding consumers' health-related risk concerns and preferences (or values) for food safety, and also gives producers trust about the potential and sustainability of a food market. In principle, markets are established when prices (in this case WTP) meet the consumers' budget and utility and the producers' expectation and motivation (Wilcock *et al*., 2004). In addition, WTP helps in identifying the potential factors driving consumers'

behaviour about food safety, the form or attributes consumers want their products to possess and the possible markets they prefer.

In the area of food safety, the concept of consumer preference (WTP) has received lots of analysis from economists in both developed and developing countries (Misra *et al*., 1991; Hammitt, 1993; Akgüngör *et al*., 1999; Boccaletti & Nardella, 2000; Huang *et al*., 1999; Vidogbena *et al*., 2015a; Suresh *et al*., 2015; Alphonce & Alfnes, 2012; Sundström & Andersson, 2009; Fu *et al*., 1999; Saraithong, 2016; Chen *et al*., 2013; Wongprawmas *et al*., 2014). While food safety can be viewed as an important multidimensional concept (Lagerkvist *et al*., 2013), the majority of studies analyzing consumers' WTP for food safety focused on a narrow range of food safety concerns in isolation, such as to minimize pesticide residues (Misra *et al*., 1991; Hammitt, 1993; Akgüngör *et al*., 1999; Huang *et al*., 1999; Boccaletti & Nardella, 2000; Vidogbena *et al*., 2015a; Suresh *et al*., 2015; Fu *et al*., 1999) or treat wastewater for irrigation (Yahaya *et al*., 2015) or avoid naturally-occurring toxins (mycotoxins) (Sckokai *et al*., 2010) or accept food certification (Saraithong, 2016; Chen *et al*., 2013), and labels (Wongprawmas *et al*., 2014).

Vis-à-vis demand for fresh safer vegetables, while consumer's WTP has also received lots of analysis from authors in developing countries (Vidogbena *et al*., 2015a; Suresh *et al*., 2015; Lagerkvist *et al*., 2013; Alphonce & Alfnes, 2012; Fu *et al*., 1999) in recent years, little analysis has occurred in Ghana (Yahaya *et al*., 2015; Acheampong *et al*., 2012). In particular, a specific study on consumers' WTP for fresh safer vegetables in the Tamale metropolis is not done to the best of the researcher's knowledge. In addition, while studies (e.g., Grunert, 2005; Wilcock *et al*., 2004) identify food safety knowledge and perceptions as important dimensions of consumer demand for food

safety, a limited number of studies (Naanwaab *et al*., 2014; McCluskey *et al*., 2005) has deemed it an extra priority to find out consumers' knowledge and perceptions towards food safety and how they affect consumers' WTP for food safety. In other words, while WTP price premiums for safer vegetables may depend on consumers' knowledge level and perceptions about food safety (Ngigi *et al*., 2011), these factors are empirically not well known in Ghana. Meanwhile, information on consumers' knowledge and perceptions are important for business plan development, market establishment and other policy decisions.

More so, this study divagates from others to find out whether consumers' WTP for safer vegetables is not only limited to individual and household characteristics, knowledge, perceptions and product attributes but also their choice of food markets because Lagerkvist *et al*. (2013) have argued that consumers' perceptions of food safety conditions at supermarkets or high-end markets are very different from traditional markets. However, this issue has not yet been addressed in the literature of WTP in Tamale to the best of the researcher's knowledge. While trust is considered as an important factor in WTP analysis (Muringai *et al*., 2017), it has not been empirically analyzed in WTP studies in Ghana. The possible challenges consumers anticipate to accessing safer vegetables have not been identified and ranked yet in the literature of consumers' WTP in Ghana. This study therefore seeks to address these gaps in literature.

Tamale is a major urban center and one of the fastest growing cities in Ghana and West Africa, and this means that the demand for fresh vegetables would be increasing faster in the area, especially alongside rising consumer affluence. A large number of farms in and around its periphery cultivate vegetables to supply consumers, mostly fresh. This

also means that more pesticide applications and irrigation are required to improve production and productivity all-year round. If nothing is done about it, conventional vegetable production will continue at least for the short-to-medium terms. There are recent reports that chemical pesticide applications and the use of untreated wastewater for irrigation practices in the Tamale Metropolis have increased. The foregoing problems lead to the formulation of the following research questions:

- The main research question is what are consumers' knowledge level and perceptions about food safety and the factors that influence consumers' willingness to pay for safer vegetables.
- *Specifically, the study seeks to ask questions such as:*
  1) What is the knowledge level and perceptions of consumers on food safety?
  2) Are consumers willing to pay a premium price for safer vegetables, and if so, how much?
  3) What factors affect consumers' WTP premium prices for safer vegetables?
  4) What are the characteristics of consumers in relation to their choice of markets for the purchase of fresh safer vegetables?
  5) What are the possible challenges that consumers are likely to face in accessing safer vegetables in Tamale?

1.2 Research Objectives

The main objective of the study is to examine consumers' knowledge level and perceptions about food safety, and factors that could influence consumers' willingness to pay for safer vegetables.

The specific objectives of the study are to;

1) Examine consumers' knowledge level and perceptions on food safety.
2) Determine whether consumers are willing to pay more for safer vegetables and by how much.
3) Understand the factors that influence consumers' WTP premium prices for safer vegetables.
4) Analyze the characteristics of consumers in relation to their choice of markets for the purchase of fresh safer vegetables.
5) Identify the possible challenges that consumers could face in accessing safer vegetables in Tamale.

1.3 Justification of the Study

Pesticide application and untreated wastewater use are major constraints of vegetable production, and these practices are also on the increase to meet demand with limited attention to safety. The recent increases in food poisoning and related-diseases may be due to the consumption of these vegetables. Vegetables-are often cited as major products incriminated in the spread of food-borne illnesses due to pesticide residues and microbial pathogen contamination (Denis *et al*., 2016; Herman *et al*., 2015; Wendel *et al*., 2009; Hanning *et al*., 2009; Grant *et al*., 2008). While pesticide residues are associated with higher risk of chronic diseases such as cancer due to their accumulative effect (Saba & Messina, 2003), some microorganisms (e.g., viruses) may also survive beyond certain temperatures. Hence, there is the need to bring to the knowledge of consumers and all other stakeholders about food safety in Ghana. The benefits of the current study are that first, it would help address consumers' concerns and desires for food safety if a market for safer vegetables is established in Tamale and

Ghana at large. The study would also be useful to producers or marketing vendors who want to produce or sell safer vegetables as to what qualities of safer vegetables consumers want and the market they want to buy the safer vegetables from. This would help establish the long-term productivity and diversity of vegetable production, and promote income generation and food security of urban and peri-urban poor farmers and other chain actors. The findings of the study are vital to policy-makers and governments who need them for planning, market development and implementation of effective food safety policies and certification. Because health risk situations of food in Ghana such as foodborne diseases extend to a wider level to affect government projects and expenditures as well as international trade, the findings this study would help in designing good agricultural policies and market incentives for urban farmers who are concerned about producing safer vegetables. It would further contribute to bridging the knowledge gaps in the literature on consumers' knowledge, perceptions and WTP for food safety.

1.4 Definition of Terms

Based on the WHO's (2012) recommendation for the production of safer vegetables, this study defines safer vegetables as those that have been cultivated without the use of synthetic pesticides via the use of treated wastewater and manure for irrigation and fertilization, and are properly handled. The term safer vegetable is measured as the assurance that the vegetable when ingested would not cause any illness to the consumer once it is ingested.

Consumer knowledge of food safety is defined in this study as the level of consumers' understanding or familiarity with certain food hazards and contamination, and their resultant effect on human health. These hazards include agrochemical residues,

microbial pathogens, heavy metals and physical materials. Also, foodborne diseases, infertility, death, malnutrition and loss of appetite were variable measuring consumer knowledge on the resultant effect of the food hazards on human health. Knowledge of food safety is measured as how much information or familiarity the consumer thinks he or she has about the phenomenon under study.

Consumers' perceptions of food safety as used in this study is defined as consumers' own definitions (or subjective views) of food safety based on certain attributes. These attributes include health, nutrition, taste, quality, hazard-free, price, packaging, environment quality, certification and labelling.

1.5 Structure of the Thesis

This study is divided into five chapters:

The foregoing chapter of the study is the introduction, which has outlined the background of the study. The background of the study provided explanation on the general notions of vegetables and food safety, and the introduction also discussed the research problem statement and the research questions. The research questions were directly translated into research objectives. This chapter also provided justification for the study, and highlighted the definitions of key concepts.

Chapter two (2) follows next with a review of literature on food safety, consumers' knowledge of food safety, consumers' perceptions of food safety, consumers' willingness to pay for food safety, food safety and quality attributes' preferences, and preference of food markets as well as the theoretical and conceptual frameworks for the study.

Chapter three (3) provides information about study area and the research methodology employed in the study. The study area elaborates on the location, size, geography, population structure and economic activities of the Tamale Metropolis. The research methodology provides the research design and quantitative techniques of data collection and analysis, including the source and types of data, sampling techniques and sample size, methods of data collection and analytical methods employed to achieve the study objectives.

Chapter four (4) outlines the results of the study. It gives a descriptive report of the sampled respondents' characteristics. The chapter analyses consumers' knowledge levels of food safety, consumers' perceptions of food safety, food shopping habits, demand for food safety and quality attributes, trust in farmers and vendors, mean WTP price premium, , reasons for willing to pay price premiums for safer vegetables, reasons for not willing to pay price premiums for safer vegetables, consumers' purchasing outlets for fresh vegetables and the factors influencing their choice, as well as the possible challenges consumers would confront in accessing safer vegetables. The results were accompanied by discussions of the key variables.

Chapter five (5) summarizes the main findings of the study and conclusions drawn from them. This chapter also provides recommendations for policy decision and future research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter of the thesis reviews literature on pertinent topics related to the study. It provides the definitions of concepts used in the study from previous studies. It consists of eight sections: the foregoing section (section 2.0) is the chapter outline, section 2.1 describes the general notions of vegetables and food safety. Sections 2.2 and 2.3 outline the theories of knowledge and perceptions, whilst the conceptual as well as theoretical frameworks of the study (thus, in measuring WTP) are outlined in sections 2.4 and 2.5. In section 2.6, empirical studies on knowledge, perceptions and WTP for food safety are discussed, highlighting the factors that affect consumers' WTP price premiums for food safety. Section 2.7 contains information on food market preference. Then, the conclusion of the chapter is given by section 2.8.

2.1 Description of (Safer) Vegetables and Food Safety

Botanically, vegetables are obtained from one or more of the succulent and edible parts of herbaceous plants (Griep *et al*., 2011). Based on classifications, cabbage and *ayoyo* (*Corchorus sp*) are leafy-vegetables, celery and onion are a stem (stalk) and a bulb, and carrot mature as root, whilst okra, pepper, tomato and cucumber are fruit-vegetables. The latter description includes fruits as a subset of vegetables, but some people prefer to call them fruits as a whole (IRAC, 2003). Griep *et al*. (2011) argued that other plants' foods such as cereals, seeds, legumes, potatoes and nuts are not considered as fruit or vegetables since their nutritional value is significantly different. Pennington & Fisher (2009) recommended vegetables and fruits to be distinguished based on their nutritional value, taste or culinary use, whilst Mehta & Cheung (2015) observed that

the organic acids and sugar contents in fruits are higher than in vegetables while Smith & Eyzaguirre (2007) stated that vegetables are also preferentially used in the preparation of stew (sauce), salad and soup, and consumed as a side dish or a main dish with rice or other starchy foods.

A balanced diet should be at least 45% vegetables made, and eaten at least five times daily (Abdulai, 2006). Vegetables are major sources of micronutrients and bioactive compounds (e.g., vitamins (A, B C, D, E, K) potassium, carotenoids, lavonoids and other polyphenols) (Griep *et al*., 2011; Barrett, 2007), and their high fiber and water (Abdulai, 2006), help to aid rapid digestion or prevent constipation and ensure proper functioning of the bowels. The Vitamin A component in vegetables is required for strong performance of respiratory and eye tissues, vitamin B for strong development of the nervous system, vitamin C is needed for the maintenance of blood cells and tissues, vitamin D is required for the maintenance of strong bones and teeth, and vitamin E for proper performance of the reproductive system. Vitamin K is effective in preventing blood clotting. The iron component of vegetables helps in the formation of blood hemoglobin.

Vegetable (and fruit) intakes are found to be associated with a reduced risk of heart disease, obesity, diabetes and cancer (Bazzano *et al*., 2002:2008; Bertoia *et al*., 2015). To gain sufficient quantities of micronutrients from vegetables (and fruits) (Bazzano *et al*., 2002: 2008; Bertoia *et al*., 2015), a daily intake of at least 400 grams of vegetables (and fruits), equivalent to 6-7% of the total calories in a 2.30 kcal/daily diet is recommended (FAO/WHO, 2003; Bishwajit *et al*., 2017). IARC (2003) reported that the intake of 400 grams per day recommended by FAO/WHO is met by only a few countries. For example, while the average intake in developed countries such as Israel,

Italy and Spain meets the recommended level of 400 grams per day, and that reported in in Low and Middle-Income Countries (LMIC) such as Mali, India and Pakistan is 100 grams per day. The World Health Organization (WHO) has established that low intakes of vegetables (and fruits) are partly responsible for about 19% of gastrointestinal cancer, 31% of ischemic heart disease and 11% of stroke in the world (IARC, 2003). More so, under-consumption of vegetables (and fruits) is responsible for about 1.7 million deaths (equivalent to 2.8% of total annual deaths), and among the 10-risk factors of global deaths. In addition, about 2.7 million potential lives could be saved every year if enough of vegetables (and fruits) are consumed. The rising importance of safe food consumption (especially fresh produce like vegetables) has drawn both national and international attention.

Vegetables, in particular are more susceptible to chemical residues and microbial pathogen contamination (Mccabe-Seller *et al*., 2004), and because they are often cited as connected with the spread of many foodborne diseases (Naanwaab *et al*., 2014; Grace, 2015), there is much concerns for their safety. The literature indicates that vegetables (and fruits) are responsible for about 46% of foodborne disease outbreaks in the USA (Tam *et al*., 2014), 10% in the UK (Fahrion *et al*., 2014), 7% in the Netherlands (Bouwknegt *et al*., 2012), 29% in India (Sudershan *et al*., 2014) and 40% in China (Sang *et al*., 2014). This suggests that ensuring safer vegetables availability on the market is necessary for the general wellbeing of the population.

The term safer vegetables, as used in this study are those that have been cultivated without the use of synthetic chemicals via the use of treated wastewater and manure for irrigation and fertilization, and are properly handled during harvesting and after-harvest (Aban *et al*., 2009). Food safety in a more general sense refers to the ways by which

microorganisms, chemical toxins, physical materials and naturally-occurring toxins (e.g., aflatoxins) that are associated with foodborne diseases and deaths are eliminated or prevented from entering foods. The FAO/WHO (2003) explains food safety as the assurance that food will not cause illness to the consumer when it is prepared and eaten according to its intended use. From the consumer's perspective, food safety relates to the consumer concern over the health implications associated with consuming certain foods (Barrena *et al*., 2003). In the broadest sense, food safety can be considered to encompass the addition or preservation of sensitive nutrients to food, and a broad range of concerns about the properties of an unfamiliar food, e.g., GMOs (Grunert, 2005).

There are two ways of defining food safety according to Grunert (2005). The first is the subjective perspective of food safety (SFS), which is based on consumer perceptions of food safety, while the second is objective perspective of food safety (OFS), a concept that is assessed and confirmed by food experts, scientists, or third- party agreement. Rohr *et al*. (2005) mentioned that food safety is closely related to food quality but the former is an important dimension of the latter in addition to attributes such as, color, size, freshness, nutrition, and measures of purity (e.g., absence of defects) since a lack of safety can result in serious injury and even death for the consumer. Food safety differ from food quality in a number of ways; first, a product can appear to be of high quality (i.e. well-coloured, appetizing and flavour, etc.), but it can be unsafe because it might be contaminated with undetected pathogenic organisms, toxic chemicals, or physical hazards (UN, 2007). Defects and improper food quality may result in consumer rejection and lower sales, while food safety hazards may be hidden and go undetected until the product has been consumed. If detected, serious food safety hazards may result in market access exclusion and major economic loss and costs.

Since food safety hazards directly affect public health and economies, achieving proper food safety must always take precedence over achieving high levels of other quality attributes (UN, 2007). These two have obvious links, but food quality is primarily an economical issue decided by the consumer, while food safety is a governmental commitment to ensure that the food supply is safe for consumers and meets regulatory requirements (Sarig, 2003).

While food safety is desirable, its credence attribute makes it difficult for the average consumer to directly ascertain or evaluate the quality before or after consumption (Torjusen *et al*. 2001; Grunert *et al*. 2004). Thus, food safety attributes may include pesticide-free, nutrition, quality, the use of additives and preservatives, genetic modifications, organic, veterinary drugs, fair trade, certification, local, farmers' support, origin, brand, animal welfare, environmental sustainability and recyclability (Moser *et al*., 2011; Wessells, 2002). These attributes are characterized by higher need for information (Rohr *et al*., 2005). Food safety matters at every stage of the food chain because food contaminations, which are caused by undesirable hazards in foods are connected to food production, storage, transportation, distribution, handling, preparation and even consumption.

The World Health Organization (WHO) (2015) over the past years has hinted that food safety is a key factor by which individuals and countries could escape the risk of food-borne diseases, and their associated deaths and economic burdens. In addition, many researchers, (Scott, 2003, McCabe-Sellers *et al*., 2004; Scallan *et al*., 2011) have hinted that children under five (5) years, the aged, and pregnant women as well as the already sick people usually endure massive sufferings from foodborne diseases than other segments of the population, and this has galvanized much concern and attention over

food safety from governments and the international community, more recently. Today, there is a mainstream consensus by the international community to approach food safety as a more central issue of food and nutrition security, politics, international trade, economic development and environmental sustainability (Wertheim-Heck, 2015; WHO, 2015). Consuming contaminated foods has enormous impacts on public health and the economy of nations (Grace, 2015). In Europe alone, outbreaks of foodborne diseases recorded in 2011 were 5,262, causing 43,473 human cases, 4,695 resulted in hospitalizations and 25 deaths (EFSA, 2012). In Ghana, cholera outbreaks are endemic, often resulting in loss of productive and healthy lives and millions of dollars for government to manage them. The Ministry of Food and Agriculture (MoFA) and the World Bank (WB) (2008) further state that foodborne disease outbreaks result in 420,000 hospitalizations each year, and at a cost of US$ 69 million.

With reference to trade, foodborne disease outbreaks are also associated with reduced volumes of export (Grace, 2015), and according to the author, the fixed costs of meeting standards tend to favour established exporters and leads to a greater reduction in developing-country exports relative to those in developed countries, and producing sub-standard foods can lead to rejections and high economic loss (Unnevehr & Ronchi, 2014). In 2015, vegetables from Ghana were rejected by the European Union (EU) markets because they failed to meet safety standards, resulting in loss of revenues (Ghana News Agency (GNA), 2015).

Food safety has become a major consumer problem recently, and many people are now afraid of food poisoning (Grunert, 2005; Jappar *et al*., 2010). In developing countries, malnutrition, food insecurity and poverty are challenges most closely linked to food safety and related diseases (IFPRI, 2009; WHO, 2015). Thus, a greater percentage of

their population lacks access to clean water (Fletcher *et al*., 2014), a challenge that leads to waterborne diseases. There is also elevated level of hazards, some largely resulting from wrong pesticide applications and the use of poor quality water (e.g., wastewater), and the use of human or animal waste in food production is common (Grace *et al*., 2010; Nguyen *et al*., 2007), and even poor hygiene and sanitation, especially in the home are a major cause of foodborne diseases (FAO, 2015). According to the FAO (2015), 30-40% of the foodborne disease outbreaks reported annually arises from poor hygiene in the home. Also, many poor countries have large informal sector operating in their food chain with relatively little organization, making management and monitoring difficult (Grace, 2015; Ordonez, 2016). Lack of affordable technology and infrastructure, as well as lack of certification schemes and information labels affect food safety supply in developing countries (Ordonez, 2016).

There are also public-sector failures resulting from inadequate policy and legislation, multiple organizations with overlapping mandates, outdated, fragmentation of missing legislation, inappropriate alignment of standards, failure to cover the informal sector, limited civil society involvement and limited enforcement affect food safety regulations (Grace, 2015), and developing countries' consumers have also shown low knowledge of health-related risks in general, and food safety threats (Ordonez, 2016). This lack of awareness and knowledge about food safety hazards also implies impediments of consumers to exert pressure on producers demanding that resources be devoted to producing safer foods.

2.1.1 Pesticide Use in Vegetable Production

Pesticides are agricultural inputs that enable farmers to control pests and weeds (Kateregga 2012; Skevas *et al*. 2013; Jansen & Dubois 2014). Pesticides were

introduced in the world after the World War II for their various benefits but the general worldwide intensive usage now poses potential hazards to the environment and human health (Chambers *et al*., 2001). The health effects of pesticide use have become one of the major public health problems worldwide because incidences of pesticide-related health impairments have increased (Macharia, 2015). Pesticide residues in vegetables have been found to be harmful to human health particularly when they are freshly consumed (Baig *et al*., 2009; Chen *et al*., 2011; Solecki *et al*., 2005). In developing countries, pesticide poisonings alone remain the cause of 150,000 deaths annually (Vidogbena *et al*., 2015a).

In humans, diseases such as headaches and nausea are known to be acute symptoms to pesticide exposure (Antle & Pingali, 1994; Chowdhury *et al*., 2012), whereas diarrheal infections are known to be acute symptoms to microbial pathogen exposure (WHO, 2006). Also, cancer, reproductive defects (Bassil *et al*. 2007), developmental impairment, immunotoxicity (Berrada *et al*. 2010), birth defects and endocrine disruption have been cited as associated symptoms of pesticide poisoning (Longnecker *et al*., 1997). Ntow *et al*. (2006) estimated that a total of 23 pesticides are used in vegetable production in Ghana (Table 2.1).

Table 2. 1: Types of Pesticides Used in Ghana

PESTICIDE TYPE	ACTIVE INGREDIENT	CHEMICAL GROUP
Herbicide (44%)	Pendimethalin	Dinitroaniline
	2, 4 - D	Aryloxyalkanoic acid
	Propanil	Anilide
	Oxadiazon	Oxadiazole
	MCPA – thioethyl	Aryloxyalkanoic acid
	Oxyfluorfen	Diphenyl ether
	Bensulfuron-methyl	Sulfonylurea
	Glyphosate	Alycine deriuntive
	Paraquat dichloride	Bipyridylium
	Acifluorfen	Diphenyl ether
	Metoachlor	Chloroacetamide
	Phenmedipharm	Carbamate
Fungicide (23%)	Mancozeb	Carbamate
	Metalaxyl-M	Acelalanine
	Thiophanate methyl	Benzimidcizole
	Carbendazim	Benzimidcizole
	Benomyl	Benzimidcizole
Insecticides (33%)	Lambda cyhalothrin	Pyrethroids
	Chlorpyrifos	Organophosphate
	Endosulfan	Organochlorine
	Dimethoate	Organophosphate
	Cypermethrine	Pyrethroid
	Deltamethrine	Pyrethroid

Source: Ntow *et al*. (2006)

2.1.2 Wastewater Use in Vegetable Production

Access to clean water for agriculture is important to meet the growing food demand (Haddadin, 2001). However, access to treated (clean) water is a challenge even for domestic consumption, hence farmers resort to the use of poor quality source of water such as wastewater. Wastewater is regarded as the cheapest source of irrigation water (Drechsel & Evans, 2010). It is believed that the growth in the use of untreated wastewater for vegetable production in urban areas of a country is driven by high urban population growth and the resultant demand for fresh vegetables as well as the general water scarcity and degradation (WHO, 2006).

Wastewater increases agricultural output and reduces water costs while farmers and consumers are exposed to a health risk from contact with an unclean source of water supply (Redwood, 2004). It is estimated that 200 million hectares of productive vegetable lands are irrigated with raw sewage or partially treated wastewater in the world (Nabulo *et al*., 2008). Karanja *et al*. (2010) mentioned that the public health risks associated with wastewater irrigation include physical injuries while irrigating and /or sourcing the water, organic and heavy metal contamination from industrial activities. Wastewater used for irrigation has often been shown to contain microbiological contaminants exceeding the WHO guidelines (Blumenthal *et al*., 2000; WHO, 2006).

2.1.3 Vegetable Safety in Ghana

In Ghana, the use of pesticides is particularly high in the production of high-value cash crops and vegetables (Gerken *et al*., 2001). The prevalence of pests and diseases is a major constraint to vegetable production in Ghana because of favorable climate, but this requires intensive effort in their management to avoid contamination through the excessive use of pesticides (Ntow *et al*., 2006). Evidence shows that the application of pesticides is not very satisfactory (both in type, interval and volume protocols) (Afari-Safeh *et al*., 2015). In Ghana, only 10% of wastewater for vegetable irrigation is also treated (Qadir *et al*., 2010). The frequent use of pesticide and untreated wastewater results in the accumulation of chemical residues, microbial pathogens and heavy metals in vegetables. Armah (2011) detected high levels of allethrin and ethoprophos above maximum residual limit (MRL) for cabbage in Ghana. Essumang *et al*. (2008) detected high levels of lambda-cyhalothrin, chlorpyrifos, fenitrothion and cypermethrin residues in tomatoes from Kumasi and Cape Coast, Ghana to be above their respective MRL.

Also, chlopyrifos (Dursban) was detected on 78% of the lettuce, lindane (Gamalin 20) on 31%, endosulfan (Thiodan) on 36%, lambdacyhalothrin (Karate) on 11%, and dichloro-diphenyl-trichloroethane on 33% above the maximum residual limit for consumption. Keraita *et al*. (2003) conducted a market survey in Kumasi, Ghana on vegetables and found that majority of the vegetables were contaminated with faecal coliforms and enteropathogens such as Salmonella and Shigella organisms. Obuobie *et al*. (2006) reported that both faecal coliforms and helminthes contamination of vegetables (lettuce, cabbage and spring onions) produced and marketed in the various cities using wastewater, exceeded the WHO recommended levels in Accra, Kumasi and Tamale.

2.2 Knowledge Theories

Product purchase decision-making process is based on the knowledge of the product. Knowledge is acquired through a variety of ways such as information sharing, education and familiarity (experience). Knowledge is defined as a complex process of remembering, relating, or judging an idea or abstract phenomenon (Gotsch *et al*., 2012). Brucks (1985) explained that one's knowledge can be measured from either the objective, subjective or prior experience perspectives. Objective knowledge (OK) refers to how much the individual knows about a concept whereas subjective knowledge (SK) refers to what the individual thinks s/he knows about the concept under study. On the other hand, prior experience (PE) refers to consumers' knowledge based on the purchase or usage of the product.

This distinction provides a common ground for maintaining contextual clarity of the concept to eliminate ambiguity. This is because, Moorman *et al*. (2004) were of the view that OK is accurate information the individual possesses about an idea or event.

On the other hand, SK refers to consumers' self-beliefs about their own knowledge. In principle, OK depends on one's ability or expertise; SK is based on expertise and experience as well as other factors (Alba & Hutchinson, 2000). This study combines both SK and OK by measuring the degree of knowledge (thus, with regards to what consumers think they know (SK) and what consumers actually know (OK) (Flynn & Goodsmith, 1999). There is also a breaking middle ground where the consumer is neutral (not sure) in his or her answer. So, the Likert-scale can measure both SK and OK (see Owusu & Anifori, 2012).

Selnes & Gronhaug (1986) argued that OK measures the confidence one has in his or her answer to the phenomenon under study. However, the authors argued that SK rather has a strong motivation to explaining consumer purchase behaviour than OK. Brucks (1985) asserted that OK has a strong positive effect on the number of attributes considered by an information searching consumer. How much knowledge one has about food safety might affect WTP positively or negatively. In conclusion, knowledge can be built into perceptions, which can also have a sweeping or giant effect on WTP, and therefore, it is also important to explain the various dimensions of perceptions.

2.3 Perception Theories

Goldsmith *et al*. (2006) argued that the human psyche is a very complex process because it involves not only the economic factors but also the emotional and social factors, making it very difficult to provide an adequate concept of consumer perception. However, Kauffman (1996) explained that the success or failure of a marketable product or service is directly related to the human psyche and their preference. Hentschel *et al*. (1986) defined perceptions as an event over time rather than as an instantaneous reaction to outside stimulation. Consumers' perception of food safety can

be defined as sensory thinking (or thought) in which they perceive and form the opinion about the merchandise (products) and the companies (producers/vendors) based on sensory stimuli before deciding to buy.

Consumer perceptions relate to human subjectivity that ultimately determines preferences based on which purchasing and consumption decisions are made (Verbeke *et al*., 2007). In addition, the authors represent the consumer perception as a minor, which can reflect, distort or deflect the information; this concept is extended to risk perception which can be seen in the same perspective. Blank (2013) explained between three types of consumer perception theories, namely self-perception, price perception and perception of benefits. The self-perception theory explains how individuals form an understanding of the motivations behind their own behaviour and whether their buying behaviour has health and environmental impacts. For example, consumers who view themselves as socially conscious tend to place more weight on issues such as environmental impact when making buying decisions than consumers who do not hold similar views of themselves. Bem (1972) attempts to explicate how an individual interprets his own behaviour, how he assigns meaning to that behaviour, and under what conditions the individual accepts experiential information as valid and worthy of incorporation into his attitude and behaviour set. The self-perception theory which is referred to as a feedback loop is often discussed theoretically and neglected empirically.

The price perception theory on the other hand explains the situation in which consumers consider the quality of the merchandise and the value of money. Janiszewski & Lichtenistein (1999) argued that with regards to the price perception, the consumer compares a certain market price of the product to an internal reference price when

judging the attractiveness of the product. However, Thaler (1985) argued that the measure of transaction utility depends on the market price the individual pays compared to the reference price. The reference price is then hypothesized to be the norm that serves as a neutral point for comparison, such that prices below it is evaluated as low (relatively inexpensive) and prices above it is evaluated as high (relatively expensive) (Kalyanaram & Winer, 1995; Grewal *et al*., 1998; Thaler, 1985; Winer, 1988). Winer (1988, p.35) analyzed price perception denoting p^o by the observed market price and p^r by individual's internal reference price. It is believed that positive values of $(p^o - p^r)$ mean negative perceptions while negative values of $(p^o - p^r)$ mean positive perceptions. It is argued that price perception, which is the difference between the market price and the reference price is directly related to consumers' overall satisfaction for a product (Jiang & Rosenbloom, 2004).

Jiang & Rosenbloom (2004) maintained that price of a product is an attribute of performance. Voss *et al*. (1998) found that price perceptions do affect satisfaction in an experimental setting involving a hotel check-in scenario. Fornell *et al*. (1996) also found that price perceptions affect customer satisfaction in a macroeconomic study involving seven industry sectors. Grewal *et al*. (1994) cited that new product's price affects consumers' perceptions of risk, and that the influence of price on consumers' perceptions of performance risk is greater when the message is framed negatively or the credibility of the source is low. In addition, the results support the prediction that the effect of price on consumers' perceptions of financial risk is greater when the message is framed positively.

The benefit perception theory relates to a situation in which consumers are concerned with how much benefit the product may offer. Saba & Messina (2002) observed that

the benefit perceptions are the benefits that individuals expect to get from the product. In theory, perceptions are shaped by knowledge, which itself is a product of exposure to sources of information and personal willingness in obtaining information (Wilcock *et al*., 2004).

2.4 Theory of Utility-Maximization and Consumer Preferences

This section of the literature review relates to the theoretical framework of consumer choice problem. Economists rely on the concept of preferences and utility-maximization models to explain WTP. Both WTP and market preference are choice problems, and require that they are well-grounded on the Theory of Utility-Maximization. The CVM and CE methods derive their theoretical foundation from the traditional theory of consumer utility problem or the Lancaster demand theory (Lancaster, 1966) but the CE model has its roots in both. has also been employed to consumer choice problem, in relation to products having several attributes. For example, the Lancaster Demand Theory analyzes consumer choice problem as embodiment of several attributes. Thus, a good (in a whole) per se does not give a utility to the consumer but the attributes or characteristics it possesses do.

More so, according to Lancaster (1966), goods can possess multiple attributes which can be shared by multiple goods, and that goods in aggregate can possess characteristics different from those pertaining to the goods separately. Following Lancaster (1966), a product can be viewed as having several attributes such as freshness/appearance, nutrition, process attributes and informational attributes (e.g., certification and labelling), but the presentation of a good in its "wholeness" such as that of the present study best fits the traditional Theory of Utility-Maximization.

The microeconomic theory of utility-maximization suggests that the consumer has certain restrictions (budget constraint) though he or she acts reasonably to maximize his or her utility (Ahlersten, 2008). The theory of utility-maximization assumes that the consumer purchases a good based on the satisfaction he hopes to derive from it. The solution to the individual's utility function starts by maximizing his or her utility as follows:

$$\mathrm{U} = \mathrm{u}_0(xq) \quad \textbf{(2.1)}$$

s.t.

$$p_x x + p_q q \leq B \quad \textbf{(2.2)}$$

$p_x x + p_q q = B$ (under non-satiation condition)

where U is the attainable utility, x and q are a vector of market goods and B is the consumer's budget given prices p_x and p_q for good x and q. The affordable alternatives are the set of bundles that satisfy the consumers' budget B and a vector of prices. Solving the constraint problem in equation 2.1 and 2.2 yields the following demand function (equation 2.3) and the direct utility function (equation 2.5) that gives rise to the indirect utility function.

$$x_i = h(p, q\, y), \quad i = 1, \ldots, n$$

(2.3)

$$v_i = v_o[h(p, q\, y)]$$

(2.4)

Note that equation 2.4 is the indirect utility function that gives the maximum utility attainable at given prices and income such that:

$$\mathrm{U}^1 = \mathrm{v}(p, q^1\, y) > \mathrm{U}^0 = \mathrm{v}(p, q^o\, y) \quad \textbf{(2.5)}$$

Equation (2.5) can be decomposed into two main measures of utility, which are the Hecksian Compensating Variation (CV), thus, equation (2.6) and the Equivalent Variation (EV), thus, equation (2.7). The two equations are measures of welfare changes.

$$\mathrm{v} = (y - WTP, q^{1}) = \mathrm{v}(p, q^{o}\ y)$$

(2.6)

$$\mathrm{v} = (y + WTP, q^{0}) = \mathrm{v}(p, q^{1}\ y)$$

(2.7)

where v is the indirect utility, y is the disposal income, q^{1} is new quantity demanded, q^{0} initial quantity demanded, p is the price of the commodity in question and WTP willingness to pay. Note that equation 2.6 is appropriate for measuring WTP whilst equation 2.7 is appropriate for measuring WTA.

2.5 Conceptual Framework

WTP derived from economic valuation methods obtained their root from the theory of consumer behavior under the subject of economic valuation.

2.5.1 Valuation of Food Safety

Viegas (2013) provides a non-market definition of food safety as a food attribute or a food product that might be valued by consumers, but are not traded on the market yet. Also, their unavailability in private markets makes them possess a public good character. Public goods are characterized by the features of non-exclusivity and non-rivalry. Thus, one consumer cannot prevent another consumer from having access to the good in question, and the consumption of the good in question by one consumer does also not reduce the availability for others. Such goods are products of a “free riding situation” where one benefits from the good without paying for it. Lagerkvist &

Hess (2011) noted that in such situations producers might not reap the benefits of using costly methods to provide the good in the market for consumers. So, normally public interventions are required to guarantee the desired levels of provision that matches society's demand (Hart *et al*., 2011; Harvey & Hubbard, 2013), because markets are unwilling to supply the levels of desired food safety by society (Viegas, 2013).

According to Viegas (2013), safer foods are income inelastic. The demand for safer foods increases as income increases, and consumers are willing to pay more for it. In short, food safety is a normal good. Markets would provide safer foods at higher prices compared to the ordinary ones for consumers, so it is price inelastic as well. Viegas (2013) stressed that when market forces operate in the food safety market, food safety possesses a more private character without having the characteristics of a public good such as, non-rivalry and non-excludability.

Economic valuation is a concept used to assess the value that individuals place on non-market goods and services. Economic valuation can be defined as the process of assigning monetary values to non-market resources, goods and services, especially where market normally fails to value them (Pearce *et al*. 2002). Example of non-market products and services include waste, pollution, air, organic food, green food, etc. are examples of goods that are value in the natural environment. Economists and decision-makers rely on economic valuation to optimize environmental or private goods, in my study safer vegetables by placing monetary values on such goods or services that usually have limited or no market. Thus, in reality, these goods may exist but market fails to value them. In some sense, it may not be perfectly done, but economists usually say that no valuation can be invariably worse than some valuation (Pearce *et al*., 2002). Valuation can help researchers reveal the true cost and benefit arising from the use

environmental resources. Valuation measures individual's preferences either for or against an environmental change; and is rapidly employed various in disciplines such as environmental economics, welfare economics, health economics, econometrics and microeconomics (Haab & McConnell, 2003).

The economic value of any good or a service is generally measured in terms of what resource users or the society at large are willing to pay for that commodity, minus what it costs to supply it. Where an environmental resource simply exists, and products and services are supplied at no cost, then it is our willingness to pay alone which describes the value of the resource in providing such commodities, whether or not actual payments are made. It can be said that the underlying factors why individual's will place monetary values on safer vegetables lie within health, nutrition, taste, and environmental friendliness. For example, individuals may be asked to state how much money they would be willing to pay for the reduction in risks of food, avoidance pollution, and waste (Pearce *et al*., 1992). Economic valuation is the tool for assigning monetary values to non-market goods (Bateman *et al*., 2002). Non-market goods are evaluated either using stated preference methods (SP) or a revealed preference (RP) methods. RP methods value individuals' preferences through the analysis of real (actual) behavior in markets that are related to the good of interest (Hole & Svensson, 2016). Viegas (2013) further argued that RP methods seek to verify whether the demand for non-market good under valuation has effects on the associated goods' markets. The various forms of RP methods are described below:

Travel cost method- This method estimates the demand for sites using travel costs, which are considered to reveal the individuals' WTP for those sites. Time and money

spent on visits leave trail of indirect evidence about the WTP for the services and amenities provided.

Hedonic price method- The hedonic price method estimates demand for non-market goods through demand and prices of multi-attribute market goods which include non-market goods as attributes versus others that do not include them (for example, Housing).

Averting behavior- It estimates the monetary value of a public good by observing the demand (and associated costs) for goods and services that avoid the loss of that public good (for example, demand for water filters that ensure water safety).

On the other hand, SP methods are based on individuals stated choices in hypothetical market scenarios (Hole & Svensson, 2016). Bateman *et al*. (2002) mentioned that SP methods ask individuals how much economic value the non-market goods has, by measuring how they would behave in a hypothetical market situation (Viegas, 2013). There is unavailability of data on safer vegetables so the use of RP methods in this study is not possible.

The SP method is employed because market failures would continue to exist if food safety is not valued. Policy-makers may not also be well informed about food safety concerns among consumers. The SP methods offer flexibility in creating specific markets of interests and allow the researcher to control the decision alternatives (Hole & Svensson, 2016). Regarding food safety, SP approaches have been used to evaluate a wide range of food safety attributes, (e.g., see Anyam *et al*., 2013; Sundström & Andersson, 2009; Yahaya *et al*., 2015). There exists a wide range of different SP

methods but the contingent valuation method (CVM) dominates in eliciting individuals' WTP (Bateman *et al*. 2002). The various SP methods are described below:

Contingent valuation (CVM)- It uses hypothetical markets to ask individuals' WTP for changes in quality or quantity of goods and services. It uses a general verbal (sometimes graphical) scenario followed by a WTP question.

Choice experiments (CE)- It uses hypothetical markets to make individuals choose from a choice set comprising goods representing different combinations of the same attributes. One of the attributes is a price variable. The repeated choices of favoured goods in a set allow for indirect derivation of WTP.

Contingent rating- Contingent ranking uses hypothetical markets to make individuals rank goods in a choice set comprising goods representing different combinations of the same attributes. Contingent rating uses hypothetical markets to make individuals rate goods in a choice set comprising goods representing different combinations of the same attributes.

Conjoint analysis- It is a more general designation for marketing research exercises, including some of the above methods (i.e. contingent rating and ranking).

2.5.2 Contingent Valuation

This section forms the conceptual framework of the study for eliciting consumers' WTP. The CVM is the most common and reliable approach to estimating the non-use values, and the existence value of public goods (Davis, 1963; Mitchell & Carson, 1989; Carson & Groves, 2007). The CVM involves asking individuals, in a survey or in experimental settings, to reveal their personal valuations of increments or decrements in unpriced goods by using contingent markets (Mu, 1988). The CVM is theoretically

founded in welfare and environmental economics. The underlying theory is that respondents are able to translate a wide range of environmental criteria into a single monetary amount representing the total value to them of that particular resource, and the more they value it the more they will be willing to pay for it. As a result of this, contingent valuation is able to measure both use and non-use values of an environmental resource theoretically (White & Lovett, 1999). The use of CVM depends on the assumption that responses to hypothetical markets reflect the choices and the values that would be revealed if there existed an actual market.

Hoyos & Mariel (2010) explained that the CVM is deeply rooted in the neoclassical concept of economic valuation under the framework of utility maximization. The writers placed the origin and developments of the concept in three historical periods; the period of 1943-1989 up to the Exxon Valdex oil spill in Alaska in the United States; covers the origin of the concept as an alternative method to revealed preference methods, especially in the field of the valuation of outdoor recreation. The period of 1989-1992 marked extensive debate on further research of the theory and empirics of the concept and other SP methods for analysing economic value of non-market goods following the Exxon Valdex oil spill in Alaska.

The CVM was given official recognition by the US Water Resources Council as a recommended valuation technique in the late 1970 (Arrow *et al*., 1993; Bateman & Willis, 1999). It also gained political acceptability, especially in the United States as an economic valuation tool; and stimulated the approval of two federal laws; including the Comprehensive Environmental Response, Compensation and Liability Act of 1980, with the purpose of identifying potentially threatened sites and funding their recovery, and its regulatory development of 1986 allowing for the recovery of lost passive-use

values and the use of CVM (Portney, 1994). Beyond the 1990s, the concept has gained a wider recognition and acceptability in academic and political studies in the US and Europe, and more recently in developing countries. The method was initially proposed by Ciriacy Wantrup (1947) and was first developed by Devis (1963) and was further used by scientists including Portney (1994). Grunert (2005) explains that for products not yet on the market, or when actual demand data is not available, consumers' willingness to pay can be measured using methods such as contingent valuation.

The method was initially applied to environmental recreation, but has become popular for valuing all sort of environmental amenities. The specific fields of study for the employment of the CVM include; water quality, freshwater fishing sites, saltwater beaches, environmental amenities, natural preserves, view-related amenities, scenic beauty, endangered species, biodiversity, fish and wildlife recreational values, disposal of toxic wastes, congestion, waterfowl hunting, urban water parks, rural-urban migration, air quality, congestion, waste management, agricultural land, marine mammals, water pollution control programs, environmental quality, air pollution control, public campground use, drinking water, nuclear plant accidents, freshwater pollution, environmental damage, surface coal mine, disposal site selection, health risks, national parks (Mitchell & Carson, 1989).

The CVM has been applied to value organic food products (Sundström & Andersson, 2009; Boccaletti & Nardella 2000; Gil *et al*., 2000; Fu *et al*., 1999). Using CVM to evaluate individuals' WTP for food safety and related issues is to present a hypothetical market scenario and ask them to state or decide on a maximum price that they are willing to pay above the market price of the good either to avoid or reduce a food safety risk. The CVM values environmental goods on two assumptions: by simply asking

respondents one of the following questions, 1) what maximum money are you willing to pay (WTP) for obtaining an environmental benefit? and 2) what maximum money are you willing to accept (WTA) for resoling an environmental deterioration? (Alberini *et al*., 1997).

The name contingent valuation method stems from the fact that the revealed WTP and WTA values are contingent on alternatives presented in the questionnaire (Randall & Stroll, 1983). Since the commodities are "public goods" in nature, market prices which are used in deriving measures for consumer surplus are not available for such goods. The CVM is used as a substitute for the "missing" market, which is used to simulate the market in the sense of eliciting revelation of preferences (WTP or WTA) analogous to those which would have resulted under market conditions (Pethig, 1994).

2.5.3 Survey Instrument and Elicitation Question Formats of the CVM

There are two established questions for eliciting the individual's WTP for an environmental good or service: (1) the open-ended approach (OE) (continuous method), including payment card (PC), which is derived by asking the respondent what maximum amount he is willing to pay each day, month or year for obtaining certain environmental benefits? and the discrete choice (DC) approach (mainly including dichotomous choice (DC) approach). The DC approach also has different elicitation formats, including the single-bounded dichotomous choice (SBDC) and double-bounded dichotomous choice (DBDC).

In the double-bounded dichotomous choice (DBDC) questions, consumers are asked whether they are willing to pay GH₵X price premium for safer vegetables? The 'yes or no' response derived from the first question is then followed by a second question,

which is based on a certain percentage increment in the current price of safer vegetables. The follow-up questions depend on the outcome of the first question. For example, if the respondent says "yes" to the first question (initial bid), the respondent is asked again whether she is willing to pay GH₵Y higher price premium based on the market price? potential response is "yes or no". If the respondent responded 'no' to the first question, she is asked again whether she is willing to pay GH₵X lower price premium based on the market price? potential response is "yes or no"?.

The SBDC was developed by Hanemann *et al*. (1984) and the DBDC was first proposed by Hanemann (1985) and developed by Hanemann *et al*. (1991). The continuous method (open-ended approach) has been used by Angelsen *et al*. (1994), single-bounded choice approach (yes or no question) by Johnson *et al*. (1990), DBDC approach by Lui *et al*. (2009), bidding game by Bateman *et al*. (1995) and the checklist method by Angelsen *et al*. (1994) and Rowe *et al*. (1996). The present study employs three elicitation techniques namely; open-ended; dichotomous choice and the follow-up questions (or DBDC).

In reviewing the effectiveness and efficiency of the various elicitation techniques, Ready *et al*. (1996) noted that the use of the open-ended approach generates lower estimates of WTP than a dichotomous choice format due to the issue of more "yea saying" among DC respondents; though Lui *et al*. (2009) reported that the discrete approach is popular compared with the open-ended approach. In 1993, the National Oceanic and Atmospheric Administration (NOAA) panel gave some important guiding principles about the application of CVM, and NOAA recommended the dichotomous choice approach for eliciting WTP for non-market goods (Arrow *et al*., 1993) which have been evaluated by several studies [1]. One advantage of the open-ended approach is

that it produces continuous data, which can be analyzed using straightforward econometric techniques (such as OLS, Tobit), and also avoid anchoring bias because it does not provide respondents with cues about what the value of the change might be (Pearce *et al*., 2002).

On the other hand, the challenges with the open-ended approach is that it produces zero answers, outliers and a large non-response rates, i.e., unrealistically large bids, and generally unreliable response. In addition, individuals find it difficult to state their true maximum WTP in a hypothetical environment, and for a change they are unfamiliar with, and have never thought of valuing it (Pearce *et al*., 2002). In addition, in terms of mimicking markets, most market transactions involve deciding whether to buy a product at fixed price rather than to state the maximum WTP value.

Pearce *et al*. (2002) reported that the SBDC can simplify the reasoning task (that is, trying to find at what price to offer) faced by respondents and Hanemann *et al*. (1991) also reported that the DBDC produces reliable and efficient estimates compared to the SBDC. The pros and cons of the various elicitation techniques resulted in the use of the three elicitation techniques. In the open-ended approach, the individuals are asked to state how much maximum price (GHS X) they are willing to pay.

The SBDC asks individuals to state whether they are willing to pay a predetermined price and an additional question to elicit respondents' decision on whether to accept a premium or a discount gives rise to the DBDC. The CVM operates on the construction of a hypothetical market in a survey. Questionnaires are designed to elicit consumers' WTP in a survey.

[1] In 1993, the NOAA panel was up in the US to review the CVM due to the controversies surrounding the Exxon Valdez oil spill incidence in the cost Alaska in 1989. At that time, WTP estimates obtained CVM estimates were contested and questioned in court.

The administration of the questionnaire is done by personal interviews (face-to-face), telephone interviews and mail interviews. In reviewing literature, the use of a survey method depends on time, convenience, demographic settings and resource availability.

The present study employs the face-to-face interview because it best fit the socioeconomic context of the study area. Thus, most of the respondents in the study area do not have mailing addresses and are not used to answering questions through the internet. In totality, mailing systems and most communication networks are not reliable in this part of the world. Face-to-face interview has been widely employed in CVM survey, especially in developing countries, where mailing systems and telephone connectivity are weak.

The main advantage of the face-to-face interview compared to the other survey methods is that it can include individuals of varying demographics, most essentially, those with poor reading ability and visual disabilities. Further, the researcher has a lot of control over the survey procedures, and can as well make use of visual aids, such as maps and photographs. It also provides easy avenue for re-explanation, and even more times until the respondent is well informed and satisfied with the concepts being developed by the researcher.

2.5.3.1 Methodological flaws and Correction for CVM Biases

The researcher admits that some controversies surround the use of the CVM so the major potential biases of the CVM were reviewed and practical solutions were searched

for adjustments to be made. In reviewing literature, it is possible for the potential biases to occur due to poor or inadequate survey design and the hypothetical questions that generate hypothetical answers (Boyle, 2003).

In CVM, the first challenge is that both the product and payment in question are hypothetical (Cummings *et al*., 1986). Authors such as Cummings *et al*. (1995), List & Shogren (1998) and Neill *et al*. (1994) argued that in hypothetical market scenarios people tend to overstate or underestimate their WTP. There are four major types of biases in value measure derived from CVM. These are starting point bias, hypothetical bias, information bias, information bias and strategic bias.

2.5.3.2 Strategic Bias

According to Mitchell & Caron (1989), strategic bias involves the effort to influence the level of provision of the environmental good by stating artificially higher or lower prices. This is mostly encountered in "free riding" situations where the individual thinks his actions may or may not influence the policy change regarding the environmental resource provision (Jakobsson & Dragun, 1996). Jakobsson & Dragun (1996) reported that strategic bias occurs if the respondent intentionally misleads the researcher. Pethig (1994) also said that the strategic bias occurs from a deliberate attempt by the respondent to influence either their payment obligation or the level of the provision of the environmental good through the stated valuations. In another argument, Hao (2008) was of the view that since the survey itself may serve as an incentive to the respondent to influence the policy, he or she may deliberately not answer the WTP questions with truth; but only answers to influence the decision-making process. However, Brookshire *et al*. (1976) conducted a hypothetical test for strategic bias by inspecting the bias. The idea behind this test is that the true bids meet

the assumption of normality of the mean; such that the strategic behavior will serve to flatten the distribution since understated and overstated bids will increase the variance in this case (Hao, 2008).

To avoid or limit strategic bias, Jakobsson & Dragun (1996) recommended that during the survey process, the researcher should provide adequate and realistic description of the environmental good to be valued and the policy scenario. Secondly, the researcher should make it clear to the respondent that his decision is not likely to influence policy directly if the product is to exist in the real world. This was however, done in the present study. Thus, cheap talk is suggested. These recommendations were taken in the present study.

2.5.3.3 Information Bias

In the CVM, both the product and the market are created in words by the researcher rather than existing. The information about the properties of the product and market such as the status quo, the alternative products and the payment vehicle provided to the respondent is equivalent to the creation of different market scenarios (Hao, 2008). Willis (1996) reported that biases will be introduced by the information provided since the responses come from the different markets provided. Jakobsson & Dragun (1996) noted that the way in which the CVM question is framed and the relevance of the information provided to the respondent for decision-making is of major concern in the survey process.

Information bias arises from: 1) the effect of information on the costs and values of the good, and 2) changes in the information provided to the respondent about the good (Ready & Hu, 1995). Respondents can use the information to form perceptions about

the good, depending on how the information was communicated (Hao, 2008). CVM design is important to reduce information bias (Hao, 2008). More so, the provision of adequate, clear and meaningful description of the environmental good will reduce information biases (Ready & Hu, 1995; Green and Tunstall, 1999). To reduce information bias, visual aids and cheap talk discussing the current status quo of the project and alternative project to ascertain the respondent knowledge can be useful.

2.5.3.4 Starting Point Bias

The dependence of CVM values on the initial value is called starting point bias (Hao, 2008). This may be a problem of the elicitation format where the respondent uses the initial price to make his or her decision. It occurs when an initial price is adjusted either upward or downward until the respondent agrees on the stated value (mostly occurs in dichotomous choice, follow-up choice or bidding game) (Hao, 2008). From two points of view, the initial price settings (starting bids) first mislead the respondent; and secondly, if the respondent values "time" highly, irritation might set in with any lengthy iterative bidding process. The use of payment cards can reduce starting point bias. Jakobsson & Dragun (1996) maintained that choosing the initial bid at random can avoid starting point bias. The present study used random starting prices generated from average market prices.

2.5.3.5 Hypothetical Bias

Loomis & Santiago (2013) defined hypothetical bias as the difference between what a person indicates they would pay in the survey or interview and what a person would actually pay. In other words, hypothetical bias in surveys reflects the old saying that "there is a difference between saying and doing." To measure hypothetical bias is difficult for public good than a private good. In private good experiments, respondents'

maximum WTP may be truncated by their assessment of the price for which some similar good sell in the market (Harrison, 2006; Harrison *et al*., 2004). Loomis & Santiago (2013) provides four major survey design approaches to reduce the bias: (1) put emphasis on the consequentiality of the survey and respondents' choices; (2) urge respondents to be honest and to act as though they really had to pay here and now; (3) use cheap talk approaches, which explicitly communicate the problem of hypothetical bias to respondents; (4) reduce social desirability bias, the tendency to give answers that the respondent considers to be socially acceptable or what they think the interviewer wants to hear.

The present study used the cheap talk approach and the honesty from the respondent to minimize the bias. According to Cummings & Taylor (1999) a "cheap talk" approach confronts the problem of hypothetical bias by telling respondents that participants in past surveys have been shown to overstate their WTP. These suggestions were employed by the study.

2.5.4 CVM versus Choice Experiment

The use of the any economic valuation method depends on the characteristics of the good or service under study (Buzby *et al*., 1995). The CVM and CE are the widely-used methods for eliciting individual's WTP for environmental or private goods but CE are much less employed than CVM (Hanley *et al*., 1998). Both the CVM and CE use stated preference data. Both methods ask respondent to express their preferences by choosing between a current status quo and an alternative project in a hypothetical market scenario (Mitchell & Carson 1989; Naidoo & Adamowicz 2005). However, the CVM is more suited for evaluating a good in its wholeness while the CE evaluates a good as a bundle of attributes. CVM generally conforms to the traditional view of

random utility theory while CE conforms to both the random utility theory and the Lancasterian approach to consumer theory (Henemann, 1984; Lusk *et al*., 2004; Carson *et al*., 2007), because the CE involves constructing multiple scenarios, presenting a choice set and asking respondents to choose the preferred option among different alternatives described by various attributes and prices (Naidoo & Adamowicz 2005).

In the CE, respondents are asked to choose between different consumption bundles, described in terms of their attributes and the levels taken by the attributes (Mitchell & Carson, 1998). In CE, choice sets are usually defined such that attribute levels are kept perfectly orthogonal across choices (Harley *et al*., 1998). With CE, it is easier to disaggregate values for environmental resources into values of the characteristics that best describes the resource than CVM (Willis & Garrod, 1995). Secondly, CE avoids part-whole bias problem of CVM since different levels of the good can be easily built into the experimental design (Hanley *et al*., 1998). Thirdly, CE avoids "yea-saying" problem encountered in DC of the CVM (Adamowicz *et al*., 1998).

One strength of the CVM is that it is grounded in the theory of welfare economics; thus, people will pay more if they get greater utility or welfare (Buzby *et al*, 1995). Secondly, hypothetical scenario can be built for any market of interest. CVM's results validity has been questioned in part due to hypothetical responses, i.e. there is little incentive for respondents to truthfully reveal their WTP (Grunert *et al*., 2005), but the CVM is best suited for valuing overall policy package while the CE is appropriate for valuing specific attributes of the project (Hanley, *et al*., 1998). This study evaluates respondents' preference for safer vegetable attributes as wholeness attributes rather than a bundle of attributes, hence the CVM is chosen over CE. In the present study, there are two types of goods; one already on the market (referred to as conventional

products) and the one with enhanced qualities (thus, a hypothetical good and yet to be introduced into the market.

2.5.5 Modelling WTP

WTP refers to the economic value of a good to an individual under given conditions (Gunatilake *et al*, 2007). WTP values have been estimated using several econometric models, depending on the type of data. Generally, there are three ways in which WTP can be elicited using contingent valuation. The first one is via open-ended questions. In this case the individual is asked how much he/she is willing to pay for a good or service that has been previously described along with a hypothetical scenario. Another approach is to use payment cards; the individuals are presented with a series of amounts for possible payments and they chose the one that is closer to their individual valuation. The last approach is to use dichotomous choice questions. If the values are largely continuous, the OLS or Tobit models may be used depending on the limit of zero observations (This type of data are usually obtained from an open questions or payment cards). For binary response data, the probit or logit models may be employed because the options available are yes or no (this data are popularly obtained from SBDC). For multiple categorical response data of unordered nature, the multinomial or conditional logit might be used (this data may be obtained from payment cards). Ordinal responses obtained from DBDC- stimulate the use of ordered regression models.

Boccaletti & Nardella (2000) and Loureiro & Umberger (2003) employed binary regression models to analyze Yes/No WTP responses. Loureiro & Umberger (2007) obtained three unordered choices and used the multinomial logit model to analyze willingness-to-pay for meat attributes in labeled ribeye beef steaks. Loureiro *et al*.

(2002) employed the ordered regression model to estimate consumers' WTP for eco-labelled apples from double-bounded dichotomous responses. The ordered regression models have also been employed by Boccaletti & Moro (2002), Misra *et al*. (1991), Cranfield & Magnusson (2003) to consumers' WTP for food safety and related products.

Unlike the OLS regression models, choice models have formidable roots in utility theory, and are analyzed as probability functions. One of such is the Random Utility Models developed by McFadden (1973), which decomposes consumers' direct utility problem (stated preference) (U) into two components: the deterministic component and the stochastic component, which is measurement errors arising from omitted attributes, discrimination errors and unmeasured preferences (McFadden, 1986) as in equation 2.8.

$$U_{ij} = x_{ij}' \beta + \varepsilon_{ij} \qquad \textbf{(2.8)}$$

where U_{ij} = utility of consumer i for product j, $x_{ij}' \beta$ = deterministic component of utility and ε_{ij} = stochastic term. The possibility to select only one of two options is at the foundation of the concept of choice problem and renders this framework consistent with demand theory (Louviere *et al*. 2005). From equation 2.8, for consumer i with a choice set represented by c_{ij}, alternative j will be chosen over alternative k only if the utility provided by alternative j is higher than k. This can be expressed as follows:

$$U_{ij} > U_{ik}, \qquad j \neq k; \qquad j,k \in C_{ij} \qquad \textbf{(2.9)}$$

In other words, the probability of individual i choosing alternative j over alternative k is equal to the probability that the utility derived from j is greater than that from k. This can be formally expressed as follows:

$$\Pr(U_{ij} > U_{ik}) = x_{ij}'\beta + \varepsilon_{ij} >, x_{ik}'\beta + \varepsilon_{ki} \qquad j \neq k; \quad j,k \in C_{ij} \tag{2.10}$$

and this may represent a binary or ordered discrete choice and the underlying error term can have normal or logistic distribution.

Modelling dichotomous choice question

Using the dichotomous choice model, simply models a dichotomous answer ($y_i = 1$ if the individual's answer is yes and $y_i = 0$ if the individual's answer is no). First, if we assume that the individual decision is inherently observed, then we to estimate the latent WTP as a linear function:

$$y_i^*(x_i, \varepsilon_i) = x_i'\beta + u_i \tag{2.11}$$

where x_i is a vector of explanatory variables, β is a vector of parameters and u_i is an error term. It is assumed that the individual will answer yes (coded 1) when the latent y_i^* is greater than the suggested amount, i.e., when $y_i^* > \gamma_i$. In other words, observed WTP $(y = 1)$ is observed when $y_i^* > 0$ and $y = 0$ when $y_i^* \leq 0$. In that case, the probability of observing a positive response given the values of the explanatory variables is given by:

$$\begin{aligned} \Pr(y = 1 \mid x) &= \Pr(y_i^* > \gamma_i) \\ &= \Pr(x'\beta_i + u_i > \gamma_i) \\ &= \Pr(u_i > \gamma_i - x'\beta_i) \end{aligned}$$

(2.12)

Modelling dichotomous question with Follow-up Questions

In this case the dependent variable assumes ordinal values. We can assume that the individual's choice is related to his or her utility as follows:

$$
\begin{aligned}
&y = 0 \quad if \quad 0 > \mathrm{U} \\
&y = 1 \quad if \quad 0 < \mathrm{U} < \gamma_1 \\
&y = 2 \quad if \quad \gamma_1 < \mathrm{U} < \gamma_2 \\
&y = 3 \quad if \quad \gamma_2 < \mathrm{U} < \gamma_3 \\
&y = 4 \quad if \quad \gamma_3 < \mathrm{U}
\end{aligned}
$$

(2.13)

Where U is the utility and y is the consumer WTP for food safety, and values are the threshold parameters or the cut-off points linking the consumer utility to WTP. The probability of observing each ordered choice is given as follows:

$$
\begin{aligned}
&\Pr(y = 0 \mid x_i) = \mathrm{F}(-x_i'\beta) \\
&\Pr(y = 1 \mid x_i) = \mathrm{F}(\gamma_1 - x_i'\beta) - \mathrm{F}(-x_i'\beta) \\
&\Pr(y = 2 \mid x_i) = \mathrm{F}(\gamma_2 - x_i'\beta) - \mathrm{F}(\gamma_1 - x_i'\beta) \\
&\Pr(y = 3 \mid x_i) = \mathrm{F}(\gamma_{31} - x_i'\beta) - \mathrm{F}(\gamma_2 - x_i'\beta) \\
&\Pr(y = 4 \mid x_i) = 1 - \mathrm{F}(\gamma_3 - x_i'\beta)
\end{aligned}
\qquad \textbf{(2.14)}
$$

The factors which are likely to influence the probability of WTP price premiums are summarized in the figure below (Figure 2.1): these factors include personal and household characteristics, for example age, income, employment status, food consumption (shopping habits and food expenditure). The conceptual framework for examining the factors influencing WTP, also demystify the factors of consumer preference for market outlets. The full line establishes the relationships between WTP and the independent variables (discussed in Section 2.6.2.1) and the dotted line shows the effect of one variable over the other. Knowledge and perception of food safety, trust, preference for quality and safety cues and place of purchase are likely to

influence consumers' WTP whereas knowledge and perception of food safety, trust, preference for quality and safety cues and socio-demographic and economic factors in turn affect consumers' place of purchase of fresh vegetables.

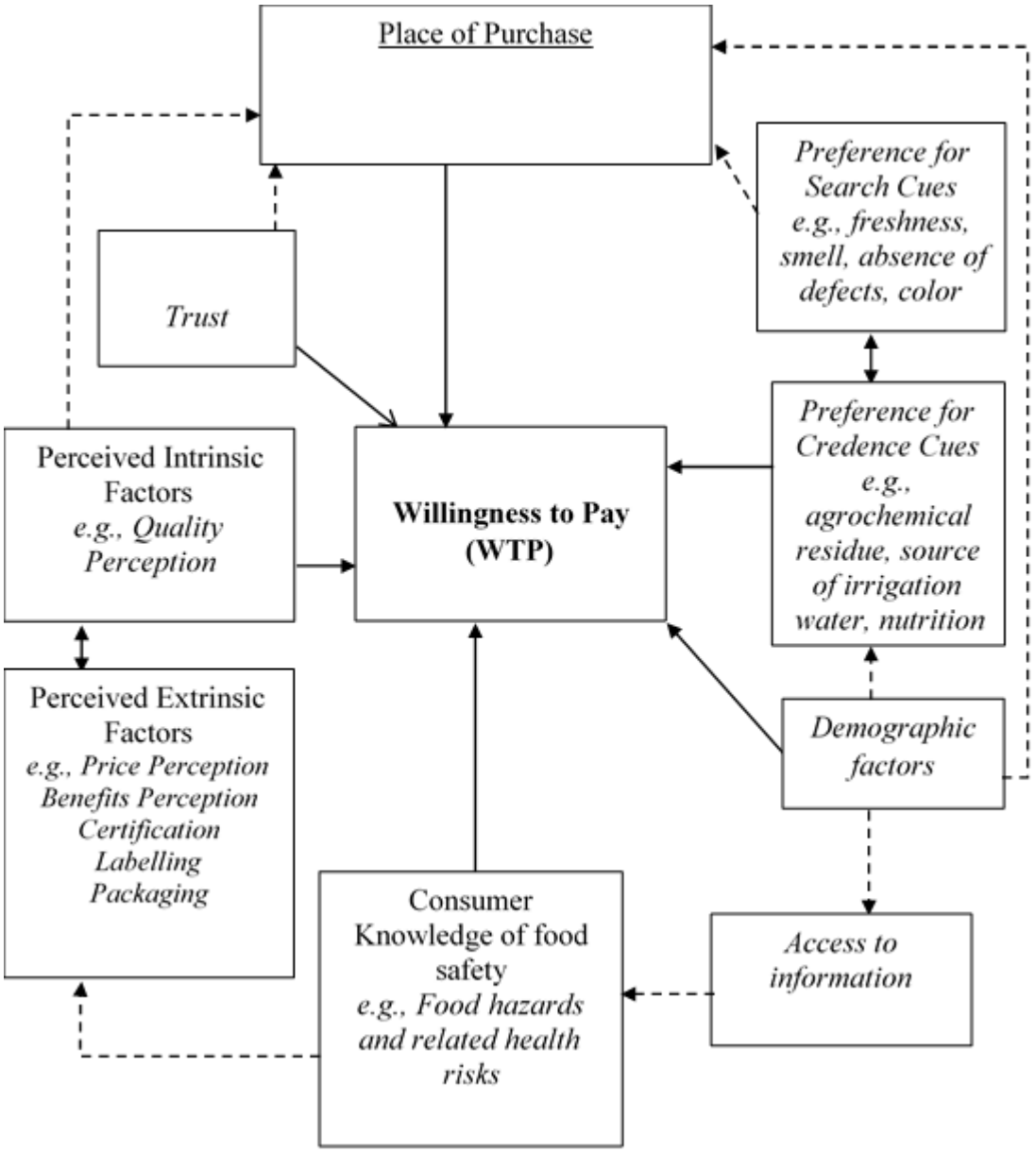

Figure 2. 1:Conceptual framework of WTP Determinants

Source: Adapted from Bonti-Ankomah & Yiridoe (2006).

2.6 Empirical Studies on Food Safety

Food safety has been a major topic in academic papers for quite a long time. Consumer perceptions of food safety (1) and demand (WTP) (2) as well as the provision of food safety (3) are important dimensions of food safety research (Grunert, 2005), and consumer knowledge of food safety (4) has also featured predominantly in academic research, recently (Wilcock *et al*., 2004).

The first and last dimensions match exactly the main objective of the present study. The first stream: 1) consumer demand for safety examines to what extent certain safety improvements correspond to consumer preferences in the sense that they result in consumer willingness to pay for the added qualities or safety attributes-which is influenced by perceptions and knowledge. The second stream (2), which is consumer perception of food safety deals with the question of how safe food is, and how consumers' perception influences their decision-making. The third stream (3): provision of safety deals with the supply of safer foods, may require changes in the organization of agriculture and food production by several actors. The demand side and supply side streams of food safety constitute the traditional approach to dealing with food safety and quality issues, and the third stream is a mediating factor between the first and second streams as it is the perception of the supply of a good that leads to the demand for of that good (see Grunert, 2005).

2.6.1 Knowledge and Perceptions of Food Safety

Knowledge and perceptions are regarded as psychological determinants of individual behaviour (Redmond & Griffith, 2004), and perceptions are shaped by knowledge (Wilcook *et al*, 2004). House *et al*. (2005) maintained that closely tied to the subject of knowledge is consumers' perceptions of food safety. There are existing differences in

the way knowledge is measured in food safety studies. The knowledge on food safety is vital because sufficient knowledge on food safety among consumers promotes positive behaviours. Few studies have examined consumers' knowledge of food safety in relation to food poisoning and related diseases (e.g., Stratev *et al*., 2017), and consumers' knowledge of food safety practices (such as, safe food handling and storage) is well-studied (Langiano *et al*., 2012). Stratev *et al*. (2017) found that 94.4% of their respondents were aware of food poisoning from various contaminants, and over 95% of their respondents agreed that diarrheal can be transmitted through contaminated food.

Consumer perceptions about food safety can also be connected to product consumption risk or quality (and safety) (Grunert, 2005). Shim *et al*. (2011) analyzed consumers' knowledge and safety perceptions of food additives. Their results implied that safety perceptions of food additives were affected by consumer awareness and knowledge. Consumer studies relating knowledge and perceptions about food safety analyze also consumer practices and beliefs of food safety (Langiano *et al*., 2012; Haapala & Probart, 2004). Langiano *et al*. (2012) analyzed consumers' food safety knowledge in relation to foodborne diseases and found that consumers knew of diarrheal, abdominal cramping, vomiting and fever as immediate symptoms of eating contaminated foods.

Consumers' perceptions of food safety play a role predominantly in two ways (Grunert, 2005). The first is that consumers perceive major safety problems, including food scares, to discern in food choice and lead consumers to avoid certain categories or brands at least for a while, until the situation has returned to normal. Food safety perceptions in this sense act as a 'sleeping giant' though they do not enter quality perceptions under normal circumstances, but can have extensive effects at times of

crisis. The second scenario occurs when consumers apply safety considerations to certain production technologies. For instance, in the case that wrong application of pesticides and use of polluted wastewater for vegetable (irrigation) production are detected (Amoah *et al*., 2006). In this case, they develop negative attitudes towards the use of these practices, which can be powerful forces in the marketplace (Grunert, 2005). Consumer risk perception in more general terms has been well-studied (Slovic *et al*., 1980; Grunert, 2005).

Haapala & Probart (2004) reported that perceptions are correlated positively with knowledge and behavior, while Griffith (2005) also reported that knowledge and perceptions influence behaviour change. For example, in a nation-wide study conducted in the UK (FDF-IEHO, 1993), it was observed that 45% of consumers were discouraged from eating certain types of foods because they knew the possible risk of food poisoning. Talaei *et al*. (2015) argued that respondents with high knowledge of food safety are more likely to increase their practice in the prevention of food and water-borne diseases. Knowledge and perceptions of food safety on consumers' decision-making can improve information flow to break asymmetry of information. Knowledge and perceptions of food safety can be strong factors affecting consumer purchase decision and WTP. The level of consumers' knowledge about food safety also depends on sociodemographic factors, and similarly, consumers' perceptions about food safety may or may not constraint behaviour.

2.6.2 Studies on Consumer WTP for Food Safety

Consumer demand for food safety has been measured as a stated preference (WTP). Quite a number of studies have been conducted regarding consumers' WTP for food safety, especially in relation to reduced pesticide residues. Vidogbena *et al*. (2015)

found that consumers were willing to pay 38% price premium for cabbage with minimized pesticides residues compared with conventionally produced cabbage in Benin. Boccaletti & Nardella (2000) showed that consumers in Italy were willing to pay premium between 6% and 10% for vegetables with reduced pesticide residues.

A study conducted by Shin *et al*. (1992) showed that consumers were willing to pay 55 cents to eliminate Salmonella and 81 cents to eliminate *Trichinella spiralis* in foods. Yahaya *et al*. (2015) in Ghana (Kumasi) recorded WTP in monetary terms, and found that consumers were willing to pay an average amount of GH₵ 4.7 per month for a technology change that would result in the production of "safer" vegetables. Chen *et al*. (2013) showed that in China, consumers were willing to pay an average price of 2.38 RMB/250 m, about 18.5% for certified milk. Misra *et al*. (1991) revealed that 54% of their sample was willing to pay up to 10% price premium for pesticide-free food. Akaichi *et al*. (2016) found that consumers in Malawi were willing to pay price for safe milk higher than the normal milk. Owusu & Anifori (2012) found consumers' willingness to pay an average of GH₵1.26 for organic lettuce. According to these findings, consumers' WTP vary according to several factors, including sociodemographic and economic factors, knowledge and perceptions towards food safety, and product characteristics such as freshness, appearance, pesticide-free as well as the nutritional values of food products.

2.6.2.1 Determinants of WTP for Food Safety

Figure 2.1 (page 52) above elaborated on some of the factors influencing WTP (i.e., knowledge, perceptions, trust, quality and safety attributes, market choice, and socioeconomic factors. Thus, the figure depicts the conceptual framework for examining the factors influencing WTP, which also represent the factors of consumer

preference of market outlet. The full line establishes the relationships between WTP and the independent variables (discussed in Section 2.7.2.1) and the dotted line shows the effect of one variable over the other.

2.6.2.1.1 Consumers' Knowledge of food safety and WTP

Research relating knowledge to food safety has evaluated their impacts on consumer decision-making processes and demand (WTP). Using an econometric model, Boccaletti & Moro (2000) found that knowledge played an important role in purchasing decisions regarding products exhibiting a lower use of pesticides and organoleptic properties. They found that consumers with strong knowledge on the use of agrochemicals in food production have higher probability of paying higher price premiums.

Alphone & Alfnes (2012) revealed positive significant relationship between awareness of poor agricultural and handling practices and higher consumer WTP. Posri *et al*. (2007) used the ordered probit model to determine the factors that drive consumer's willingness to pay premiums for reduced pesticide residues in vegetables in Northeast Thailand. They realized that adequate awareness or information of relative risks associated with vegetable consumption increases the probability of offering the highest WTP price premium for the products.

Li *et al*. (2003) also found that (subjective) knowledge significantly related to WTP for genetically-modified foods, Gil & Soler (2006) reported that knowledge on organic food was one of the major factors that influence the decision to pay a premium for organic olive. Posri *et al*. (2006) observed greater WTP price premiums for the products with reduced or no pesticides, since consumers were aware of the relative

risks. Vidogbena *et al*. (2015) also reported that high knowledge of pesticides significantly increases consumers' WTP for cabbage with minimized pesticide residues in Southern Benin.

2.6.1.2.2 Consumer Perceptions of food safety and WTP

Grunert (2005) revealed that perception of food safety leads to purchase only if the safety (quality) attributes as perceived is high enough for the consumer to be willing to pay the price. Krissoff (1998) revealed that consumers who perceived safer foods to be healthier and more environmentally friendly were willing to pay more for organic food products. In a study conducted by Angulo *et al*. (2005) consumers who perceived poor agricultural production practices on humans and the environment were less willing to pay for beef, and this is a positive behavioural change.

Cranfield & Magnusson (2003) concluded that negative perceptions of Canadian consumers about health and environmental concerns significantly influenced their WTP for pesticide-free food products positively. In Nairobi (Kenya), Lagarkvist *et al*. (2011) studied consumers WTP for safer vegetables and realized that perceived risk was one of the most important determinants of consumers' WTP for safer leafy vegetables. As part of a measure of food safety, Angulo *et al*. (2005) estimated consumers' WTP for labelled beef. They realized that perception of a negative impact of agricultural production on the environment and health concerns have a great influence on the food consumer WTP for beef.

2.6.1.2.3 Demographic factors and WTP

Demographic factors such as gender, age, education and income have featured predominantly as key demographic determinants of WTP, and varying conclusions

have been drawn. For example, Misra *et al*. (1991), Lin (1995), McCluskey *et al*. (2005), Henson (1996), Sckokai *et al*. (2010), Chen *et al*. (2013) and Vidogbena *et al*. (2015) all observed greater WTP for food safety among females than male consumers, but their findings were found to be inconsistent with Nayga (1996) and Yahaya *et al*. (2015) who revealed that males have higher likelihood to pay more for food safety. The observed differences might result from two influences: the first is that males may be concerned about food safety and willing to pay more because they provide disposal income for the purchasing of food. Secondly, females may be concerned about food safety and willing to pay more because they are mostly involved in food purchases and cooking. In other words, higher WTP by males is concerned with higher marginal utility of money (constant) whilst higher WTP by females is concerned with marginal utility of health.

Boccaletti & Nardella (2000) found that WTP for pesticide-free vegetables (and fruits) is positively influenced by income and negatively related to education. Lin (1995), McGuirk *et al*. (1990), Ngayga (1996), Posri *et al*. (2006), Chen *et al*. (2013), Yahaya *et al*. (2015) revealed significant positive relationship between WTP and income, indicating that food safety is a normal good (income inelastic) because the quality is valued more than income, especially for wealthier consumers. Lagarkvist *et al*. (2011) found that income only played a subordinate role in explaining consumers' WTP. Therefore, the low-income consumers will have smaller WTP because the large percentage of their income will be spent on the product.

With regards to education and WTP, positive significant relationship has been reported by Lin (1995), McGuirk *et al*. (1990), Ngayga (1996) and Posri *et al*. (2006) whilst Boccaletti & Nardella (2000) and Sckokai *et al*. (2010) recorded a negative significant

relationship between WTP and education, and older consumers (Vidogbéna *et al*., 2015). Sckokai *et al*. (2010) revealed that the youth are more probable of paying more for food safety whilst Hammitt & Haninger (2007) established that the probability of WTP to reduce mortality risk of food was higher for older respondents than younger ones. Using the OLS regression, Buzby *et al*. (1995) showed that consumers' WTP for food safety increases significantly with age, but Misra *et al*. (1991) also found that old age exerts positive influence on WTP for pesticide residue-free products.

In the Northeast parts of Thailand, Posri *et al*. (2006) confirmed that consumers WTP higher price premiums for reduced pesticide residues in vegetables increase with age, but Cranfield & Magnusson (2003) in Canada found a contrary result, showing that younger consumers were WTP more for pesticide-free food products. The findings also show that single consumers and non-employed consumers are most likely to pay higher price premiums for food safety (Lin, 1995; Ngayga, 1996), but this is not supported by McGuirk *et al*. (1990).

2.6.1.2.4 Trust and WTP

It is agreed that related to the increased complexity of the food chain and consumer disembeddedness in food production systems, consumers should rely on actors in the food chain to provide safe food. From literature, two (2) important characteristics of trust are a consumer's willingness to accept personal vulnerability (Rousseau *et al*., 1998) and their reliance upon others (Cvetkovich *et al*., 2002). According to Siegrist *et al*. (2000), trust in food chain is the willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of public health and safety.

Although trust consists of multiple dimensions, such as competence, openness, honesty, care, or fairness (Frewer *et al.*, 1996; Johnson, 1999; Poortinga & Pidgeon, 2003; Renn & Levine 1991), a distinction can be made between two main trust concepts: relational and calculative trust as defined by Earle (2010). According to Earle (2010), relational trust refers to trust in relationships (thus, one person trusts another) and looks at intentions. This dimension relates to openness, honesty, and care. On the other hand, calculative trust relates to past behavior and restrictions on future behavior, and deals with abilities and perceived competence.

Lewicki *et al*. (1998) also made a distinction between trust (low vs. high) and distrust (low vs. high), resulting in four unique combinations. They argued that when there is low trust and low distrust, the involvement between the trustor and the trustee is minimal. Poortinga & Pidgeon (2003) refer to this situation as "distrust". High trust, low distrust indicates a kind of "active trust" where the trustor identifies with the trusted values. Poortinga & Pidgeon (2003) call this "acceptance". In a situation of low trust, high distrust the trustor perceives that the trustee has a different set of values and motives.

In an empirical setting, James & Marks (2008) discriminate between trust, distrust, non-trust and uncertainty. Trusting consumers are those who express trust in all actors in the food chain. Distrusting consumers express little or no trust in One specific actor in the food industry (e.g. they do not trust retailers, but do trust farmers), while non-trusting implies those consumers have no trust in any actor. Moreover, a fourth group is formed by consumers who are uncertain whether they trust actors in the food chain. These consumers might experience ambivalence regarding trusting different food chain actors. Although a number of studies have analyzed consumers' preferences for natural

products, there is limited information on whether the demand for natural products is related to high or low levels of trust in the food system (Muringai *et al*., 2017; Latvala, 2010).

Meanwhile, consumers' trust may reduce uncertainties when they make choices among products with credence attributes (Kjaernes *et al*., 2007) such as claims of being naturally produced. Latvala (2010) revealed trust to be one of the significant factors that influence WTP. The author further revealed that negative experiences heard from other people increased the probability of WTP. Muringai *et al*. (2017) also reported that though both low and high trusting consumers were willing to pay significant premiums for traditionally raised pork over conventional pork, WTP values were higher for the high trust group as compared to the low trust group.

2.6.1.2.5 Food Safety, Quality Attributes and WTP

A product can be rejected or accepted based on its physical characteristics or information provided on those attributes that cannot be observed directly. It is believed that consumers are their own determinants of their foods, whether by physical or psychological interpretation. Concepcion (2009) revealed that consumers use five criteria in their decision to purchase fresh vegetables. These are price, quality, appearance, packaging and phytosanitary consideration. Food attributes can be categorized into search, experience or credence attributes. Search attributes such as freshness and appearance allow quality to be evaluated before purchasing or consumption is done. Experience attributes such as flavour or taste do not allow quality to be evaluated unless the consumers have used the product. On the other hand, credence attributes are those that consumers cannot infer for themselves before or after

purchase or consumption. In the present study, quality (freshness), appearance, source of irrigation water and chemical/pesticide used are represented as quality attributes.

Aban *et al*. (2009), Probst (2010) and Obuobie *et al*. (2014) found that attributes that are very desirable to consumers included fresh looking, fresh tasting, high quality, seedless, reasonably priced, healthy, high in nutrition, looks sweet, free of insect bites, sale priced, and free of pesticides. A study conducted by Nouhoheflin *et al*. (2004) revealed that the characteristics Ghanaian consumers look for in assessing the quality of vegetable are: damage free, freshness, size, bright colour and hardness. They found that consumers' willingness to pay for chemical free vegetable is influence by factors such as the awareness of chemical residue, the availability, the label and the taste. Makatouni (2002) reported that product characteristics such as nutritive value and freshness, influence consumer' willingness to purchase organic products.

Bonti-Ankomah & Yiridoe (2006) also reported that consumers were willing to pay more for organics products because of their nutritive value. Poole & Martínez-Carrasco (2007) found that consumers' purchase decisions were based mainly on overall visual appearance, firmness of the fruit, colour of peel, aroma and fruit size. Van Der Pol & Ryan (1996) used conjoint analysis to establish consumer preferences for fruit and vegetables in Scotland, and revealed that factors which influence consumption of fruit and vegetables are freshness, appearance, season and nutritional value. Fotopoulos & Krystallis (2002) examined organic products as eco-products‖ suitable for green‖ consumers, and found that consumers consider attributes such as appearance, size, colour, freshness and other intrinsic attributes like taste, and nutritional value during purchase of organic products.

2.7 Food Market Preference

Food market is a medium that connect consumers to their food choice or a place where consumers exercise their preferences and purchasing power over foods (Meng *et al*., 2014). Food markets exist as traditional (e.g., open-air, roadside shops, hawking, on-farm (farmer) markets) and modern markets including supermarkets and specialty shops. Traditional markets are the oldest markets in the world, and dominate food marketing outlets in Ghana. Gonzales *et al*. (2016) reported that 70% of fruits and vegetables are purchased from traditional markets in Ghana. Consumers prefer markets due to availability, price, distance and convenience (Ali *et al*., 2015), as well as wide spectrum of products of good quality (Henson & Reardon, 2005; Hawkes, 2008). The markets exist as mediums that connect consumers to their food choice or a place where consumers exercise their preferences and purchasing power over foods (Meng *et al*., 2014). Demographic factors (e.g., age, education, marital status, distance, income, and occupation) influence consumers' preference of markets (Meng *et al*., 2014; Okello *et al*., 2012; Ali *et al*., 2015), and the multivariate ordered probit regression has been employed by Meng *et al*. (2014) to analyze the factors that affect consumers' choice of food markets in Ghana. Henson & Reardon (2005) and Hawkes (2008) revealed that consumer preference for market (supermarket) increases with income and education. In other words, the high-income and the highly-educated consumers prefer to shop at the supermarket compared to low-income households, in other markets. Of course, now more people work outside from the home so most consumers require convenience and less time to do shopping on the market (Kapoor & Moorthy, 2015). A study conducted by Ali *et al*. (2015) showed that consumers prefer availability of food within a shorter distance, usually less than one kilometer.

2.8 Conclusion

Food safety is global challenge and foodborne disease outbreaks and incidents, including those arising from natural, accidental, and deliberate contamination of food, have been identified by the World Health Organization (WHO) as major global public health threats of the 21st century (WHO, 2007). Food may be accidentally or deliberately contaminated by microbiological, chemical or physical hazards. In addition, there are other hazards/factors which cause contamination to food such as Genetically Modified Organisms (GMOs) and radioactive substances. Consumer concerns about food safety are growing due to increased awareness of agriculture and information. While food quality is primarily an economical or physical issue decided by the consumer, food safety is a governmental commitment to ensure that the food supply is safe for consumers and meets regulatory requirements since the consumer cannot self-detect food safety by a mere observation (Sarig, 2003). Consumer perceptions show an increasing concern about food safety and properties of the food they buy and eat. CVM continues to gain popularity among the stated preference methods for valuing individuals' preferences for non-market goods though controversies surround its use. WTP studies provide a solid foundation for policy-makers.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter consists of the materials and methods used to collect, process, analyze and present the data. It discusses the study area which is given by section 3.1. Section 3.2 contains the research design; under it we have the target population, data, method of sampling and data collection and questionnaire design. The conceptual framework is contained in section 3.3 and the theoretical framework of the study is also given by section 3.4. Section 3.5 contains the methods of data analysis; under it we have the econometric framework for estimating consumers' WTP and choice of market is also presented under this section. This same section includes the analysis of consumers' knowledge and perceptions about food safety as well as the methods of measuring challenges consumers anticipate to accessing safer vegetables in the Tamale Metropolis.

3.1 The Study Area

Tamale Metropolis was used as the study area. The Metropolis is one of the 26 districts in the Northern region of Ghana. The Tamale Metropolis is also one of the six Metropolitan Assemblies (TaMA) in Ghana and the only metropolis in the three Northern Regions. Tamale is the capital and the most urbanized district located at the center of the Northern Region, and it lies between latitude 9.16° and 9.34° North and longitudes 00.36° and 00.57°. It covers a land area of about 922Km^2 and is located approximately 180 metres above sea level.

The topography is generally rolling with some shallow valleys which serve as stream courses. The Tamale Metropolis shares boundaries with five other districts, which

include Savelugu- Nanton to the North, Yendi Municipal Assembly to the East, Tolon and Kumbungu to the West, Central Gonja to the South-West and East Gonja to the South. There are about 115 communities in the Tamale Metropolis (GSS, 2014). The population of the metropolis, according to the GSS (2014) population and housing census report was 223,252 with 49.7% of the total population being males and 50.3% being females. The population of the Metropolis is about 9.4% of the total population in the Northern Region, and of these 80.8% live in urban areas (GSS, 2014). Also, 63.6% of the population is adults.

Tamale Metropolis has a total of 219,971 households, living in 19,387 houses (GSS, 2014). The average household size in the metropolis is 6.3 persons per household (GSS, 2014). The percentage of the population which ages 11 years or more is 60.1%, of which 54.8% can read and write English and other Ghanaian languages (GSS, 2014). Tamale is the fastest-growing city in Ghana, and among the few in West Africa (MOFEP, 2016). GSS (2014) estimated that 63.3% of the working population is economically active in the Metropolis. Of these, 92.6% are employed. There are four major markets in the metropolis, which are the Aboabo market, Kukuo market, Central market and Lamashegu market.

Tamale is an important urban hub in the semi-arid savanna region of northern Ghana, and is experiencing rapid expansion due to internal population growth and in-migration from surrounding rural areas as well as from neighboring regions. The metropolis also stands a good chance to gain from domestic trade (from such markets as Techiman and Kumasi) and cross-border trade (from markets in Burkina Faso, Niger, Mali and Togo).

Agriculture and Vegetable production

In Tamale, about 26.1% of households practice agriculture (GSS, 2014). Most (84.8%) of the agricultural households in the metropolis are involved in crop farming. In Tamale, vegetable production is an influential agro-economic activity for income generation and livelihood of many households and business entities such as input dealers, marketers and food vending joints. The cultivation of vegetables in the Metropolis is traditionally characterized by the use of rudimentary tools such as hoes and cutlasses on the small-scale level, land and water resource scarcity and small-scale irrigation.

The main vegetables cultivated in the core and peri-urban areas are tomato (Lycopersicum esculentum), pepper (Capsicum), cassava (Manihot esculentum), cabbage (Brassica oleraceae), "okra" (Abelmoschus ssp), "ayoyo" (Corchorus spp), kenaf and lettuce (Latuca sativa), "alefu" (Amaranthus spp), legumes and other local leafy vegetables, e.g., Hibiscus sabdariffa ('Bra'-Kenaf) (Shaibu, 2002). It is estimated that about 48%, 27% and 11% of farmers in Tamale cultivate Ayoyo, Cabbage and Okra, respectively (Obuobie *et al*., 2014; Shaibu, 2002). According to Obuobie *et al*. (2006), the main vegetable production sites in the metropolis are:

(1) Builpiela, which is located to the south of Tamale, about 2 km from the centre of the city. Builpiela's prominence in vegetable production in Tamale is due to the year-round availability of water from a dam constructed in 1960 to supply water for domestic use, livestock and vegetable cultivation. Also, the floodplains to the valley in which the dam is located provide ready land for the farmers since it cannot be used for building purposes.

(2) Sangani, which is located to the northeast of Tamale, about 2 km from the centre of the metropolis and like Builpiela, Sangani also contributes greatly to vegetable production in the metropolis. Farmers use water from surface ponds, which are available year-round. Though located in the urban core, vegetable farmers in Sangani whose lands are close to the water sources do not experience encroachment as elsewhere in the city. This is because the chief of the area supports the farmers by preventing encroachment on their land.

(3) Water Works, which is located in a suburb of Tamale called Gumbihini, is so named because of the existence of a dam that was built originally to provide pipe-borne water for Tamale. The dam is no longer used for domestic water provisioning, thus giving the residents of the area around the dam the opportunity to use the water for irrigated vegetable production.

(4) Zagyuri, which is located about 8 km north of Tamale on the Tamale-Savelugu road. It is opposite Kamina Barracks and farmers use untreated sewage water for vegetable production. Farmers engaged in urban and peri-urban agriculture face significant health risks associated with use of waste and wastewater for vegetable production. Climate change is likely to exacerbate vulnerabilities associated with increased marginalization of land and water resources for agriculture in and around Tamale.

In the Metropolis, pesticide application has been a common practice of controlling pests and diseases in the cultivation of vegetables (Badii *et al*., 2014). According to the authors, more than 90% of vegetable farmers in the Metropolis apply about 3 to 4 different types of pesticides on their fields.

Access to water, especially for dry season farming is crucial to ensure all year-round supply of vegetables in cities. According to a study conducted by Abdul- Ganiyu *et al*., (2002) on the sources of water for urban vegetable production, one third of the population of Tamale is served with portable water while the rest depends on dam and dug out that retains run off from the previous rainy season.

In addition, ground water availability in the Metropolis is limited with a depth ranging from 18-122 m, depending on the rock material present beneath the soil horizon. This situation, together with limited financial resources, low educational know-how and lack of awareness on the health effects of contamination water make vegetable farmers use almost any water that they can lay their hands on regardless of its source especially during the dry season.

The major water sources include residential and industrial fluids. In the Metropolis, large quantities of vegetables such as cabbage, carrots, tomatoes and other crops are being produced using wastewater especially during the long dry season irrigation farming. Few vegetable farmers in the Metropolis use pipe borne water or treat wastewater for irrigation (Drechsel *et al*., 2006).

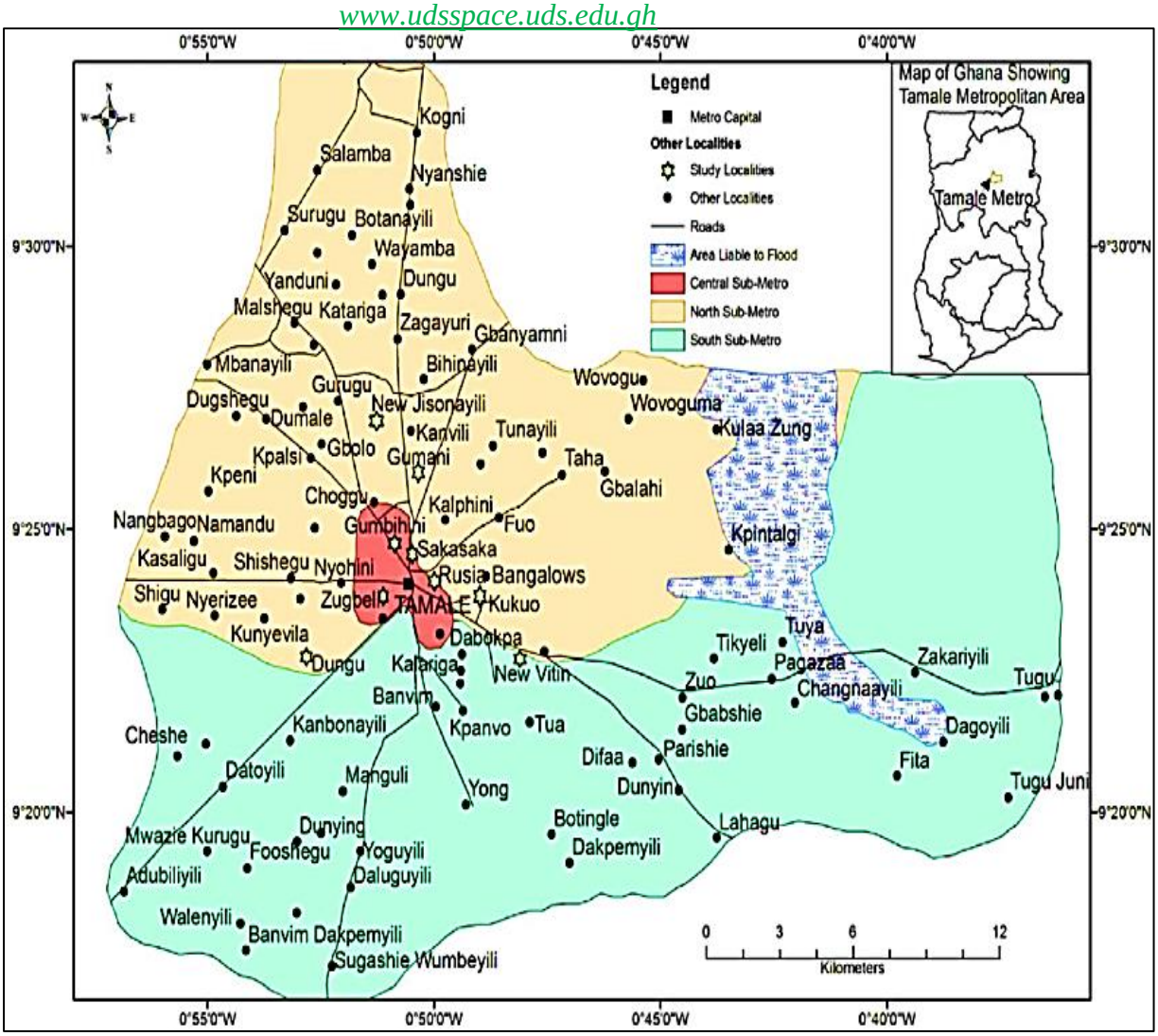

Figure 3. 1: Tamale Map showing the Various Communities

Source: Town and Country Planning Department, Tamale

3.2 Research Design

Research design is the blueprint for conducting a study, and according to Burns & Grove (2010), research design is used for conducting a study with maximum control over factors that may interfere with the validity of the findings. As a plan of the research, it describes how, when and where data are collected and analyzed (Parahoo, 1997). It can also be the researcher's overall frame for answering the research question or testing research hypothesis (Polit & Beck, 2010).

This study employed three types of research designs for data collection and analysis. These are cross-sectional research design, descriptive research design and quantitative research design. Labaree (2009) argued that cross-sectional research provides a clear 'snapshot' of the outcome and the characteristics associated with it, at a specific point in time. For this study, cross-sectional research was used to obtain data from consumers in a survey (using methods and tools such as, multi-stage sampling technique, personal interviews and questionnaire).

On the other hand, Burns & Grove (2010) indicate that descriptive research is designed to provide a picture of a concept, as it answers questions "what/which" and "how" associated with a concept and it does not draw a conclusion to ascertain answers to why (Labaree, 2009). For this study, descriptive research was used to explicate the consumers' knowledge and perceptions of food safety, and demographic factors as well.

Quantitative research design is used to determine the relationship between an independent variable (s) and a dependent or outcome variable (s) within a population based on which inferences or conclusions are made (Creswell, 2003; Labaree, 2009).

For this study, quantitative research design was used to examine the relationships WTP and a set of independent variables relating consumers' knowledge and perceptions of food safety, trust, food safety and quality attributes and demographic factors. Thus, the study used a quasi-experimental research design.

The target population is the total number of units from which the data are collected, such as individuals (Parahoo, 1997), whilst population describes all the elements that meet the criteria for inclusion in a study. Those individuals eligible for the study are determined by the eligibility criteria, thus, using "a list of characteristics of the respondents that qualify one for the inclusion in the target population" (Burns & Grove, 2010). For this study, the population under study is urban and peri-urban consumers in the Tamale Metropolis and vegetable consumers as the targeted population. According to this study, vegetable consumers that are eligible for the study are those of age 15 years or more who do the purchases or preparation of food, and/or provide disposal income for food purchases.

3.3 Data Sources and Types

The study used mainly primary data, which was obtained from the cross-sectional survey in Tamale. The data comprised of both continuous and categorical scales. The WTP data contained both continuous and discrete set (ordinal) variables and consumers' knowledge and perceptions were collected using Likert-scale questions. The study also obtained data on socio-demographic and economic characteristics, preference for food safety and quality cues, food shopping habits, food expenditure, income, trust and market preference.

3.4 Sampling Technique and Sample Size

The main survey was conducted for 350 urban and peri-urban consumers in the Tamale Metropolis in the month of November 2016, following a pre-test of the questionnaire. The sample was chosen from consumers, and was defined as "a proportion of vegetable consumers taken from the total population in Tamale. A multi-stage sampling technique was used to obtain the study sample (see equation 3.0). In the first-stage, the simple random sampling technique was used to select 1200 waypoints, which were assumed to be houses. In this second stage, the systematic sampling technique was used to select 350 consumers. In doing the systematic sampling, the n^{th} rule gave the number three (3) because N/n (i.e., $1200/350 \approx 3$). Using three as a width to create the intervals, the number three was randomly chosen from the first interval (1-3). Thereof, every 3rd was artificially included in the sample.

The sampling selection procedure is outlined as follows: First, the 350 sampled waypoints were planted in the GPS route planner, and then set out on a route map which was used to locate each point. The enumerator followed the direction of a point until a house was found. However, a margin of error of about 10 meters away from a house was allowed in the case where house was indeterminate or where the point fell between two or more houses. However, any waypoint that fell on non-household structures, for example public offices, churches, mosques, school, roads or bushes was treated as a misplaced point, and additional waypoints were systematically planted thereafter when the 350 points were exhausted. Moreover, if a household was identified by the GPS device but members were unavailable for the interview, they were re-visited at a later time or day. Once the household was tracked with members available, an adult individual in the household depending on his or her involvement in food

shopping and cooking, or provided he allocate his disposal income for food purchasing was selected. Once the respondent agrees to participate in the survey, she/he was interviewed face-to-face. The interview time was pegged at 20-30 minutes per questionnaire, and no photographs were used during the interview process. However, the respondent was at liberty to infer a response from another knowledgeable household member when the need arises.

Plate 1. 1: Two brands of GPS devices (GARMIN) used for tracking the household in which the respondent lived

The appropriate sample size was determined as follows. The study used 64% as percentage of the adult population in Tamale (GSS, 2014) to do the calculation of the sampled size, with a z-value of 1.96 at a margin of error of 0.05. The sample size formula given by Cochran's (1977):

$$n = \frac{z^2 * p(1-p)}{e^2}$$

$$= \frac{1.96^2(0.64)(1-0.64)}{0.05^2} = \frac{3.84 \times 0.23}{0.0025} = \frac{0.88}{0.0025} \qquad \textbf{(3.0)}$$

$$= 352 \approx 350$$

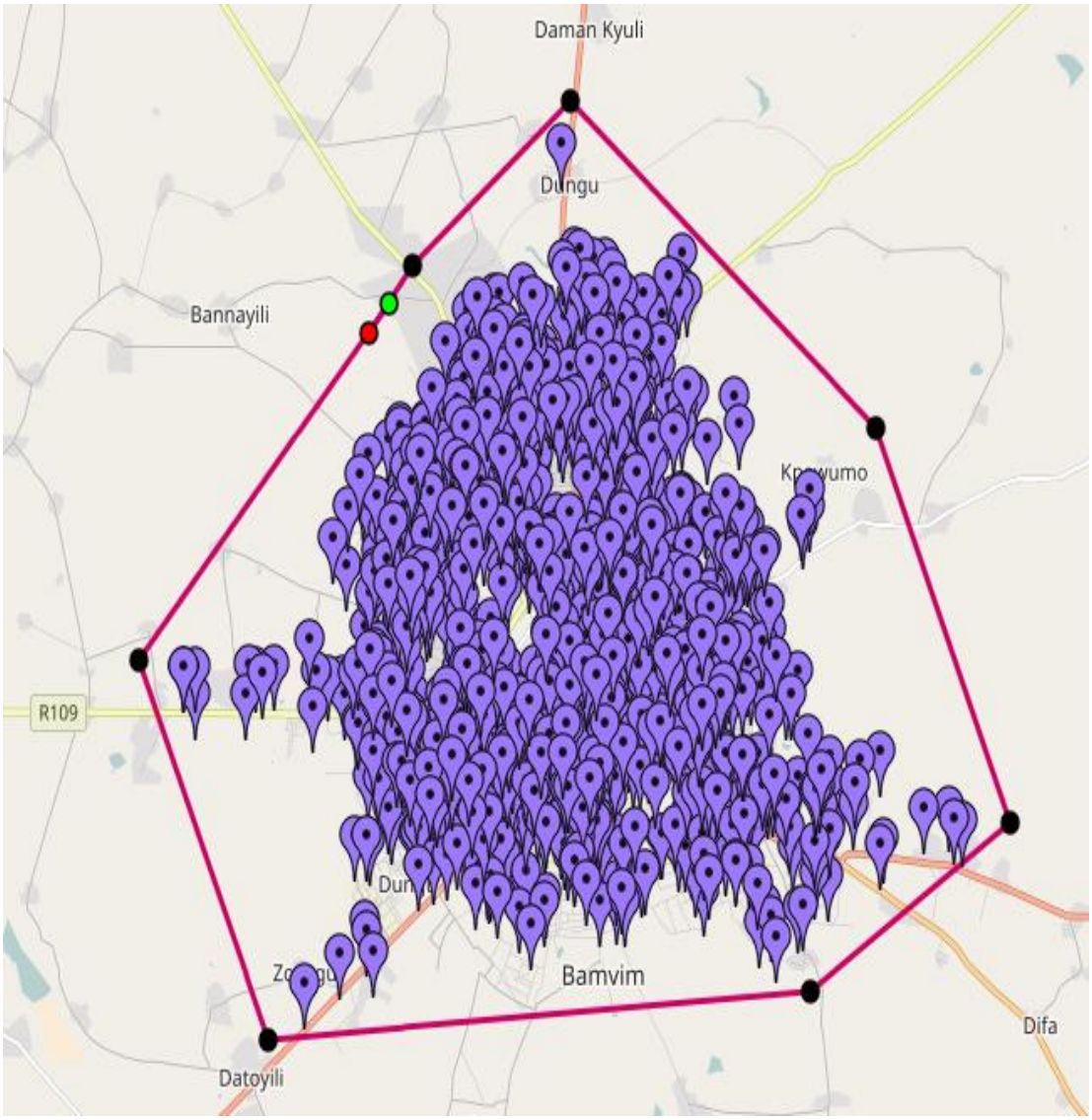

Figure 3. 2a: Map of Tamale showing the GPS Waypoints

Source: Author's Construct

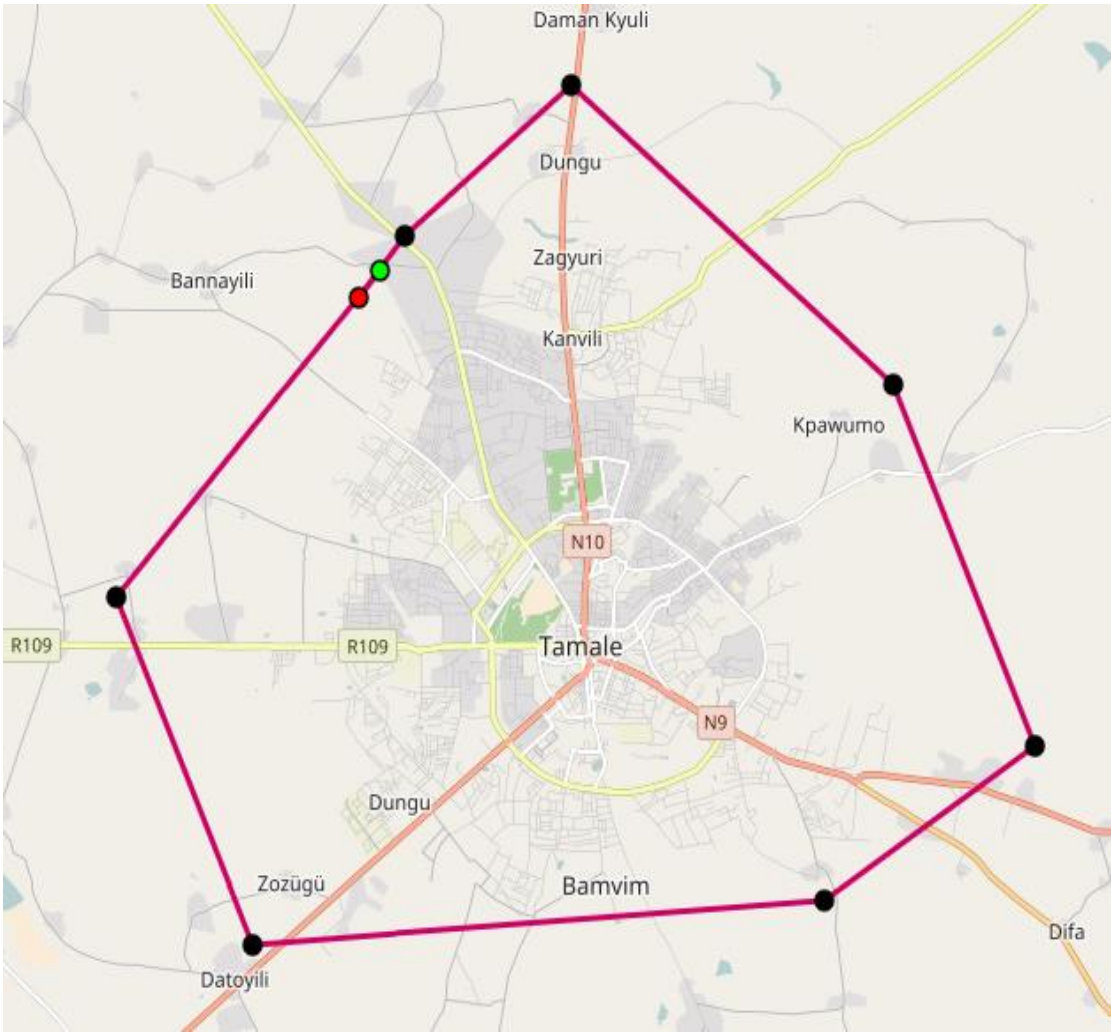

Figure 3. 3b: Map of Tamale showing the GPS Waypoints

Source: Author's Construct, 2017

3.5 Models Theoretical Framework

3.5.1 Random Utility Theory

The random utility model was employed to understand the factors influencing consumers' willingness to pay for a product. In the present study, the respondent is assumed to purchase two products, measured in terms of WTP; thus, product A (denoted as a safer vegetable) and product B (denoted as a conventional vegetable).

In the first situation, the consumer is expected to choose a product that maximizes her utility. This condition is given by equation (3.1), and can be called the indirect utility function that gives the consumer maximum utility at given prices and income. Equation 3.1 is the indirect utility function if the consumer is willing to pay more for safer vegetables and equation 3.2 is the indirect utility function if the consumer is not willing to pay more for safer vegetables:

$$\mathrm{v}(p_S, h, y, z) \quad \textbf{(3.1)}$$

$$\mathrm{v}(p_S - t, h - d, y, z) \quad \textbf{(3.2)}$$

where p_S is the price of the safer vegetables, consumers' health stock h, current income y, z is the vector of observable characteristics of the respondents $p_S - t$ is the prices of conventional vegetables, $h - d$ is illness and d is the damage.

Because in competitive markets information about poor practices might be symmetric, t is a mark-up in cost after employing safer methods from the perspective of producers. In other words, t is the consumer willingness to pay for safer vegetables from the perspective of consumers (Lui *et al*., 2009). In addition, since chemical and microbial

contaminants can damage consumers' health, and this might decrease the health stock of the consumer from h to $h-d$ if she chooses to consume the conventional vegetables. In general, the production cost for producing safer vegetables will rise because farmers might use expensive methods such as wastewater treatment, and thus increasing the price of safer vegetables. If a consumer has fixed budget, then t willing to pay higher premium prices for safer vegetables might mean that she sacrifices part of the income on other consumables to settle the WTP. At market equilibrium, the indirect utility function for consuming safer vegetables equates the indirect utility function for conventionally produced vegetables.

This can be mathematically represented as:

$$\mathrm{v}(p_S, h, y, z) = \mathrm{v}(p_S - t, h - d, y, z)$$

(3.3)

and at disequilibrium in favour of safer vegetables, then the above equation becomes:

$$\mathrm{v}(p_S, h, y, z) > \mathrm{v}(p_S - t, h - d, y, z)$$

Taking the first order condition of $\mathrm{v}(p_S - t, h - d, y, z)$, we have

$$\mathrm{v}(p_S - t, h - d, y, z) \approx \mathrm{v}(p_S, h, y, z) - \frac{\partial \mathrm{v}}{\partial y} t - \frac{\partial \mathrm{v}}{\partial h} d$$

(3.4)

Combining **(3.4)** and **(3.5)** gives:

$$t = -\frac{\partial \mathrm{v}/\partial \mathrm{h}}{\partial \mathrm{v}/\partial \mathrm{y}} d$$

(3.5)

By the Roy's identity, we have

$$t = \frac{d}{x_m}\frac{\partial \mathrm{v}/\partial \mathrm{h}}{\partial \mathrm{v}/\partial \mathrm{y}}$$

(3.6)

where x_m = Marshallian demand for the safer vegetables. Assuming the demand elasticity of vegetables is very small regardless of whether it has been cultivated with or without chemicals and untreated wastewater, the total consumption of vegetables is constant for the consumer. Define $k = d/x_m$; denoting the health damage from consuming per unit vegetables, and for a certain consumer, k is a constant.

Rewriting equation (3.6);

$$t = k\frac{\partial \mathrm{v}/\partial \mathrm{h}}{\partial \mathrm{v}/\partial \mathrm{y}}$$

(3.7)

where $\partial \mathrm{v}/\partial \mathrm{h}$ is defined as the marginal utility of health $\partial \mathrm{v}/\partial \mathrm{y}$ is defined as the marginal utility of money.

Using equation (3.7), two important hypotheses are made; health concern regarding food safety and income.

i. Ho_1: Consumers' willingness to pay for safer vegetables is positively correlated with the marginal utility of health.
ii. Ho_2: Consumer willingness to pay for safer vegetables is negatively correlated with the marginal utility of money, meaning that the rich will have smaller $\partial V / \partial m$, so consumer willingness to pay would increase as income increases.

3.6 Conceptual Framework

The CVM is a market survey method used to estimate values for nonmarket or private goods such as safer vegetables. CVM involves asking respondents in a survey or

experimental settings to state their willingness to pay for an improvement in the quantity and quality of a good or service or reveal their personal valuations of increments or decrements in unpriced goods, by using hypothetical or contingent markets. Contingent markets elicit contingent choices (Randall & Stroll, 1983). CVM survey defines the good of interest, the change in the product, the institutional structure under which the good is to be provided, the method of payment and the decision rule which determines whether to implement the offered programme (Hao, 2008).

In the CVM, respondents are neither asked about their opinions nor about their attitudes; instead they are asked about their contingent valuation in a setting such as "if this happens (e.g., if vegetables are made safer than the conventional ones that may have no pesticide residues and foodborne pathogens in them), would you be willing to pay more?" (Hao, 2008). In this study, the CVM was used to elicit respondents' WTP for safer vegetables. Elicitation methods for CVM can be classified into open–ended and the discrete choice (single and double-bounded) elicitation formats. The study employed both the open-ended, single-bounded dichotomous choice and the double-bounded dichotomous choice techniques.

In the open-ended technique, respondents were asked to state at what maximum price (GH₵X) they were willing to pay for safer vegetables. The estimates derived from the open-ended questions are continuous and can be estimated using OLS or Tobit models. In the single-bounded dichotomous choice (SBDC) questions, the respondents were asked whether they were willing to pay GH₵X price premium for safer vegetables? The response derived from the single-bounded dichotomous choice question is either yes or no, which induce a binary model. In the double-bounded dichotomous choice (DBDC) questions, consumers were asked whether they were willing to pay GH₵X

price premium for safer vegetables? The 'yes or no' response derived from the first question is then followed by a second question, which is based on a certain percentage increment in the current price of safer vegetables. The follow-up questions depend on the outcome of the first question. For example, if the respondent says "yes" to the first question (initial bid), the respondent is asked again whether she is willing to pay GH₵Y higher price premium based on the market? potential response is "yes or no".

If the respondent responded 'no' to the first question, she is asked again whether she is willing to pay GH₵X lower price premium based on the market? potential response is "yes or no"?. Following this preamble, four different potential outcomes are derived from the double-bounded dichotomous choice technique. Let Bi, BL and BU denote the first bid, second lower bid and second upper bid respectively, then the expected outcomes can be displayed as:

If we consider Figure 3.3;

0 = Zero WTP (*WTP<Bi*) -which stands for consumers who are willing to pay at the market price.

1 = *Bi> WTP <B_L (NO-NO)* – (meaning that the respondent is not interested in paying for the first bid and the second lower bid). This respondent is called lowest WTP bidder not a zero WTP.

2 = *Bi > WTP > B_L (NO-YES)* - (meaning that the respondent is not willing to pay the first bid but his utility for the second lower bid is high). This respondent is called a lower WTP bidder.

3 = *Bi* < *WTP* < B_U *(YES-NO)* - (meaning that the respondent is willing to pay the first bid but his utility for the second upper bid is low). This respondent is called the moderate WTP bidder.

4 = *Bi* < *WT P* > B_U *(YES-YES)* - (meaning that the respondent is willing to pay the first bid and the second upper bid). This respondent is called the highest WTP bidder

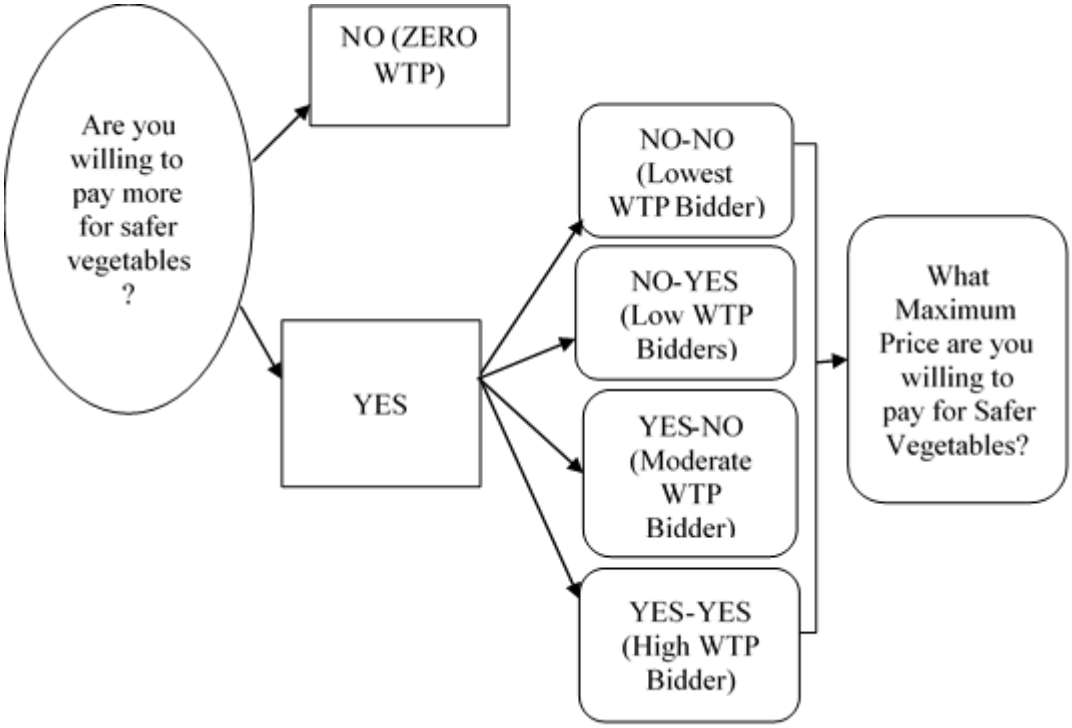

Figure 3. 4: Modelling WTP for safer vegetables (Conceptual Model)

3.7 Data Presentation and Analysis

The data was processed in STATA 14, and the analysis was done based on descriptive statistics and econometric models. Descriptive statistics such as mean, standard deviation, minimum, maximum and coefficient of variation were used to summarize the data on consumers' food safety knowledge and perceptions. A contingent valuation data was estimated to obtain the mean willingness to pay (MWTP) and the factors influencing consumers' WTP using the ordered logit model. The multivariate probit model was used to analyze consumers' choice of place of purchase of fresh vegetables.

The kendall's coefficient was employed to assess consumers' level of agreement about the possible constraints they anticipate to accessing fresh safer vegetables in the Tamale Metropolis.

3.7.1 The Models

3.7.1.1 Analysis of Factors that Affect Consumers' WTP for Safer Vegetables

The ordered logit regression model is appropriate for analyzing an ordered discrete choice, and an underlying error term with a logistic distribution. The ordered regression model is an extension of a binary model used to analyze situation of choices between only 2 alternatives (Greene & Hensher, 2010). For all random utility models, there is a continuously varying strength of preferences for the individuals that would underline the decision to pay and how much to pay, but this is latent or unobserved. What is actually observed is the individual's decision to pay. Using, the price premiums (bids) as the threshold parameters, as the latent (unobserved) variable crosses to a higher unknown threshold parameter, we move up the ordering of alternatives. The latent unobserved continuous variable is a linear combination of some explanatory variables and an error term, which is logistically distributed as:

$$y_i^* = x'\beta + \varepsilon_i : \quad N(0, 2/3\pi) \qquad \forall \; i = 1,..., N \tag{3.8}$$

where the observed ordinal variable, takes on values 0 through m according to the following scheme:

$$y = j \Leftrightarrow \gamma_{j-1} < U \leq \gamma_j$$

(3.9)

and further expansion of the choice variable, which is related to the utility the following equation:

$$
\begin{aligned}
y &= 0 \quad if \quad 0 > U \\
y &= 1 \quad if \quad 0 < U < \gamma_1 \\
y &= 2 \quad if \quad \gamma_1 < U < \gamma_2 \\
y &= 3 \quad if \quad \gamma_2 < U < \gamma_3 \\
y &= 4 \quad if \quad \gamma_3 < U
\end{aligned}
\tag{3.10}
$$

where Y is the consumer WTP for safer vegetables, Y* and values are the threshold parameters or the cut-off points (γ) linking the consumer utility to WTP. However, due to the presence of cutoffs points that defines the boundaries of price premiums for each WTP bid, no additional constant is introduced. Threshold parameters represent points at which the change in utility is sufficiently high to merit a consumer being willing to pay more for the selected product (Cranfield & Magnusson, 2003). According to (Hill *et al*., 2008), an inclusion of additional constant in the ordered model results in perfect multicollinearity.

The threshold parameters divide the range of WTP into cells which are then identified with the observed ratings (Greene & Hensher, 2010). Rarely do they have economic meaning, but they are used to compute the individual probabilities. However, each significant cutoff point distinguishes one WTP premium from the other. In relation to the four categorical outcomes, three cutoff points are included in the estimation. The number of thresholds is one less the number of categories. In practice, probabilities known as the marginal effect from the ordered logit regression can be estimated for all the categories of the response variable. However, the coefficients generated in the single step are limited to only the direction in terms of its interpretation. But because of the latent factor assumption, it's preferred to replace consumer utility level with the latent dependent variable.

Similarly, using the threshold parameters, the observed dependent variable is defined by:

$$y_i = \begin{cases} 0 = y_i^* < 0 & Zero \ \text{WTP Bidder} \\ 1 = 0 < y_i^* < \gamma_1 & NO-NO \ \text{WTP Bidder} \\ 2 = \gamma_1 < y_i^* < \gamma_2 & NO-YES \ \text{WTP Bidder} \\ 3 = \gamma_2 < y_i^* < \gamma_3 & YES-NO \ \text{WTP Bidder} \\ 4 = \gamma_3 \leq y_i^* & YES-YES \ \text{WTP Bidder} \end{cases}$$

(3.11)

It's reasonable to assume that the dependent variable has ordered values such that: ZERO WTP (NO WTP Bidders) < NO-NO WTP (Lowest WTP Bidders) < NO-YES (Low WTP Bidders) < YES-NO (Moderate WTP Bidders) < YES-YES (High WTP Bidders). Remember that the ZERO WTP Bidders stand for consumers who are not willing to pay more; NO-NO WTP Bidders are consumers who are willing to pay more but not willing to pay for both the initial bid and the second lower bid (discount) (they are given the market price of the conventional vegetable); NO-YES WTP Bidders are consumers who are not willing to pay the initial bid but accept the discount bid; YES-NO WTP Bidders are consumers who accept the initial bid but reject the second upper bid (premium) and YES-YES WTP Bidders are consumers who accept both the initial bid and the second higher bid. Under the assumption of Gaussian, the ordered probit probabilities are given by Maddela (1983).

Generically, the probability of m-categories is given by:

$$\Pr_j = \Pr(y = j/x) = F(\gamma_j - x_i'\beta) - F(\gamma_{j-1} - x_i'\beta) \qquad \textbf{(3.12)}$$

and the probabilities of each ordered outcome is such that, firstly, the probability of observing the highest bid which is a YES-YES response equals the probability that, the

consumers' WTP lies above the second highest bid offered. Secondly, the probability of observing the highest bid which is a YES-NO response equals the probability that, the consumers'' WTP of consumer i lies between the initial bid and the second highest bid offered. Thirdly, the probability of observing the moderate bid, which is a NO-YES response equals the probability that, the consumers' WTP lies between the initial bid and the second lowest bid. Lastly, the probability of observing the lowest bid, which is a NO-NO response equals the probability that, the consumers' WTP lies below both the first bid and the second lower bid offered:

This is given by equation 3.13.

$$\Pr_{j} = \begin{cases} \Pr(y=0|x) = F(-x_i'\beta) \\ \Pr(y=1/x) = F(\gamma_1 - x_i'\beta) - \mathrm{F}(-x_i'\beta) \\ \Pr(y=2/x) = F(\gamma_2 - x_i'\beta) - \mathrm{F}(\gamma_1 - x_i'\beta) \\ \Pr(y=3/x) = F(\gamma_3 - x_i'\beta) - F(\gamma_2 - x_i'\beta) \\ \Pr(y=4/x) = 1 - F(\gamma_3 - x_i'\beta) \end{cases} \quad \textbf{(3.13)}$$

The parameters can be consistently and efficiently estimated using the maximum likelihood (ML) criteria. The log-likelihood function is given by:

$$\ln \ell = \sum_{i=1}^{N}\sum_{j=0}^{N} Z_{ij} \ln[F_{ij} - F_{ij-1}]$$

(3.14)

The empirical model for analyzing the factors affecting consumers' WTP price premiums for safer vegetables is given below:

$$y_{ij} = \sum_{i=1}^{30} x_{ij}'\beta + \varepsilon_{ij} \quad \textbf{(3.15)}$$

where y_{ij} = willingness to pay, x are explanatory variables, β is the unknown parameters relating to the explanatory variables (to be estimated) and ε_{ij} is the error term.

In all, three separate ordered logit estimations were mounted for the three vegetables; cabbage, ayoyo and okra.

Note that the detail description of the explanatory variables of the ordered logit regression model is given in Table 3.1. We need to calculate the marginal effects of each of the explanatory variable on the dependent variable. The generic formula for calculating the marginal effects of the ordered logit model is given by:

$$\frac{\partial \Pr(y_i = j/x)}{\partial x} = \beta[F(\mu_{j-1} - x'\beta) - F(\mu_j - x'\beta)]$$

(3.16)

In interpreting the marginal effect, we refer to the direction and magnitude of the estimate. The direction of the parameter estimates can be positive or negative. Positive coefficient increases the likelihood of observing success in the highest bid and negative coefficient reduces the likelihood of observing success in the highest bid for WTP if the coefficient (Hill *et al.*, 2008). For a continuous independent variable, a negative coefficient indicates that, the lower WTP bid is more likely to be observed. In other words, if the value of the explanatory variable increases, the probability that the individual is willing to pay higher bids reduces. Conversely, if the coefficient is positive, it has a direct relationship with the individuals' WTP to pay the highest bid for safer vegetables. In other words, if the value of explanatory variable is increased, the likelihood of observing the highest WTP bids for the individual increases. In relation to the coefficient for a dichotomous explanatory variable, a positive coefficient means

that, the highest category (in this case coded 4) is more likely to pay the highest WTP bid.

Table 3. 1: Description of Variables used in the Ordered logit model

Variable	Variable	Measurement	Expected sign
X_1	Gender	dummy 1 if respondent is a male; 0 otherwise	-
X_2	Age	In years	-
X_3	Education	dummy 1 if respondent is formally-educated; 0 otherwise	+
X_4	Marital status	dummy 1 if respondent is married; 0 otherwise	+
X_5	Salaried worker	dummy 1 if respondent does salaried work; 0 otherwise	+
X_6	Self-employed	dummy 1 if respondent does own work; 0 otherwise	+
X_7	Monthly income	Ghana cedi	+
X_8	Household income earning members	Number of people	+
X_9	Vegetable expenditure	Ghana cedi	-
X_{10}	Frequency of vegetable shopping	dummy 1 if respondent buys vegetables daily; 0 otherwise	-
X_{11}	Appearance	Dummy; 0 if respondent considers appearance when buying vegetables, 1 otherwise	-
X_{12}	Nutritional quality	Dummy; 0 if respondent considers nutrition when buying vegetables, 1 otherwise	-
X_{13}	Source of irrigation	Dummy; 0 if respondent considers the source of irrigation water (waste or clean) when buying vegetables, 1 otherwise	-
X_{14}	Use of Agrochemical	Dummy; 0 if respondent considers the use of agrochemicals when buying vegetables, 1 otherwise	-
X_{15}	Open market	dummy 1 if respondent buys vegetables from the open-air market; 0 otherwise	-
X_{16}	Supermarket	dummy 1 if respondent buys vegetables from the supermarket; 0 otherwise	+
X_{17}	Farm-gate	dummy 1 if respondent buys vegetables from the farm-gate; 0 otherwise	-
X_{18}	Trust in farmers	Dummy based on the mean score; 1 for trust high thus, if respondent trust score is equal or higher than the mean score, 0 otherwise	+
X_{19}	Trust in traders	Dummy based on the mean score; 1 for trust high thus, if respondent trust score is equal or higher	+

		than the mean score, 0 otherwise	
X_{20}	Quality perception	Mean score	+
X_{21}	Price perception	Mean score	+
X_{22}	Packaging perception	Mean score	+
X_{23}	Environment perception	Mean score	+
X_{24}	Health perception	Mean score	+
X_{25}	Taste perception	Mean score	
X_{26}	Nutrition perception	Mean score	+
X_{27}	Hazard-free	Mean score	+
X_{28}	Certification perception	Mean score	+
X_{29}	Labelling perception	Mean score	+
X_{30}	Overall food safety knowledge	Mean score	+

3.7.1.2 Analysis of Consumers' Choice of Safer Vegetable Markets

To analyze consumers' choice of safer vegetable markets, a multivariate probit (MVP) model was employed. The MVP model is also based on the framework of random utility. This is because, consumers' choice of safer vegetables' markets is a choice problem. In the present study, consumers were asked to state the "markets" from which they would buy their fresh safer vegetables from. Three main types of markets were identified, and these include open-air markets, supermarkets and farm-gate markets. This resulted in a dependent variable with three separate binary categories. The concept here is that each market outlet is a binary outcome. The reason is that consumers purchase vegetables from different products on different markets. For example, the consumer might buy cabbage from the supermarket and the okra from the farm-gate and otherwise. The choice of buying from one market is not solely independent of the others because consumers were at liberty to choose more than one market, suggesting possible correlation between the dependent variable. This means that a separate estimation using a probit model might generate bias and inconsistent results. The MV model allows for this possible contemporaneous correlation in their choice of fresh safer vegetable markets (i.e., open market, supermarket and farm gate).

The general multivariate probit model can be as expressed as follows:

$$pM_{ij} = \vartheta' S_{ij} + \varepsilon_{ij}$$

(3.17)

where S_{ij} is the vector of explanatory variables (Table 3.2 contains the descriptions of the explanatory variables), ϑ' is the vector of unknown parameters to be estimated; ε_{ij} are the error terms. The error terms $\varepsilon_1, \varepsilon_2, ..., \varepsilon_m$ have a multivariate normal distribution with mean vector 0 and covariance matrix $\sum$ with diagonal elements equal to 1. $pM_{ij} = (j = 1, ..., m)$ represent the choice of safer vegetables' markets, $m = 3$ presented to the consumer, S_{ij} is a vector of observed characteristics that affect choice of fresh safer vegetable markets, and is estimated against a vector of unknown parameters ϑ, and is the stochastic parameter.

Equation 3.17 can be empirically implemented using a series of independent probit model for each choice of vegetable market (Velandia *et al*., 2009). However, it is not impossible for the consumer to choose more than one alternative at a time, (simultaneously), and, thus, it is likely to find correlation between the alternatives. When this happens, the unobserved error terms for the probit model would not be independent, and an attempt to estimate a single probit model in this condition may result in biased estimates of the choice probabilities and incorrect estimates of the standard errors of the estimates. We use maximum likelihood (ML) procedures to estimate the parameters of the multivariate probit model with the assumption of multivariate normality.

The probabilities that enter the likelihood function (as well as the derivatives needed for the ML procedure) are computed using the Geweke-HajivassiliouKeane (GHK) simulation procedure, which produces approximations to the m-fold multivariate normal integrals:

$$\int_{-\infty_m}^{S_m} \ldots \int_{-\infty}^{S_1} \rho(S_1,\ldots,S_m)\partial S_1,\ldots,\partial S_m \qquad \textbf{(3.18)}$$

where $\rho(\bullet)$ is the multivariate normal density. The log likelihood for the multivariate model is then calculated as the sum of the logs of the probabilities of the observed outcomes defined as:

$$\Pr(pM_1,\ldots,pM_m / S_1,\ldots,S_m) = \text{MVN}\ \ (\text{Tz}, \text{TRT}')$$

(3.19)

where Z is a vector defined from $\text{Z} = \text{S}'_{\text{m}}\vartheta$, R is the correlation matrix, and T is a diagonal matrix with $\text{t}_{\text{mm}} = 2y_m - 1$, and MVN refers to the density being multivariate normal (Greene, 2008).

The marginal effect of the multivariate probit model shows how an explanatory variable affects the probability of choosing one market outlet, conditional on the other markets being provided.

According to Velandia *et al*. (2009), the marginal effect of the above distribution can be calculated as follows;

$$\frac{\partial E_1}{\partial S} = \sum_{j=1}^{m}\left[\frac{1}{P_2,.m}\frac{\partial P_1}{\partial z_m}\right]\sigma_m - E_1 \times \sum_{j=2}^{m}\left[\frac{1}{P_2,m}\frac{\partial P_2}{\partial z_m}\right]\sigma_{m'}$$

(3.20)

where s is the union of all the regressors that appear in the model and σ_m is defined such that $z_m = \vartheta' s_m = \sigma' s_m$.

The empirical model of the MV probit is given by:

$$pM_{ij} = \vartheta_o + \sum_{i=1}^{27} s'_{ij}\vartheta + \sum_{i=1}^{27} r'_{ij}\vartheta + \sum_{i=1}^{27} l'_{ij}\vartheta + \omega_{ij} \quad \textbf{(3.21)}$$

where pM_{ij} = market choice, s_{ij} = vector of explanatory variables for the first dependent variable, r_{ij} =vector of explanatory variables for the second dependent variable and l_{ij} = vector of explanatory variables for the third dependent variable, ω_{ij} =composite error term. Note that the detailed descriptions of the explanatory variables are given by Table 3.2.

Table 3. 2: Description of Variables used in the multivariate probit model

Variable	Variable	Measurement
$\mathbf{X_1}$	Gender	dummy 1 if respondent is a male; 0 otherwise
$\mathbf{X_2}$	Age	In years
$\mathbf{X_3}$	Education	dummy 1 if respondent is formally-educated; 0 otherwise
$\mathbf{X_4}$	Marital status	dummy 1 if respondent is married; 0 otherwise
$\mathbf{X_5}$	Salaried worker	dummy 1 if respondent does salaried work; 0 otherwise
$\mathbf{X_6}$	Self-employed	dummy 1 if respondent does own work; 0 otherwise
$\mathbf{X_7}$	Monthly income	Ghana cedi
$\mathbf{X_8}$	Household income earning members	Number of people
$\mathbf{X_9}$	Vegetable expenditure	Ghana cedi
$\mathbf{X_{10}}$	Frequency of vegetable shopping	dummy 1 if respondent buys vegetables daily; 0 otherwise

X_{11}	Appearance	Dummy; 0 if respondent considers appearance when buying vegetables, 1 otherwise
X_{12}	Nutritional values	Dummy; 0 if respondent considers nutrition when buying vegetables, 1 otherwise
X_{13}	Source of irrigation	Dummy; 0 if respondent considers the source of irrigation water (waste or clean) when buying vegetables, 1 otherwise
X_{14}	Use of Agrochemical	Dummy; 0 if respondent considers the use of agrochemicals when buying vegetables, 1 otherwise
X_{15}	Trust in farmers	Dummy based on the mean score; 1 for trust high thus, if respondent trust score is equal or higher than the mean score, 0 otherwise
X_{16}	Trust in traders	Dummy based on the mean score; 1 for trust high thus, if respondent trust score is equal or higher than the mean score, 0 otherwise
X_{17}	Quality perception	Mean score
X_{18}	Price perception	Mean score
X_{19}	Packaging perception	Mean score
X_{20}	Environment perception	Mean score
X_{21}	Health perception	Mean score
X_{22}	Taste perception	Mean score
X_{23}	Nutrition perception	Mean score
X_{24}	Hazard-free	Mean score
X_{25}	Certification perception	Mean score
X_{26}	Labelling perception	Mean score
X_{27}	Overall food safety knowledge	Mean score

3.7.2 Analyzing of Food Safety Knowledge (FSK) and Perceptions (FSP)

A list of four food contaminants (i.e., microbial pathogens, agrochemical residues, heavy metals and physical materials) and five health-related implications of food contaminants were presented to the respondents to state their level of agreement based on the extent to which the concepts are possible. The responses were measured on an ordinal scale of -1 to 1, indicating the degree to which consumers were in agreement or disagreement on various food safety issues. A response of -1 indicated strong disagreement on the particular food safety issue, while a response of +1 indicted strong agreement. A zero-score meant neutral. These responses were then averaged to form a knowledge index. This was also used to measure consumers' perceptions of food safety, thus, using a list of ten possible attributes of food safety (they include, health,

nutrition, taste, hazard-free, quality, price, packaging, environment, certification and labelling).

3.7.3 Analyzing Possible Constraints that Consumers Might Confront in Accessing Safer Vegetables

The Kendall's coefficient of concordance (W) was used to rank and test the level of agreement between consumers' perceived challenges in accessing safer vegetables in Tamale. The Kendall's coefficient (W) is a measure of the degree of agreements among m number of observations (respondents) of n set of challenges (Legendre, 2005). The Kendall's coefficient of concordance is calculated on an ordinal or interval scale. The Kendall's coefficient has a value of $0 \le W \le 1$, with 1 representing perfect concordance. W is a non-parametric test (ordered categories) that is used when the result comes from different sources (from different judges) and concerns (constraints) for $(k >= 2)$ objects. The Kendall's coefficient of concordance measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of the sum of ranks. The formula for computing Kendall's coefficient of concordance is specified below:

$$W = \frac{\left[\sum T^2 - \left(\sum T\right)^2 / n\right] / n}{m^2\left(n^2 - 1\right)/12} = \frac{12\left[\sum T^2 - \left(\sum T\right)^2 / n\right]}{nm^2\left(n^2 - 1\right)}$$

(3.22)

where T = sum of ranks for each constraint being ranked, m = number of observations, n = number of constraints. The Kendall's coefficient of concordance is accompanied by a test using the chi-square distribution. W tests the null hypothesis of no agreement among the perceived challenges faced by consumers in accessing safer vegetables. The chi-square formula for testing the significance among the consumers' perceived challenges in accessing safer vegetables is given as:

$$\chi^2 = m(n-1)\mathrm{W} \qquad \textbf{(3.23)}$$

The decision rule is that if the chi-square computed is greater than the chi-square critical, then the null hypothesis is rejected in favor of the alternative hypothesis meaning that there is agreement among the ranking of the consumers' perceived challenges in accessing safer vegetables.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter contains the results and discussions of the field data. It presents the results on respondents' demographic characteristics (section 4.1), frequency of food shopping (section 4.2), vegetable expenditure (section 4.3), attributes respondents consider when buying vegetables on the market (section 4.4), respondents' level of trust in farmers and traders (section 4.5), respondents' food safety knowledge (section 4.6) and perceptions (section 4.7), respondents' WTP more for safer vegetables (section 4.8), determinants of WTP a price premium for safer vegetables (section 4.10), respondents' preferences for fresh vegetable market outlets (section 4.11) and the possible challenges that respondents think they would face in accessing safer vegetables (section 4.12).

4.1 Descriptive Results

This section presents the results of gender, age, education, marital status, religion and ethnicity of 331 respondents. The remaining 19 observations were not included in the analysis because of large missing responses.

4.1.1 Sex of Respondents

Sex was measured a dummy, coded a value of 1 if the respondent is a male and 0 if the respondent is a female. The results revealed that the majority (71.9%) of the respondents was females and the remaining 28.1% were males (Table 4.1). This result is supported by Danso-Abbeam *et al*. (2014) who found 84.16% of their respondents being females and 15.84% were males in Tamale. Gender-wise, food purchases and cooking are dominated by women in almost all traditional households (Assibey-Mensah, 1998). Many a time, it is the duty of the woman to take decisions regarding what type of food is to be purchased and prepared or consumed (Isife & Emodi, 2000). This indicates the amount of information about food purchase and preparation that women have compared with men.

Table 4. 1: Results of Gender of Respondents

Variable	Group	Frequency	Percentage
Gender	Feale	238	71.9
	Male	93	28.1
	Total	**331**	**100.0**

Source: Author's Construct from Field Data, 2016

4.1.2 Age of Respondents

Age is measured as a continuous variable, indicating the number of years the respondent had at the time of the survey. The results indicated an average age of 38 years for the sample which shows that the respondents surveyed are within the active working age group, capable of providing some disposal income for household food

consumption. The minimum age was 16 years and the maximum age was 75 years (Table 4.2). Similarly, the highest (28.7%) of respondents was between the age bracket of 26-35 years.

Table 4. 2: Results of Age of Respondents

Variable	Group	Frequency	Percentage	Mean	SD	Min	Max
Age (in years)				38	12.6	16	75
	16 – 25	58	17.5				
	26-35	95	28.7				
	36-45	90	27.2				
	46-55	47	14.2				
	>55	41	12.4				
	Total	**331**	**100.0**				

Source: Author's Construct from Field Data, 2016

4.1.3 Education of Respondents

Education was categorized into "no formal", "non-formal", "primary school", "junior high school", "senior high school" and "tertiary" education. In all, 65% of the respondents surveyed were educated beyond the primary school level (Table 4.3), and this signifies that the sample was fairly-educated to possess adequate information about food safety. This result is consistent with national data (GLSS 6 round), which shows that about 44.6% of persons aged at least 15 years are educated beyond the basic education level in Ghana (GSS, 2014). The results showed that the highest percentage (32.3%) of the respondents surveyed had no formal education followed by tertiary education (29.9%). These results are not in line with Danso-Abbeam *et al*. (2014) who found that 62.5% of their respondents in Tamale obtained tertiary education but it is consistent with Alhassan *et al*. (2017) who asserted that 36.7% of respondents surveyed in Tamale had no formal education. The cross-tab unveils significant differences (chi2=60.42; sig. <0.01) between education and sex. Males have a significant higher

education than females. Comparatively, majority of males have senior high (24.7%) and tertiary (53.8%) education than females (13.9%) and (20.6%) respectively. Gender inequality in education is still a major issue in Tamale.

Table 4. 3: Distribution of Educational level of Respondents by Sex

Variable	Male (%)	Female (%)	Pooled (%)	*Sig.*
Education				60.42***
No formal	5.4	42.9	32.3	
Non-formal	3.2	2.5	2.7	
Primary school	6.5	9.6	8.8	
Junior high	6.5	10.5	9.4	
Senior high	24.7	13.9	16.9	
Tertiary	53.7	20.6	29.9	
Total %	**100**	**100**	**100**	
n	**93**	**238**	**331**	

Source: Author's Construct from Field Data, 2016

4.1.4 Marital Status of Respondents

Marriage is an important aspect of the culture of traditional societies. The study revealed that majority (76.5%) of the respondents surveyed was married. Also, the percentage of the respondents who were never married, widowed and divorced were 16.1%, 6.5% and 0.9% respectively (Table 4.4). These results are in consonance with Danso-Abbeam *et al*. (2014) who asserted that 83.33% of their respondents surveyed was married. In Ghana, 57.7% of people at least age 12 years have ever married (GSS, 2014). In Tamale, 48.6% of people aged at least 12 years have married, 44.2% have never married (44.2%) and 4.0% are widowed. Marital status was further dummied, which assumes a value of 1 if respondent is married and 0 otherwise. Results also show that there are significant differences in marital status of males and females (chi2 = 15.15; sig. < 0.01).

Table 4. 4: Distribution of Marital Status of Respondents by Sex

Marital status	Male (%)	Female (%)	Pooled (%)	*Sig.*
Single	21.5	13.4	15.7	12.15***
Married	78.5	76.5	77.0	
Divorced	0.0	1.3	0.9	
Widowed	0.0	8.8	6.3	
Total %	**100.0**	**100.0**	**100.0**	
n	**93**	**238**	**331**	

Source: Author's Construct from Field Data, 2016

4.1.5 Major Occupation of Respondents

The study found most (47.7%) of the respondents surveyed to be petty traders (Table 4.5) and this is consistent with the results of Alhassan *et al*. (2017) who reported that 41.7% of their respondents in Tamale are traders; indicating that Tamale is a commercial business hub in the three Northern Regions and the West African sub-region, and also fast-urbanizing. More so, 20.4% of the respondents were salaried workers; 11.3% were into craft work; 7.2% were students and only 3.5% of the surveyed respondents were wage workers. In the Tamale Metropolis, 33.0% are engaged as service and sales workers, 21.5% are traders and craftsmen, 17.6 are employed in agriculture, 8.1% are doing professionals work (GSS, 2014).

Table 4. 5: Results of Major Occupation of Respondents

Variable	Group	Frequency	Percentage
Occupation	Farming	27	8.2
	Waged worker	11	3.3
	Salaried worker	65	19.6
	Petty trading	152	45.9
	Craftsman	36	10.9
	Student	23	6.9
	Others	17	5.1
	Total	**331**	**100.0**

Source: Author's Construct from Field Data, 2016

4.1.6 Religion of Respondents

The study obtained data on religious status of respondents. By comparison, about 73.0% of household heads are Christians in Ghana, and this is especially the case of people staying in the Southern Belt. But in the Northern Belt, especially the Northern Region, Islam is practiced by a high proportion (83.6%) of households (GSS, 2014). Tamale is also Islam dominated (GSS, 2014), and this corresponds with the results of the study since the majority (76.8%) of the respondents interviewed was Muslims. Also, 22.6% of the respondents were Christians while 0.6% were traditionalists (Table 4.6).

Table 4. 6: Results of Religious Affiliation of Respondents

Variable	Group	Frequency	Percentage
Religion	Traditional	2	0.6
	Christian	74	22.4
	Islam	255	77.0
	Total	**331**	**100.0**

Source: Author's Construct from Field Data, 2016

4.1.7 Ethnicity of Respondents

The study showed that the majority (66.5%) of respondents in Tamale was Dagombas (Table 4.7). This is not surprising because in the Northern Region, 67.1% of households are Mole-Dagabni (GSS, 2014), and Tamale is also dominated by Dagbon people who are mostly Dagombas. The study also identified that 8.2% of the respondents were Mamprusis followed by Frafras (8.2%) and Gonjas (7.6%). This is

also true because Mamprusi and the Gonjas share boundaries with the Dagombas and moreover, the Frafras are located at the Upper East Region closer to the Northern Region. It was further revealed that only 1.2% of the respondents were Akans.

Table 4. 7: Results of Ethnicity of Respondents

Variable	Group	Frequency	Percentage
Ethnicity	Dagomba	220	66.50
	Gonja	25	7.60
	Mamprusi	27	8.20
	Kasena/Nankana	7	1.50
	Akan	4	1.20
	Frafra	27	8.20
	Mosi	3	0.90
	Konkomba	15	4.50
	Bimoba	1	0.30
	Dagati	1	0.30
	Fulani	1	0.30
	Total	**331**	**100.0**

Source: Author's Construct from Field Data, 2016

4.1.8 Monthly Income

Income was measured as a continuous variable in Ghana cedi (or GH₵). The results revealed that on average respondents' households earn an income of GH₵ 1,239.9 a month. The minimum monthly income earned by respondents' household was GH₵ 20 and the maximum was GH₵ 15,400 (Table 4.8). The monthly income tends to combine the income earned by mature working persons (thus, 15 years or more) from both major and minor occupations. The study further revealed that the highest percentage (32.1%) of the respondents earned a monthly income of equal to or less than GH₵500 (lowest income earners) and the lowest percentage (6.3%) of respondents earned a monthly income between GH₵ 1501 and GH₵ 2000 (upper middle-income earners). Comparatively, there were statistical significant differences between the household incomes of males and females in the sample (chi2 = 7.69; sig<0.05).

Table 4. 8: Results of Household Income of Respondents

Variable	Male (%)	Female (%)	Pooled (%)	*Sig.*
Income group				7.69**
GH₵<=500	23.3	35.7	32.1	
GH₵501- ¢1500	43.0	37.6	39.2	
GH₵1501-¢2500	18.6	9.5	12.2	
GH₵>2500	15.1	17.2	16.5	
Total	100.0	100.0	**100**	
n	**93**	**238**	**331**	
Mean income = GH₵ 1239.9				
Std. Dev. = 1388.4				
Minimum =GH₵ 20				
Maximum = GH₵1540020				

Source: Author's Construct from Field Data, 2016

4.1.8.1 Household Income and Paid Employment status

Results in Table 4.18 show a higher significant household income (GH₵ 2012.3) for salaried workers compared to self-employed (GH₵ 1102.7) and no work respondents (GH₵ 766.6). The F-value of the analysis of variance (ANOVA)showed that there exist signifcant difference in the income of household among the different paid job working

Table 4.8. 1: Distribution of household income by paid Employment

Employment status	Mean Income	Std. Dev.	F-value	P-value
Salaried	2012.3	2116.3	12.6	0.0000
Self-employed	1102.7	1087.9		
No work	766.6	882.4		
Total	1239.9	1388.3		

Source: Author's Construct from Field Data, 2016

4.2 Frequency of Food Shopping

In terms of how many times respondents buy foods on the markets, the study found that most of the respondents are regular buyers of fish and vegetables compared with other food items. Thus, the highest percentage (76.9%) of the respondents buys fish daily followed by vegetables (70.4%) (Table 4.9). The results on vegetables can be compared

to Acheampong *et al*. (2012), who revealed that most respondents (88.7%) purchased vegetables daily. This is partly because fish and vegetables are highly perishable and easily get spoiled if refrigeration is scarce to preserve them. This suggests that consumers may prefer safer vegetables to be fresh and very appealing to the eye. This assertion is in line with Ali *et al*. (2015) who asserted that respondents buy vegetables more frequently due to their perishable nature. Vegetable shopping continues to gain popularity in the Ghanaian household (GSS, 2014). However, staples such as rice, maize and yam, and fish dominate in this study with regards to the total share of the food expenditure. Vegetables were bought in smaller quantities, usually in small tins and bundles and not stored but consumed immediately, whilst cereals were bought in larger quantities in bags or 'olonka' (a local measuring bowl of 5kg) and stored for a month or more.

Vegetables are used for a variety of meals as a main dish (e.g., as salad) or a side dish (e.g., soup and sauce) and eaten with cereals (Smith & Eyzaguirre, 2007). Cabbage was consumed outside the home, usually purchase together with rice at street food joints, restaurants and hotels while *ayoyo* and okra were consumed in the home. This might suggest that respondents purchased more *ayoyo* and okra than cabbage. The study further found that shopping patterns were likely to change in the dry season, especially with vegetables, because most respondents buy large volumes of vegetables sometimes once or twice a week and processed or prepared into meals and stored to save money and availability. In Tamale, vegetables are relatively scare in the dry season compared to the wet season. The highest percentage (57.1%) of the respondents buys beverages daily. The study further revealed that 44.9% and 42.2% of the respondents bought fruits and meat once or twice a week, respectively (Table 4.9). Also, 40.4% bought staples

monthly because of their less perishability and are mostly consumed. In most households in the north, fish and fish products are mostly mashed into vegetable soup and sauce as a main meal or a side dish to complement starchy foods such as *Banku, Kenkey and Tuozafi*. Meat is less consumed and predominantly found in occasional meals or food bought outside from the home in Tamale, especially among poor households. Beverages and fruits were consumed as snacks and deserts, mostly outside home.

Table 4. 9: Results of Frequency of Food Shopping

Food item	(n)	Frequency of Shopping					
		Daily (%)	Weekly (%)	Fortnightly (%)	Monthly (%)	Others (%)	Total (%)
Vegetables	331	70.4	27.8	0.3	0.6	0.9	100.0
Fruits	301	33.9	44.9	11.0	6.5	3.7	100.0
Beverages	266	57.1	19.6	1.5	12.0	9.8	100.0
Fish	324	76.9	15.1	0.6	6.5	0.9	100.0
Meat	296	30.7	42.2	4.4	12.2	10.5	100.0
Staples	329	9.0	22.8	10.6	40.4	17.2	100.0

Source: Author's Construct from Field Data, 2016

4.3 Weekly Food Expenditure

The study obtained weekly food expenditure from respondents, and found that on an average, respondents' household spends GH₵ 125.3 on food items only a week (Table 4.10). The minimum amount of money spent on food every week was GH₵ 10.6 and

the maximum amount of money spent on food every week was GH₵ 1,102. The finding of this study is higher than the national average of GH₵ 3,673 per annum (equivalent to GH₵ 70.6 per week) on food and non-alcoholic beverages for all households, and GH₵ 4,471 per annum (equivalent to GH₵90 per week) for urban households (GSS, 2014; GLSS Round 6 Report). The study also revealed that out of the total amount spent on food, 24.9% is spent on staples followed by fish and fish products (17.7%), vegetables (17.6%), beverages (16.0%) meat (15.7) and fruits (8.1%). Respondents' frequent purchase of vegetables in smaller quantities can make them spend high amount of their food budget on them. This means that respondents may either reduce the volumes of vegetable products bought or increase its share to total food budget when price increases. The study revealed that staple foods dominate household expenditure with a mean of GH₵ 31.2 per week, followed by fish (GH₵ 22.24), vegetables (GH₵ 22.01), beverages (GH₵ 20.05), meat (GH₵ 19.73) and fruits (GH₵ 10.1). The results of the study were compared with the Ghana Living Standards Survey (GLSS Round 6) Report and found that households in Ghana spend, on an average, 8.3% of their total food expenditure on fish and sea products, 8.0% on bread and cereals, 5.4% on vegetables, 3.7% on meat and 2.8% on non-alcoholic beverages. The result of expenditure on vegetables of the present study is consistent with the GLSS Round Six (6) data.

Table 4. 10: Results of household food expenditure (Weekly basis)

Food item	(n)	Mean (GH₵)	SD	Min	Max	% of Total Exp.	Rank
Staples	329	31.2	52.9	0	840	24.9	1st
Meat	297	19.7	38.9	0	420	15.7	5th
Fish	324	22.2	29.5	0	420	17.7	2nd
Beverages (*non-alcoholic*)	266	20.1	21.8	0.13	105	16.0	4th

Fruits	301	10.1	18.3	0	210	8.1	6th
Vegetables	331	22.0	19.7	0.4	140	17.6	3rd
Pooled Expenditure	331	125.3	103.8	10.6	1102	100.0	

Source: Author's Construct from Field Data, 2016

4.4 Respondents' Food Safety Knowledge (FSK)

This variable was measured as general awareness and the amount of idea or information individuals perceive to possess about a phenomenon or concept. In the current study, knowledge was defined as the level of respondents' understanding or familiarity with certain food hazards and contamination, and their resultant effect on human health. The overall knowledge of food safety was computed as a maximum of nine points: four of the questions relating to 4 perpetual food hazards, namely pathogenic microorganisms, agrochemical residues, heavy metals and physical materials that could cause vegetable poisoning, and the remaining five questions relate to the impacts of consuming contaminated foods on human health, namely foodborne diseases, malnutrition, death, infertility and loss of appetite. The study revealed that knowledge score on agrochemical residues was the highest (0.82) followed by microbial pathogens (0.7) among respondents, heavy metals (0.58) and physical materials (e.g., pieces of glass) (0.53) (Table 4.12). Interestingly, Acheampong *et al*. (2012) maintain that the majority (70.1%) of consumers in Ghana (Kunmasi) have no knowledge of how vegetable producers controlled vegetable pests and diseases. The results of the study are in line with that of Asiegbu *et al*. (2016) which indicated that most food consumers generally agreed that microbial pathogens are strongly associated with food contamination. It has been observed that most consumers consider bacteria and pesticide residues in foods as their most important concern (Nocella *et al*., 2014). In Ghana, consumers' food safety knowledge, especially with regards to pathogens and pesticides can be attributable to current practices in vegetable production. The study

found that consumers strongly believe that agrochemical residues and pathogens have stronger impacts on food contamination than heavy metals and physical materials, suggesting greater awareness creation on the impact of heavy metals and physical materials on human health.

Table 4. 11: Results of Consumer Knowledge of food hazards

Knowledge items	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	CV
Microbial pathogens	331	0.746	0.403	-1	1	-1.99	7.44	54.0
Chemical residues	331	0.822	0.355	-1	1	-2.94	14.00	43.1
Heavy metals	331	0.582	0.536	-1	1	-1.25	3.76	92.2
Physical materials	331	0.533	0.545	-1	1	-1.14	3.58	102.3

Source: Author's Construct from Field Data, 2016

Also, with regards to the resultant effects of food contaminants on human health, the study found that consumers' knowledge score on foodborne diseases was the highest (0.82) effect of the food hazards followed by deaths (0.74). In Kumasi, many consumers were generally un aware the consumption of contaminated vegetables caused any diseases (Acheampong *et al*., 2012). The findings further revealed that consumers' knowledge of malnutrition (0.58) was moderate, whilst their knowledge on loss of appetite (0.47) and infertility (0.18) were small (see Table 4.13). These results might be attributable to the persistent episodes of foodborne diseases and deaths reported by the media in Ghana. Inferring from the findings, respondents have high knowledge of foodborne diseases and immediate death as consequences of consuming contaminated foods and this can be attributed to the greater awareness of the occurrences of foodborne diseases and its associated deaths in Ghana. It can also be inferred that consumers have greater concerns for foodborne diseases and deaths than malnutrition, loss of appetite and infertility as health consequences of consuming contaminated foods.

Table 4. 12:Results of Consumer Knowledge of food related health risk

Knowledge items	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	CV
Illness	331	0.890	0.254	-1	1	-2.96	15.39	28.5
Malnutrition	331	0.582	0.510	-1	1	-1.22	3.84	87.7
Infertility	331	0.186	0.574	-1	1	-0.28	2.11	309.1
Death	331	0.628	0.505	-1	1	-1.39	4.13	80.4
Loss of appetite	331	0.474	0.549	-1	1	0.92	3.00	115.8

Source: Author's Construct from Field Data, 2016

4.5 Respondents' Perceptions of Food Safety

This study explored respondents' perceptions of food safety, in relation to quality, price, packaging, absence of hazards, environment, health, nutrition, taste, certification and labelling. This was based on respondents' subjective views about food safety as indicated by Grunert (2005) that food safety is a concept that lies in the mind or eye of the beholder. Generally, the study established that respondents had the highest positive perception of food safety on health (0.83) followed by nutrition (0.63), hazard-free (0.59), taste (0.58) and quality (0.50), environmentally (0.32), certification (0.16), labelling (0.10), packaging (0.06) and price (0.01) (Table 4.14). In other words, respondents were much concerned about food being healthier, nutritious, poison-free, tastier and having better quality.

On the other hand, consumers loosely defined food safety as environmentally-friendly, certified food, labelled food, well-packaged food, and expensive. In other words, respondents do not associate food safety with environmental issues, certification, labeling, packaging and price. These results can be compared to the findings of Aban *et al*. (2009) who investigated consumers' perceptions of food safety in Philippines.

According to them, Philippian consumers defined food safety in vegetables as "clean vegetables", and further found that some consumers had started to be food safety

conscious by purchasing vegetables that are organic, food safety labelled, and well packaged. Others also defined food safety as naturally or organically-grown and does not contain any chemical/pesticide residues whereas properly handled.

In Spain, Akgungor *et al*. (2001) found that Spanish consumers perceived food safety in vegetables as those organic that are tested or certified to be free from or with permissible amount of some hazards.

In Vietnam, Wertheim-Heck (2015) also established that consumers define food safety as "clean vegetables", referring to those 'without or with permissible level of residues of agro-chemicals. In-terms of quality and nutrition, Aban *et al*. (2009) further revealed that food safety is one that meets quality attributes such as freshness and is nutritious.

Table 4. 13: Results of Consumers' Food Safety Perceptions

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	CV
Health perception	331	0.83	0.29	-1	1	-2.08	9.70	34.3
Nutrition perception	331	0.63	0.52	-1	1	-0.15	4.47	82.6
Hazard-free	331	0.59	0.50	-1	1	-1.57	5.21	84.9
Taste perception	331	0.58	0.51	-1	1	-1.19	3.73	88.0
Quality perception	331	0.50	0.58	-1	1	-1.09	3.26	114.6
Environment	331	0.32	0.56	-1	1	-0.67	2.71	175.8
Certification perception	331	0.16	0.66	-1	1	-0.07	1.63	421.2
Labelling perception	331	0.10	0.67	-1	1	0.07	1.62	690.1
Packaging perception	331	0.06	0.62	-1	1	0.09	1.78	982.3
Price perception	331	0.01	0.66	-1	1	0.21	1.72	7325.6

Source: Author's Construct from Field Data, 2016

4.6 The Attributes Respondents consider when Buying Vegetables

Steenkamp *et al*. (1996) suggested that a products' quality attributes forms the basis for consumer preferences for that product based on which the product either accepted or rejected. The study used four (4) different attributes to elicit respondents' response on their choice of food safety and quality attributes when buying vegetables on the market; namely; freshness/appearance, nutritional qualities, source of irrigation and the use of agrochemical. The findings revealed that the highest percentage (97%) of respondents claimed that they buy vegetables when the vegetables look fresh and/or appear good (see Table 4.11). in Kumasi, Ghana, Acheampong *et al*. (2012) found that the highest (59.8%) percentage of consumers use freshness as an important attribute when buying vegetables.

The literature shows that attributes related to visual ideals are central to consumers' choice of vegetables (Aban *et al*., 2009; Hussin *et al*., 2010; Probst *et al*., 2010 and Coulibaly *et al*., 2011). About, 85.5% of the respondents reported that the nutritional qualities (e.g., vitamins and minerals) was one of the reasons why they bought vegetables and this is in consonance with Hussin *et al*. (2010) who revealed that nutrition value influences respondents' choice of vegetable.

The study also found that 70.3% and 60.0% of the respondents consider the source of irrigation water and the use of agrochemicals when buying vegetables on the market, and these results are also in line with Hussin *et al*. (2010) who revealed that nutritional value and pesticide-free vegetable are appealing to consumers. This suggests that food safety is the primary concern for consumers nowadays when buying vegetables. These results are in line with the findings of Ngigi *et al*. (2011) who reported that the attributes that consumers consider most important when buying vegetables include

nutrition, sensory and safety attributes at purchase point compared to ethics and convenience. The high dependency on search attributes on the market by consumers could be attributable to the fact that those attributes are observable and tangible to consumers. Thus, whether (or not) information labels and certification are provided on the products, consumers can use their senses to evaluate the quality in them.

Alternatively, attributes related to nutrition and production methods (such as, the use of pesticides and untreated wastewater) cannot be evaluated by consumers so the provision of information labels and certification on safer vegetables might be necessary to inform consumers' purchasing decisions, alongside creating additional cost for local producers, and increasing the prices of safer vegetables.

Table 4. 14: Results of Attributes Consumers consider when buying vegetables

Attributes	Frequency	Yes (%)	No (%)	Total (%)
Appearance	329	97.0	3	100
Nutritional values	324	85.5	14.5	100
Source of irrigation water	326	70.3	29.7	100
Use of agrochemicals	329	66.0	34	100

Source: Author's Construct from Field Data, 2016

4.7 Respondents' Trust in Farmers and Traders

Trust is a key factor that might influence preference for food safety markets. Thus, if consumers perceive current conventional vegetables by farmers and traders to be safer and healthier with high trust, they are unlikely to pay more for quality improvement in the product and vice versa (Muringai *et al*., 2017). Therefore, the study included respondents' general trusts in farmers and traders as determinants of WTP. The results showed that on average, respondents have very little trust in food actors, most especially farmers and traders. The results show that the highest (37.9%) of the respondents surveyed stated that they do not trust farmers very much whilst 13.5%

reported that they have high trust in farmers (Figure 4.1). Also, the greatest percentage (38.1%) of the respondents surveyed stated that they do not trust traders very much whilst 8.4% stated that they have high trust in traders (Figure 4.1). It is hypothesized that respondents with lower levels of trust may be willing to pay higher premiums for safer vegetables.

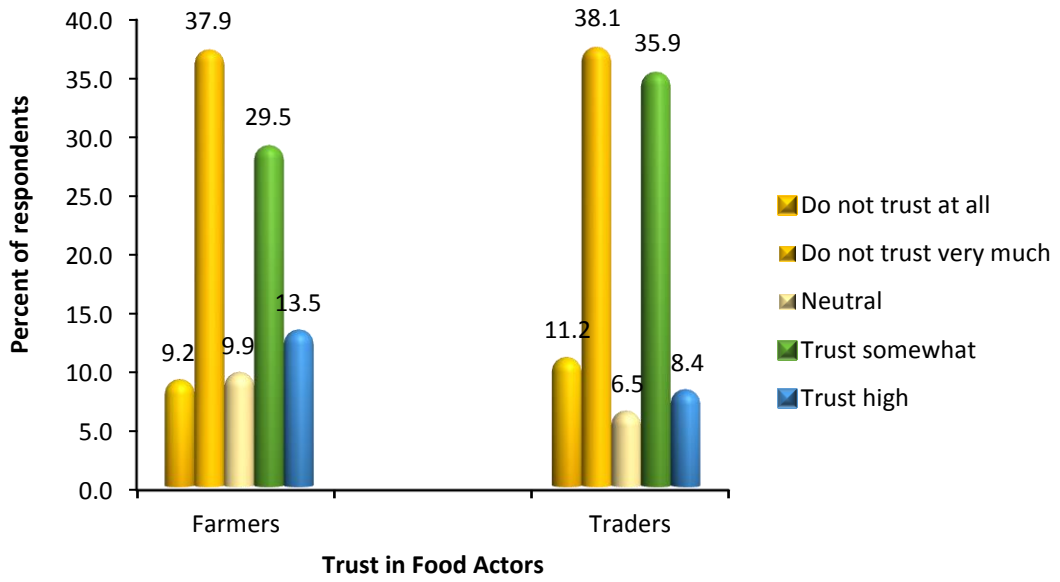

Figure 4. 1: Result of Consumers' Trust on Farmers and Traders
Source: Author's Construct from Field Data, 2016

4.8 Willingness to Pay Price Premium for Safer Vegetables

The study presents the WTP responses based on the elicitation formats. Of the 331 consumers surveyed, 73 (22.1%) were not willing to pay more (zero WTP) for safer cabbage whereas the remaining 77.9% were willing to pay price premiums for safer cabbage (Table 4.15 & Figure 4.2). Furthermore, 75 (22.6%) of the consumers were not willing to pay more (zero WTP) for safer ayoyo and okra, respectively while the remaining 77.4% were willing to pay certain price premiums for the vegetables (Table 4.15 & Figure 4.2). These results are in line with Suresh *et al*. (2015) who reported that about 85% of the Delhi consumers were willing to pay more for residue-safe vegetables

but contrary to Ngigi *et al.* (2011) who revealed that slightly over 39% of Kale consumers were willing to pay for quality vegetables in Nairobi. Also, the results revealed that 39.6% of the consumers were willing to pay the highest price premium (YES-YES) for safer cabbage whilst 56.2% were willing to pay the highest price premium (YES-YES) for safer ayoyo. Also, more than sixty percent (62.8%) were willing to pay the highest price premium (YES-YES) for safer okra (Table 4.15 & Figure 4.2). The study found that consumers have higher WTP for safer okra followed by safer ayoyo and cabbage. Higher WTP for ayoyo and okra could be the case that these two vegetables are highly consumed by household in Tamale compared to cabbage. Cabbage, which is an exotic vegetable is rarely prepared and eaten by traditional households. They are mostly consumed outside the home in food joints.

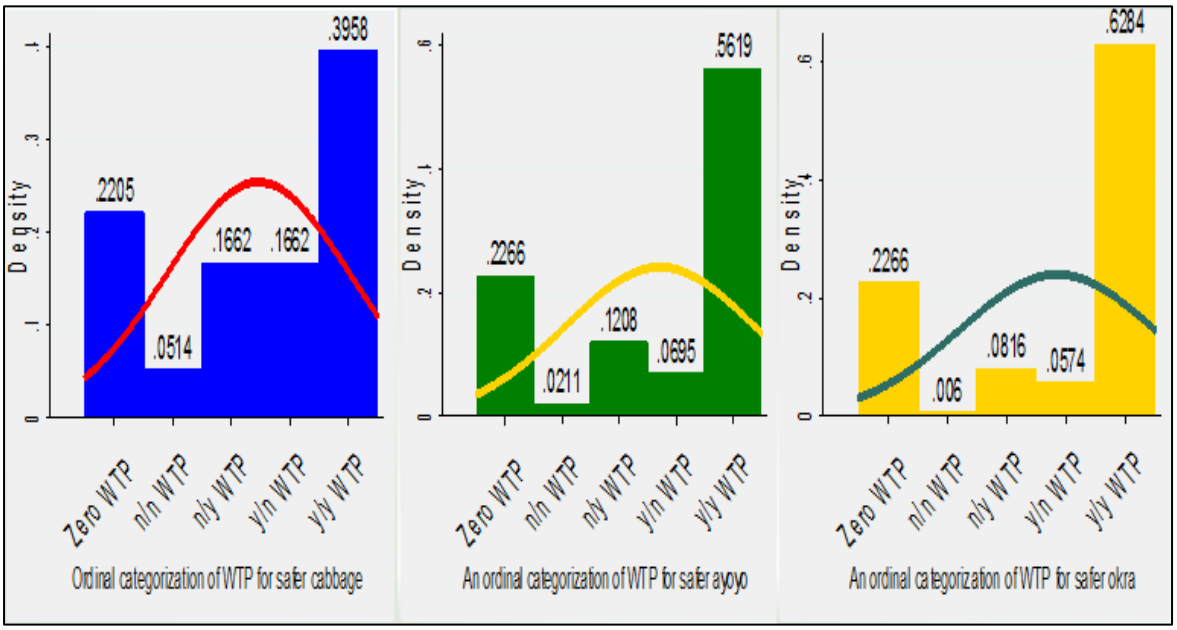

Figure 4. 2: WTP premium prices Distributions

Source: Author's Construct from Field Data, 2016

Table 4. 15: Results of WTP price premiums for safer vegetables

	Cabbage		Ayoyo		Okra	
WTP bids	*n*	*%*	*n*	*%*	*n*	*%*
Zero WTP	73	22.1	75	22.7	75	22.7

₵$_1$>WTP (NO-NO)	17	5.1	7	2.1	2	0.6
₵$_1$>WTP<₵$_2$ (NO-YES)	55	16.6	40	12.1	27	8.2
₵$_2$>WTP>₵$_2$ (YES-NO)	55	16.6	23	7.0	19	5.7
WTP>₵$_3$ (YES-YES)	131	39.6	186	56.2	208	62.8
Total	331	100.0	331	100.0	331	100.0

Source: Author's Construct from Field Data, 2016

4.8.1 Estimating Total WTP (TWTP) and Mean WTP (MWTP) for safer vegetables

The study recorded a minimum WTP amount for 1.5 kg of safer cabbage to be GH₵ 3.5 and the maximum WTP amount for the same size of the vegetable was GH₵ 15. The mean willingness to pay (MWTP) for 1.5 kg safer cabbage was GH₵ 8.00 (US$ 1.90) (thus, about 128.6% premium price) (Table 4.16). In terms of the results of the percentage price premium, Nouhohefin *et al*. (2004) reported that the MWTP for pesticide-free vegetables was 57% for cabbage. Lippe *et al*. (2010) found a 91% WTP on average for chemical-free cabbage in Thailand. In Vietnam, Mergenthaler *et al*. (2009) found that consumers were willing to pay 60% price premiums for safer vegetables on average. It was revealed that the minimum WTP amount for 1 bundle of safer ayoyo was GH₵ 1.2 and the MWTP for 1 bundle of safer ayoyo was GH₵ 3.27 (US$ 0.78) (thus, about 197.3% premium price). Interestingly, the maximum WTP for 1 bundle of safer ayoyo was GH₵ 5 and the minimum WTP for 0.5 kg safer okra was GH₵ 1 (Table 4.16). Also, a mean WTP amount of GH₵ 2.89 (US$ 0.69) was recorded for 0.5 kg safer okra (thus, about 189.0% premium price). The maximum WTP amount of 0.5 kg safer okra was GH₵ 5. The results showed that though the MWTP for safer cabbage seems higher than the MWTP for safer ayoyo and safer okra, in percentage terms, respondents were willing to pay high premium price for safer ayoyo and safer okra in ascending order of magnitude than safer cabbage. This might be attributable to

the fact that cabbage (as an exotic vegetable) is rarely consumed by residents compared to ayoyo and okra.

Table 4. 16: Results of Consumers' WTP a price premium from Ordered Logit estimations

Statistics	MWTP (GH₵)	% Increment of premium price	Min	Max	UD$ Equivalence
Safer Cabbage	8.00	128.6	3.5	15	1.90
Safer Ayoyo	3.27	197.3	1.2	5	0.78
Safer Okra	2.89	189.0	1	5	0.69

Source: Author's Construct from Field Data, 2016

Note: *At the time of Data collection, the Mean Daily Interbank FX Rates of dollar and cedi for the month of November and December (2016) were UD$ 1 ~ GH₵ 4.20988 and GH₵ 4.17981, respectively (Bank of Ghana (BoG), 2016). Average market price for conventional cabbage =GH₵ 3.50, average market price for conventional ayoyo=GH₵ 1.10; average market price for conventional okra =GH₵ 1.00.*

4.8.2 Reasons for willing to pay for safer vegetables

The study asked consumers to state the reasons why they were willing to pay more for safer vegetables. The results revealed that health, nutrition and taste were the most important concerns driving consumers' WTP price premiums for safer vegetables and price was their least concern. The study found that 99.2% of the consumers were willing to pay more for safer vegetables because of their health benefits; 85% said yes because of their high nutritional value (e.g., vitamins and minerals); 81.2% said yes because of the good taste and lastly, 52.5% stated affordable price as the main reason for willing to pay more for safer vegetables (Table 4.17). The results suggest that there is a growing but hidden health conscious individuals so in the future (especially in the next 10-20 years) the demand for safer foods is expected to rise. Now, developing countries' consumers do not necessarily consider food safety as secondary concern (Ordonez, 2016). The results of this study are pointing to the fact that consumers in developing countries are gradually becoming concerned about food safety.

Table 4. 17: Results of Reasons for willing to pay more for safe vegetables

Reasons	Total (*n*)	Yes *n* (%)	No *n* (%)	Do not know *n* (%)
Affordability	263	138 (52.5)	125 (47.5)	0 (0.0)
Nutrition	263	226 (85.9)	18 (6.8)	19 (7.2)
Taste	261	212 (81.2)	35 (13.4)	14 (5.4)
Health	264	262 (99.2)	2 (0.8)	0 (0.0)

Source: Author's Construct from Field Data, 2016

4.8.3 Reasons for not willing to pay more for safer vegetables

Similarly, the study asked consumers to state the reasons why they were not willing to pay more for safer vegetables. The results also revealed that higher price was the major reason (66.6%) they were not willing to pay more for safer vegetables. The others are their inability to differentiate between safer vegetables and conventional vegetables (30.3%) and their beliefs that market vendors supply them safe vegetables (12.1%) (Table 4.18). Lack of distinction between safer and conventional vegetables create information asymmetry in the vegetable market. Most studies have argued that developing countries' consumers are financially constrained, and this affects their demand for safer food (Ordonez, 2016).

Table 4. 18: Results of reasons for not willing to pay more for safe vegetables

Reasons	(*n*)	%
Non-affordability	44	66.7%
Conventionally-produced are safe	20	30.3%
My market vendors only sell me safe vegetables	8	12.1%
No reason	2	3.0%

Source: Author's Construct from Field Data, 2016

4.8.4 Empirical Regression Results of Factors Affecting Consumers' WTP more for Safer Cabbage

The ordered logit regression model was used to analyze factors that influence consumers' WTP price premiums for safer cabbage. The dependent variable (WTP

price premiums for safer vegetables) was measured on an ordinal scale of 5; with 0 as the lowest value indicating ZERO WTP, 1 for NO-NO WTP, 2 for NO-YES WTP, 3 for YES-NO WTP and 4 as the highest value indicating YES-YES WTP.

For the cabbage model, the coefficients and standard errors of the explanatory variables, and the marginal effect on the individual price premiums are presented in Table 4.20. The model contained 30 explanatory variables measured as either continuous or dichotomous variable (Table 4.20). The maximum likelihood results of the ordered logit regression model revealed that the coefficients of education, nutritional values, source of irrigation water, trust in traders and price perception were negative and significantly related to WTP price premiums for safer cabbage whereas salaried worker, self-employed, trust in farmers, health perception and perception about hazard-free had a positive significant influence on WTP price premiums for safer cabbage. The model was statistically significant at 1% level using the LR chi^2 test (108.47) (Table 4.19), which implies that at least one of the explanatory variables has a significant influence on consumers' WTP price premiums for safer cabbage. The pseudo $R^2$of 0.1429 shows that about 14.29% of the probability of willing to pay price premium safer cabbage is explained by the explanatory variables. In addition, the count R^2 of 0.487 shows that the overall ability of model to yield correct predictions of consumers' WTP price premiums for safer cabbage is 48.7% (Table 4.19).

Table 4. 19: Model fit Statistics from the Ordered Logit Models for analyzing consumers' WTP price premiums for safer cabbage

Statistics	Estimated Value
Number of Obs.	286
LR Chi^2 (30)	108.47
P-Value	0.000
Pseudo R^2	14.29%

Count R^2	48.70%

Source: Author's Construct from Ordered Logit Regression Model Estimation

Education and WTP price premiums for Safer Cabbage

The education variable was measured as a dummy, with 1 indicating the attainment of formal education and 0 indicating no formal education among consumers. The coefficient of this variable was negative and significant (at 5% level), with the negative significant sign showing that the attainment of formal education reduces the probability of willing to pay the highest price premium (YES-YES) for safer cabbage, other things held constant. This result does meet expected a *priori* because educated consumers have greater access to information, which is expected to increase their preference for safer food products, which often come with higher prices. However, in case they assume to already purchasing such products, then, they have no incentive to pay a premium for safer cabbage. The marginal effect of education on the highest WTP price premium (YES-YES) for safer cabbage is -0.155, meaning that consumers with formal education have lower probability of willing to pay paying the highest price premium (YES-YES) for safer cabbage by 15.5% compared to consumers with no formal education, holding all other variables constant. The literature by Suresh *et al*. (2015), Boccaletti & Nardella (2000), Sckokai *et al*. (2010) and Vidogbéna *et al*. (2015) is in line with the result of education as their studies found a negative relationship between education and consumers' WTP. However, the results of studies by Lin (1995), McGuirk *et al*. (1990), Ngayga (1996) and Posri *et al*. (2006) are not consistent with this study because they found a positive significant relationship between education and WTP.

Self-employed and WTP price premiums for Safer Cabbage

Self-employed was a dummy obtained from an indicator variable employment status with unemployed consumers being the reference category. This variable was found to have a positive significant relationship (at 10% level) on consumers' WTP price premiums for safer cabbage, compared to the reference category (unemployed consumers). The significant positive sign on the coefficient of self-employed means that the probability of willing to pay the highest price premiums (YES-YES) for safer cabbage increases significantly for consumers who are self-employed compared to those who are unemployed, other things held constant. A reason for this could be that self-employed consumers have higher household income (Table 4.1.8.1). thus, demand is backed by purchasing power, so those who have a secure source of income will be more willing to more for safer cabbage than those without a secure source of income. The marginal effect of self-employed on the consumers' WTP the highest price premium (YES-YES) for safer cabbage is 0.184, meaning that consumers who are self-employed have higher probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 18.4% than unemployed consumers, holding all other variables constant. This finding is consistent with that of McGuirk *et al*. (1990) who reported that employed consumers are most likely to be willing to pay more for food safety. Contrary to this finding, Ngayga (1996) revealed that unemployed consumers are more willing to pay higher WTP price premium for food safety compared to employed-consumers.

Salaried Worker and WTP price premiums for Safer Cabbage

Similarly, salaried worker was a dummy coded 1 if respondent is a salaried worker, 0 otherwise. The coefficient of salaried worker was also positive and significant at 10% level. The positive significant sign on the coefficient of salaried worker implies that

consumers who are salaried workers are more probable of willing to pay the highest price premiums (YES-YES) for safer cabbage compared to unemployed consumers, holding all other variables constant. In other words, being a salaried worker increases the probability of willing to pay the highest price premium (YES-YES). A reason could be that salaried workers have secured source of income that can enable them pay higher prices for safer cabbage, and even sustain them into the future when prices increase. Ii other words, certainty of income from public sector or more formal employment may make it an easier source of payment of safer cabbage. The marginal effect of salaried worker on consumers' WTP the highest price premium (YES-YES) for safer cabbage is 0.228, meaning that being a salaried worker increases one's probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 22.8%, holding all other variables constant.

Household Monthly Income and WTP price premiums for Safer Cabbage

Household monthly income was measured on a continuous scale. The literature states that income and demand for normal goods are positively related (Viegas, 2013), and this is true for this study. The estimated coefficient on income is significant and positive, in accord with the theoretical expectation that higher income consumers can afford and demand higher quality products. Thus, the positive significant relationship between household monthly income and consumers' WTP price premiums for safer cabbage (at 10% level), other things being constant. This is not surprising because the literature has found that the proportion of consumers buying safer food products is increasing and this has been partly attributed to increases in income. Households with higher income have their members employed or earning incomes (Table 4.1.8.1). This posits that a rise in the economic wellbeing of consumers will positively increase

consumer demand for food safety. This result is in line with Boccaletti & Nardella (2000), Posri *et al*. (2006) and Yahaya *et al*. (2015) who also found a positive significant relationship between household income and consumers' WTP. The effect of income on consumers' WTP the highest price premium was not particularly strong. For example, the marginal effect of income on WTP the highest price premiums (YES-YES) for safer cabbage is 0.00006, meaning that a marginal increase in income increases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 0.006%, holding all other variables constant. Inferring from the marginal effect estimate, the study concludes that income has negligible impact on WTP.

Nutritional Values and WTP price premiums for Safer Cabbage

Nutritional value of vegetables was measured as a dummy with 0 indicating consumers who consider the nutritional values when buying vegetables and 1 if otherwise. From the results, the aspect of vegetables related to nutritional values had a significant negative effect on consumers' WTP price premiums for safer cabbage (at 5% level). The significant negative sign on the coefficients of nutritional values on consumers' WTP price premiums for safer cabbage means that consumers who consider nutritional values when buying vegetables have higher probability of willing to pay the highest price premium (YES-YES) for safer cabbage, other things being constant. The marginal effect of nutritional values on consumers' WTP the highest price premium (YES-YES) for safer cabbage is -0.177, which shows that consumers who consider nutritional values when buying vegetables are more likely to be willing to pay the highest price premium (YES-YES) for safer cabbage by 17.7%, holding all other variables constant. This result is consistent with Makatouni (2002) who reported that consumers were

willing to pay more for safe organic products because of product characteristics such as nutritional values. Also, in Ghana, Bonti-Ankomah & Yiridoe (2006) revealed that consumers were willing to pay more for organic products because of their nutritional value.

Source of Irrigation Water and WTP price premiums for Safer Cabbage

The source of irrigation water was measured as a dummy variable with 0 indicating consumers who consider the source of irrigation water when buying vegetables and 1 if otherwise. The source of irrigation water has a negative significant influence on consumers' WTP for safer cabbage (at 1% level). This result means that consumers who consider the source of irrigation water have higher probability of willing to pay the highest price premium (YES-YES) for safer cabbage, other things being constant. This result meets expected a *priori* because microbial contamination, which arises from the use of untreated wastewater is a common concern of consumers. The marginal effect of source of irrigation on consumers' WTP the highest price premium (YES-YES) for safer cabbage is -0.239, meaning that consumers who consider the source of irrigation water when buying vegetables are most likely to be willing to pay the highest price premium for safer cabbage by 23.9%. In other words, considering the source of irrigation water when buying vegetables increases the probability of willing to pay the highest price premium (YES-YES) by 23.9%, holding all other variables constant.

Trust in Farmers and WTP price premiums for Safer Cabbage

The coefficient of trust was positive and significantly related to consumers' WTP price premiums for safer cabbage at 5% level. Thus, other things held constant, high trust in farmers increases consumers' WTP the highest price premium for safer cabbage. Latvala (2010) also found a significant positive relationship between trust and WTP. A

marginal increase in consumers' trust in farmers increases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 8.8%, holding all other variables constant. The literature showed that trust is linked to credibility of both information and current practices (Rohr *et al*., 2005). Latvala (2010) argued that trust can be related to information provided by producers about the product and the credibility of the status quo of the production practices. High trust in the credibility of status quo of vegetable production practices means lower probability of paying higher price premiums for safer ayoyo and vice versa. However, Muringai *et al*. (2017). revealed that consumers with high trust in food actors were willing to pay slightly higher price premium than consumers with low trust. The literature argued that since the market outcome of food safety depends on consumer confidence toward supply chain operators complying with these standards, the role of trust in consumer willingness-to-pay (WTP) for food safety is paramount (Nocella *et al*., 2010).

Trust in Traders and WTP price premiums for Safer Cabbage

On the other hand, high trust in traders significantly reduces the probability of paying the highest WTP price premium (YES-YES) for safer cabbage at 1% level, holding all other variables constant. The marginal effect of trust in traders on consumers' WTP the highest price premium (YES-YES) is -0.11319, which implies that a marginal increase in consumers' trust in traders decreases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 11.3%, holding all other variables constant. This result is expected. It could be the case that consumers are used to buying their fresh vegetables (cabbage) from traders, who sells them high-quality and safer products. While trust is built over time and has to do with credibility of information and experience; in this case, if consumers trust traders high as supplying them high-quality

and safer cabbage, then they have no incentive for paying higher price premiums for safer cabbage. In other words, when consumers consider their market vendors supplying them safe vegetables at current prices, they will not be willing to pay more. This group of consumers is confident in conventional vegetables.

Price Perception and WTP price premiums for Safer Cabbage

All perception variables were measured on a continuous scale. From the results, high price perception about food safety significantly reduces WTP the highest price premium (YES-YES) for safer cabbage at 1% level, other things being constant. This means that consumers demand for safer cabbage will be low if the perceived price is relatively high and vice versa. This result is consistent with Fu *et al*. (1999), who reveal that consumers who consider the price of vegetables a very important factor in their purchase decision are less willing to pay more for lower risk vegetable. This is consistent with both theoretical and empirical models of demand. Price perception is the price above the "fair" price which justifies the "true" value of the product (Vlosky, 1999). Rohr *et al*. (2005) defined consumers who were unwilling to pay a premium price for specially approved products as ''price-sensitive''. This result subjectively meets the law of demand, which states that, at a fixed income and taste, the highest the price, the lower the quantity demanded. Even that, demand is backed by willingness and ability. A marginal increase in price perception increases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 2.59%, holding all other variables constant.

Health Perception and WTP price premiums for Safer Cabbage

The results also revealed that the probability of paying the highest WTP price premium (YES-YES) for safer cabbage increases significantly with increases in health

perception in relation to food safety at 5% level, holding all other variables constant. Thus, the stronger consumers perceive safer foods to be healthier, the higher they are willing to pay the highest price premiums (YES-YES). The marginal effect of health perception on consumers' WTP the highest price premium (YES-YES) is 0.231, which implies that a marginal increase in health perception increases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 23.1%, holding all other variables constant. In other words, consumers are more willing to pay the highest price premium (YES-YES) for safer cabbage to reduce health-related risk of vegetables. This result is comparable to the previous results of this study on the reasons why consumers are willing to pay more for safer vegetables as the larger majority stated more on WTP for safer cabbage because of their health benefits (Suresh *et al*., 2015). This group of consumers may view the health implications of pesticide residues more seriously than the other group. This is consistent with theoretical models which show marginal WTP is increasing in the initial risk level (Jones-Lee, 1974; Weinstein *et al*, 1980), although it may also reflect greater concern about health or about increased susceptibility to adverse effects of consuming pesticide residues. For example, Angulo *et al*. (2005) revealed that consumer perception of the negative impact of agricultural production on health concerns positively their WTP. Thus, the higher consumers perceive safer foods to be healthier, the more they are willing to pay (Harper *et al*., 2002). The result also indicates a correct identification of a safer food as a key factor of human health, and for overcoming health-related risks of foods. The literature showed that consumers' perception about food safety that organic products are healthier affected consumers to pay for organic food products (Krissoff, 1998).

Hazard-free Perception and WTP price premiums for Safer Cabbage

The coefficient of consumers' perception about hazard-free food in relation to food safety was significant (at 10% level) and positive, meaning that the probability of paying the highest WTP price premium (YES-YES) increases with high consumers' perception about hazard-free food in relation to food safety, other things being constant. This result meets expected a *priori* and is consistent on theoretical grounds. This is not surprising because many studies have revealed chemical residues and microbial pathogens are main concerns of consumers (Amoah *et al*., 2006; Lante *et al*., 2012; Drechsel & Keraita, 2014). The implication of the result is that if consumers perceive the existence of a latent hazard to their health as a result of the foods they are purchasing, they will react by reducing, postponing, or even avoiding purchasing that food product and if they perceive that the product is safe for their health, they will react in the, opposite way by purchasing it (Yeung & Monis, 2001). A marginal increase in consumers' perception about hazard-free food in relation to food safety increases the probability of willing to pay the highest price premium (YES-YES) for safer cabbage by 11.3%, holding all other variables constant.

Table 4. 20: Result of Ordered logit model showing the determinants of WTP for Safer Cabbage

			ZERO-WTP	NO-NO WTP	NO-YES WTP	YES-NO WTP	YES-YES WTP
Variable	*coeff*	*se*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*
Gender	-0.1206	0.3361	0.0141	0.0043	0.0107	-0.0018	-0.0274
Age	-0.0115	0.0107	0.0013	0.0004	0.0010	-0.0001	-0.0026
Education	-0.7138**	0.3611	0.0911	0.0258	0.0571	-0.0190	-0.1551**
Marital status	-0.0901	0.3040	0.0101	0.0031	0.0082	-0.0008	-0.0207
Salaried worker	0.9522*	0.5485	-0.0900	-0.0301	-0.0912	-0.0166	0.2280*
Self-employed	0.8508*	0.4571	-0.1091	-0.0306	-0.0669	0.0226	0.1841*
Monthly income	0.0003*	0.0001	-0.0000	-0.0000	-0.0000	0.0000	0.0000*
Household income	-0.1851	0.1241	0.0212	0.0065	0.0168	-0.0022	-0.0423
Vegetable expendit	0.0062	0.0088	-0.0007	-0.0002	-0.0005	0.0000	0.0014
Frequency of veget	-0.0411	0.3223	0.0046	0.0014	0.0037	-0.0004	-0.0094
Appearance	-0.0216	0.8407	0.0025	0.0007	0.0019	-0.0002	-0.0049
Nutritional quality	-0.8651**	0.4079	0.1222	0.0315	0.0587	-0.0352	-0.1773**
Source of irrigatior	-1.1469***	0.3469	0.1561	0.0408	0.0806	-0.0381	-0.2394***
Use of Agrochemic	-0.0890	0.3235	0.0103	0.0031	0.0080	-0.0012	-0.0202
Open market	-0.1849	0.3282	0.0203	0.0064	0.0172	-0.0010	-0.0429
Supermarket	0.0660	0.3081	-0.0075	-0.0023	-0.0060	0.0007	0.0151
Farm-gate	-0.1821	0.3190	0.0206	0.0064	0.0166	-0.0018	-0.0418
Trust in farmers	0.3865**	0.1820	-0.0443	-0.0137	-0.0350	0.0047	0.0884**
Trust in traders	-0.4944***	0.1894	0.0567	0.0175	0.0448	-0.0060	-0.1131***
Quality perception	-0.0420	0.2812	0.0048	0.0014	0.0038	-0.0005	-0.0096
Price perception	-0.3847*	0.2249	0.0441	0.0136	0.0349	-0.0047	-0.0880*
Packaging percepti	-0.1131	0.2438	0.0129	0.0040	0.0102	-0.0013	-0.0259
Environment perce	0.3763	0.2658	-0.0432	-0.0133	-0.0341	0.0046	0.0861
Health perception	1.0123**	0.5056	-0.1162	-0.0360	-0.0918	0.0124	0.2317**
Taste perception	0.1048	0.3053	-0.0120	-0.0037	-0.0095	0.0012	0.0239
Nutrition perceptio	0.2122	0.3565	-0.0243	-0.0075	-0.0192	0.0026	0.0485
Hazard-free	0.6408*	0.3642	-0.0736	-0.0228	-0.0581	0.0078	0.1467*
Certification percep	0.1713	0.3785	-0.0196	-0.0060	-0.0155	0.0021	0.0392
Labelling perceptic	-0.3802	0.3630	0.0436	0.0135	0.0345	-0.0046	-0.0870
Overall food safety knowledge	-0.0480	0.0681	0.0055	0.0017	0.0043	-0.0005	-0.0110

Significant Levels: *0.1 (at 10%), **0.05 (at 5%), **0.01 (at 1%)
Source: Author's Estimation from Field Data, 2016

4.8.5 Empirical Regression Results of Factors Affecting Consumers' WTP price premiums for Safer *Ayoyo*

The results of the ordered logit regression model for analyzing consumers' WTP price premiums for safer *ayoyo* also revealed that eight (8) of the thirty (30) explanatory variables were statistically different from zero (Table 4.21). Thus, weekly vegetable expenditure, trust in farmers and health perception had a positive significant influence on consumers' WTP price premium for safer *ayoyo* whilst frequency of vegetable shopping, nutritional qualities, trust in traders, packaging perception and perception about nutrition in relation to food safety had a negative significant effect on consumers' WTP price premium for safer *ayoyo*. The results showed that the explanatory variables are significantly different from zero based on the LR chi^2 (78.94; p-value< 1%) (Table 4.21) for safer *ayoyo*, indicating that at least one of the explanatory variables has a significant influence on consumers' WTP price premiums for safer *ayoyo*. The pseudo R^2 (0.1218) implies that about 12.2% of the probability of willingness to pay price premiums for safer *ayoyo* is explained by all the explanatory variables, and the count R^2 (0.605) indicates that the overall ability of model to yield correct predictions of consumers' WTP price premiums for safer *ayoyo* is 60.5% (Table 4.21).

Table 4. 21: Model fit Statistics from the Ordered Logit Models for analyzing consumers' WTP price premiums for safer ayoyo

Statistics	Estimated Value
Number of Obs.	286
LR Chi^2 (30)	78.94
P-Value	0.000
Pseudo R^2	12.2%
Count R^2	60.5%

Source: Author's Construct from Ordered Logit Regression Model Estimation

Weekly Vegetable Expenditure and WTP price premiums for Safer Ayoyo

Weekly vegetable expenditure measured as a continuous variable, was significant (at 5% level) and positively related to consumers' WTP price premiums for safer *ayoyo*. The positive significant sign of the coefficient of weekly vegetable expenditure on consumers' WTP price premium for safer ayoyo means that consumers with larger weekly vegetable expenditure are more probable to pay the highest WTP price premium for safer ayoyo, holding all other variables constant. A reason could be that high vegetable expenditure households are also richer. The marginal effect of weekly vegetable expenditure on consumers' WTP the highest price premium is 0.005, meaning that a marginal increase in weekly vegetable expenditure variable increases the probability of paying the highest WTP price premium (YES-YES) by 0.5%, holding all other variables constant.

Frequency of Vegetable Shopping and WTP price premiums for Safer Ayoyo

Frequency of vegetable shopping variable denoted by 1 for daily shoppers and 0 if otherwise was significant (at 1% level) and negatively related to consumers' WTP price premiums for safer ayoyo. This means that daily shoppers of vegetables have lower probability of willing to pay the highest price premium (YES-YES) than non-daily shoppers of vegetables or higher probability of paying ZERO WTP, other things being constant. A reason could be that consumers want their ayoyo to be fresh, and are willing to pay more if it is harvested and sold at the shortest possible time, for example daily. The marginal effect of frequency of vegetable shopping on consumers willing to pay the highest price premium (YES-YES) is 0.00550, which implies that consumers who buy vegetables daily increases by the probability of willing to pay the highest

price premium (YES-YES) for safer ayoyo by 22.0%, holding all other variables constant.

Nutritional Values and WTP price premiums for Safer Ayoyo

The results also found a negative significant relationship (at 1% level) between nutritional values and consumers' WTP price premiums for safer ayoyo, which means that other things being constant, consumers who consider nutritional qualities when buying vegetables have high probability of paying the highest WTP price premium (YES-YES) for safer ayoyo. The marginal effect of nutritional values on consumers' WTP the highest price premium (YES-YES) is -0.343, indicating that consumers who consider nutritional values when buying vegetables are more probable of paying the highest price premium (YES-YES) for safer ayoyo by 34.3%, holding all other variables constant. The result of the marginal change in probability of willing to pay the highest price premium for safer ayoyo is higher than the marginal effect of nutritional values in the cabbage model (see Table 4.20) but less than the marginal effect of nutritional values in the okra model (see Table 4.24).

Trust in Farmers and WTP price premiums for Safer Ayoyo

Trust in farmers was significant (at 1% level) and positively related to consumers' WTP price premiums for safer ayoyo, meaning that high trust in farmers increases the probability of paying the highest WTP price premium (YES-YES) for safer ayoyo, holding all other variables constant. The marginal effect of trust in farmers on consumers' WTP the highest price premium for safer ayoyo is 0.129, which implies that a marginal increase in consumers' trust in farmers increases the probability of paying the highest WTP price premium (YES-YES) for safer ayoyo by 12.9%, holding all other variables constant. Contrasting, the marginal effect of trust in farmers in the

ayoyo model is higher than the marginal effect of trust in farmers in the cabbage model (see Table 4.20) but less than the marginal effect of trust in farmers in okra model (see Table 4.24). This could be that respondents believed that farmers can supply safer ayoyo and okra than cabbage.

Trust in Traders and WTP price premiums for Safer Ayoyo

Similarly, the significance (at 10% level) and negative effect of trust in farmers and consumers' WTP price premiums for safer ayoyo means that high trust in traders reduces consumers' WTP the highest price premium (YES-YES) for safer ayoyo, other things being equal. The marginal effect of trust in traders on consumers' WTP the highest price premium (YES-YES) is -0.092, indicating that a marginal increase in consumers' trust in traders decreases the probability of willing to pay the highest WTP price premium (YES-YES) for safer ayoyo by 9.2%, holding all other variables constant. Remember that with this variable, the marginal change in probability of paying the highest WTP price premium for safer ayoyo is less than both the marginal effect of trust in traders in the cabbage model (see Table 4.20) and the okra model (see Table 4.24).

Packaging Perception and WTP price premiums for Safer Ayoyo

The results further revealed that consumers' perception about packaging in relation to food safety significantly reduces the highest WTP price premium and increases zero WTP price premium safer ayoyo at 5% level, other things being constant. In other words, consumers' perception that safer food must be properly packaged increases their likelihood of paying the highest WTP price premium (YES-YES) for safer ayoyo. The marginal effect of consumers' perception about packaging in relation to food safety on the highest WTP price premium (YES-YES) is -0.129, which means a marginal

increase in consumers' perception about packaging in relation to food decreases the probability of paying the highest price premium (YES-YES) for safer ayoyo by 12.96%, holding all other variables constant.

Health Perception and WTP price premiums for Safer Ayoyo

Health perception in relation to food safety was significant (at 10% level) and positively associated with consumers' WTP price premiums for safer ayoyo. The expected positive significant influence of health perception on consumers' WTP the highest price (YES-YES) for safer ayoyo means that the probability of paying the highest WTP price premium (YES-YES) increases significantly with high perception about health in relation to food safety, holding all other variables constant. The marginal effect of health perception on the highest WTP price premium (YES-YES) is 0.253, indicating that a marginal increase in health perception increases the probability of willing to pay the highest price premium (YES-YES) for safer ayoyo by 25.3%, holding all other variables constant. By comparison, the marginal effect of health perception in the ayoyo model is higher than the marginal effect of health perception in the cabbage model (see Table 4.20) but less than the marginal effect of health perception in okra model (see Table 4.24). This shows that respondents consider safer ayoyo and okra to be healthier than safer cabbage.

Nutrition Perception and WTP price premiums for Safer Ayoyo

The coefficient of nutrition perception in relation to food safety was significant (at 10% level) and negatively related to consumers' WTP price premiums for safer ayoyo, meaning that the probability of paying the highest WTP price premium (YES-YES) reduces with nutrition perception in relation to food safety, holding all other variables constant. The marginal effect of nutrition perception on the highest WTP price

premium for safer ayoyo is -0.188, meaning a marginal increase in nutrition perception in relation to food safety reduces the probability of paying the highest price premium (YES-YES) for safer ayoyo by 18.8%, holding all other variables constant.

Table 4. 22: Result of Ordered logit model showing the determinants of WTP for Safer Ayoyo

			ZERO-WTP	NO-NO WTP	NO-YES WTP	YES-NO WTP	YES-YES WTP
Variable	*coeff*	*se*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*
Gender	-0.0670	0.3535	0.0086	0.0012	0.0055	0.0013	-0.0165
Age	-0.0192	0.0117	0.0024	0.0003	0.0016	0.0004	-0.0047
Educ	0.0245	0.3771	0.0031	-0.0004	-0.0020	-0.0005	0.0060
Mari	-0.2404	0.3268	0.0293	0.0041	0.0203	0.0054	-0.0590
Salar	0.8195	0.5992	-0.0884	-0.0130	-0.0690	-0.0227	0.1930
Self-	0.6386	0.4867	-0.0877	-0.0113	-0.0498	-0.0092	0.1579
Mont	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
Hous ning members	-0.1549	0.1384	0.0197	0.0027	0.0129	0.0031	-0.0383
Vege	0.0222**	0.0104	-0.0028	-0.0004	-0.0019	-0.0004	0.0055**
Frequ e shopping	-0.9283***	0.3564	0.1045	0.0150	0.0771	0.0237	-0.2202***
Appe	0.6734	1.0447	-0.0681	-0.0104	-0.0573	-0.0206	0.1563
Nutri	-1.4572***	0.4489	0.2509	0.0236	0.0732	-0.0050	-0.3427***
Sourc	-0.5866	0.3710	0.0809	0.0104	0.0457	0.0084	-0.1453
Use c	-0.0946	0.3488	0.0121	0.0017	0.0078	0.0018	-0.0234
Oper	-0.3693	0.3473	0.0434	0.0062	0.0313	0.0090	-0.0898
Supe	0.2823	0.3189	-0.0350	-0.0049	-0.0236	-0.0060	0.0694
Farm	-0.4438	0.3432	0.0547	0.0076	0.0370	0.0095	-0.1088
Trust	0.5215***	0.2017	-0.0663	-0.0091	-0.0434	-0.0104	0.1290***
Trust	-0.3725*	0.2049	0.0473	0.0065	0.0310	0.0074	-0.0921*
Qual	-0.0859	0.3235	0.0109	0.0015	0.0071	0.0017	-0.0212
Price	-0.0361	0.2404	0.0046	0.0006	0.0030	0.0007	-0.0089
Pack	-0.5237**	0.2624	0.0665	0.0091	0.0436	0.0104	-0.1296**
Envi on	0.0857	0.2868	-0.0109	-0.0015	-0.0071	-0.0017	0.0212
Healt	1.0259*	0.5761	-0.1303	-0.0179	-0.0853	-0.0204	0.2539*
Taste	0.3318	0.3510	-0.0422	-0.0058	-0.0276	-0.0066	0.0821
Nutri	-0.7618*	0.4461	0.0968	0.0133	0.0634	0.0151	-0.1885*
Haza	0.1579	0.4135	-0.0201	-0.0028	-0.0131	-0.0031	0.0390
Certi on	0.2907	0.3826	-0.0369	-0.0051	-0.0242	-0.0058	0.0719
Labe	-0.4541	0.3661	0.0577	0.0079	0.0378	0.0090	-0.1123
Over owledge	-0.0929	0.0733	0.0118	0.0016	0.0077	0.0019	-0.0229

Significant Levels: *0.1 (at 10%), **0.05 (at 5%), **0.01 (at 1%)
Source: Author's Estimation results from Field data, 2016

4.8.6 Empirical Regression Results of Factors Affecting Consumers' WTP price premiums for Safer Okra

The results revealed that ten (10) of the thirty (30) explanatory variables included in the ordered logit regression model for analyzing consumers' WTP price premiums for safer okra were statistically significant (Table 4.23). The results found age, frequency of vegetable shopping, nutritional quality, use of agrochemical in vegetable production, purchase of vegetables from the farm-gate, trust in traders to be significant and negatively related to WTP price premiums for safer okra whereas education, monthly income, trust in farmers and health perception were significant and positively related to WTP price premiums for safer okra. The LR chi^2 test (82.25) (Table 4.23) was statistically significant at 1% level, indicating that one or more of the explanatory variables has a significant influence on consumers' WTP price premiums for safer ayoyo. The results additionally revealed a pseudo R^2 of 0.163, meaning that about 16.3% of the probability of willing to price premiums for safer okra is explained by all the explanatory variables. Again, the count R^2 (0.699) indicated that the overall ability of model to yield correct predictions of consumers' WTP price premiums for safer okra is 69.9% (Table 4.23).

Table 4. 23: Model fit Statistics from the Ordered Logit Models for analyzing consumers' WTP price premiums for safer okra

Statistics	Estimated Value
Number of Obs.	286
LR Chi^2 (30)	82.25
P-Value	0.000
Pseudo R^2	16.3%
Count R^2	69.9%

Source: Author's Construct from Ordered Logit Regression Model Estimation

Age and WTP price premiums for Safer Okra

Age was measured as a continuous variable (in years). The results revealed that WTP price premiums for safer okra decreases significantly with age at 5% level, holding all other explanatory variables constant. In other words, younger consumers have higher probability of paying the WTP highest price premium (YES-YES) for safer okra. The marginal effect of age on the highest WTP price premium (YES-YES) for safer okra is -0.0074, indicating that a marginal increase in age reduces the probability of paying the highest WTP price premium by 0.74%, holding all other variables constant. This can be true in that younger consumers have more years to live and might be concerned about eating healthier foods to live longer compared to the aging population (Yahaya *et al*., 2015). Also, the younger ones are also richer and more adventurous in terms of experimenting. This result is in line with Posri *et al*. (2006) who reported that younger consumers are more willing to pay higher price premium than older consumers. However, Govindasamy *et al*. (1999) found an inconsistent result with the present study who found that older consumers are more probable to be willing to pay higher price premiums for food safety.

Education and WTP price premiums for Safer Okra

The coefficient of education was positive and significantly related to consumers' WTP price premium for safer okra (at 10% level), meaning that the acquisition of formal education increases the likelihood of paying the highest WTP (YES-YES) for safer okra, holding all other variables constant. The marginal effect of education on the highest WTP price premium (YES-YES) for safer okra is 0.149, meaning that consumers with formal education are more likely to pay the highest price premium (YES-YES) for safer okra by 14.9% compared to consumers with no formal education,

holding all other variables constant. By comparison, the marginal effect of education in the cabbage model is higher than the marginal effect of education in the okra (see Table 4.20). However, education is negative in the cabbage model but positive in the okra model. A reason could be expressed by the relative difference in prices of the two vegetables.

Household Monthly Income and WTP price premiums for Safer Okra

The study also revealed that the likelihood of consumers' WTP price premiums for safer okra significantly increases with for households with higher monthly income at 10% level, other things being constant. The marginal effect of income for safer okra is 0.00008, meaning that a marginal increase in income increases the probability of willing to pay the highest price premium (YES-YES) for safer okra by 0.008%, holding all other variables constant. By comparison, the marginal effect of income in the cabbage model is less than the marginal effect of income in the okra (see Table 4.20). But income is positive in both the cabbage model and the okra model. In both the cabbage model and okra model, income may play a dormant role in consumers' WTP because its effect is very negligible.

Frequency of Vegetable Shopping and WTP price premiums for Safer Okra

The frequency of vegetable shopping had a significant negative effect on consumers' WTP price premiums for safer okra at 1% level, meaning that daily vegetable shoppers have lower probability of paying the highest WTP price premium (YES-YES) than non-daily shoppers of vegetables. The marginal effect of frequency of vegetable shopping irrigation on consumers' WTP the highest price premium (YES-YES) for safer okra is -0.223, which implies that consumers who buy vegetables daily are less probable of paying the highest WTP price premium (YES-YES) for safer okra by

22.3% compared to consumers who do not consider the source of irrigation water when buying vegetables, holding all other variables constant.

Nutritional Values and WTP price premiums for Safer Okra

The coefficient of nutritional values was negative and significant at 1% level. The significant negative sign on the coefficients of nutritional qualities on consumers' WTP price premiums for safer okra means that consumers who consider nutritional values when buying vegetables have higher probability of paying the highest WTP price premium (YES-YES) for safer okra, holding all other variable constant. The marginal effect of nutritional values on consumers' WTP the highest price premium (YES-YES) for safer okra is -0.419, which shows that consumers who consider nutritional values when buying vegetables are more probable of paying the highest WTP price premium (YES-YES) for safer okra by 41.9% compared to consumers who do not consider nutritional values when buying vegetables, holding all other variables constant.

Use of Agrochemicals and WTP price premiums for Safer Okra

The coefficient of use of agrochemicals was negative and significant at 5%, meaning that consumers who consider the use of agrochemicals when buying vegetables have larger likelihood to pay the highest price premium (YES-YES) for safer okra, holding all other variables constant. The marginal effect of use of agrochemical on the highest WTP price premium (YES-YES) for safer okra is -0.176, which implies that consumers who consider the use of agrochemicals when buying vegetables are more likely to pay the highest price premium (YES-YES) for safer okra by 17.6% compared to consumers who do not consider the use of agrochemicals when buying vegetables, holding all other variables constant.

Trust in Farmers and WTP price premiums for Safer Okra

The results also revealed that trust in farmers and consumers' WTP price premiums for safer okra are significantly related at 10% level and positive. This means that high trust in farmers increases the probability of paying the highest WTP price premium for safer okra, holding all other variables constant. The marginal effect of trust in farmers on consumers' WTP the highest price premium for safer okra is 0.143, which indicates that a marginal increase in consumers' trust in farmers increases the probability of willing to pay the highest price premium (YES-YES) for safer okra by 14.3%. The effect of trust on consumers' WTP the highest price premium was particularly strong compared to the highest WTP price premium for safer okra, holding all other variables constant.

Trust in Traders and WTP price premiums for Safer Okra

Also, high trust in traders significantly reduces consumers' WTP the highest price premium (YES-YES) for safer okra at 1% level, holding all other variables constant. The marginal effect of trust in traders on the highest WTP price premium (YES-YES) for safer okra is -0.150, which implies that a marginal increase in consumers' trust in traders decreases the probability of willing to pay the highest price premium (YES-YES) for safer okra by 15.0%, holding all other variables constant.

Purchase of Vegetables from the farm-gate and WTP price premiums for Safer Okra

The coefficient of purchase of vegetables from farm-gate was significant at 1% level and has a negative effect on consumers' WTP price premiums for safer okra. The negative significant relationship between purchase of vegetables from farm-gate and consumers' WTP the highest price (YES-YES) for safer okra implies that the highest WTP price premium (YES-YES) reduces significantly for consumers who buys their

vegetables from the farm-gate, holding all other variables constant. The marginal effect of purchase of vegetables from farm-gate on the highest WTP price premium (YES-YES) for safer okra is -0.153, indicating that consumers who purchase of vegetables from farm-gate are less willing to pay the highest price premium (YES-YES) for safer okra by 15.3%, holding all other variables constant.

Health Perception and WTP price premiums for Safer Okra

The coefficient of health perception in relation to food safety was positive and significant at 1% level. The expected positive significant influence of health perception on consumers' WTP the highest price (YES-YES) for safer okra means that probability of paying the highest WTP price premium (YES-YES) increases significantly with high perception about health in relation to food safety, holding all other variables constant. The marginal effect of health perception on the highest WTP price premium (YES-YES) for safer okra is 0.493, indicating that a marginal increase in health perception increases the probability of willing to pay the highest price premium (YES-YES) for safer okra by 49.3%, holding all other variables constant.

Table 4. 24: Result of Ordered logit model showing the determinants of WTP for Safer Okra

			ZERO-WTP	NO-NO WTP	NO-YES WTP	YES-NO WTP	YES-YES WTP
Variable	*coeff*	*se*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*	*marginal effect*
Gender	0.5614	0.4027	-0.0615	-0.0029	-0.0344	-0.0217	0.1205
Age	-0.0333**	0.0133	0.0040	0.0002	0.0021	0.0012	-0.0074**
Education	0.7034*	0.4212	-0.0759	-0.0036	-0.0427	-0.0272	0.1494*
Marital status	-0.3803	0.3571	0.0422	0.0020	0.0235	0.0147	-0.0824
Salaried worker	0.6085	0.6203	-0.0637	-0.0031	-0.0368	-0.0240	0.1276
Self-employed	0.7627	0.5105	-0.0998	-0.0043	-0.0470	-0.0249	0.1760
Monthly income	0.0003*	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000*
Household inco ers	-0.1323	0.1654	0.0157	0.0007	0.0083	0.0049	-0.0296
Vegetable expe	0.0175	0.0113	-0.0021	-0.0001	-0.0011	-0.0007	0.0039
Frequency of ve	-1.0904***	0.3971	0.1123	0.0053	0.0639	0.0417	-0.2232***
Appearance	0.7599	1.0059	-0.0693	-0.0035	-0.0435	-0.0309	0.1471
Nutritional qual	-1.7921***	0.4808	0.3101	0.0092	0.0798	0.0208	-0.4199***
Source of irriga	0.0971	0.4027	-0.0114	-0.0005	-0.0061	-0.0037	0.0216
Use of Agroche	-0.7661**	0.3749	0.0995	0.0043	0.0473	0.0252	-0.1762**
Open market	-0.4902	0.4028	0.0523	0.0025	0.0299	0.0193	-0.1040
Supermarket	0.2640	0.3582	-0.0307	-0.0014	-0.0165	-0.0100	0.0585
Farm-gate	-0.7051*	0.3783	0.0800	0.0037	0.0433	0.0265	-0.1534*
Trust in farmers	0.6384***	0.2267	-0.0758	-0.0035	-0.0402	-0.0238	0.1432***
Trust in traders	-0.6723***	0.2364	0.0798	0.0037	0.0423	0.0250	-0.1508***
Quality percepti	-0.1230	0.3573	0.0146	0.0007	0.0077	0.0046	-0.0275
Price perceptior	-0.2883	0.2713	0.0342	0.0016	0.0181	0.0107	-0.0646
Packaging perce	0.0132	0.2887	-0.0016	-0.0001	-0.0008	-0.0005	0.0029
Environment pe	0.0565	0.3121	-0.0067	-0.0003	-0.0036	-0.0021	0.0126
Health perceptic	2.2018***	0.6039	-0.2614	-0.0120	-0.1386	-0.0820	0.4939***
Taste perceptior	0.0667	0.3738	-0.0079	-0.0004	-0.0042	-0.0025	0.0149
Nutrition percep	0.2439	0.4603	-0.0290	-0.0013	-0.0154	-0.0091	0.0547
Hazard-free	-0.5786	0.4630	0.0687	0.0032	0.0364	0.0216	-0.1298
Certification pe	-0.1431	0.4208	0.0170	0.0008	0.0090	0.0053	-0.0320
Labelling perce	-0.0871	0.3972	0.0103	0.0005	0.0055	0.0032	-0.0195
Overall food safety knowledge	-0.0756	0.0777	0.0090	0.0004	0.0048	0.0028	-0.0169

Significant Levels: *0.1 (at 10%), **0.05 (at 5%), **0.01 (at 1%)

Source: Author's Estimation results, 2017

4.9 Consumers' Choice of Fresh Safer Vegetable Markets

Traditional markets (open-air market/road-side shops/hawking) are mostly used by households in the purchase of fresh vegetables in Ghana (Meng *et al*., 2014; Gonzalez *et al*., 2016), and this is true for the study. This study presents evidence of high potential of open-air market in the selling of fresh safer vegetables in Tamale, as the highest percentage of consumers (93%) would want to buy their fresh safer vegetables from the open market (Table 4.25). Acheampong *et al*. (2012) have already estimated that most urban consumers (96.4%) purchased vegetables mostly from the market. Also, 72.9% of the consumers would want to buy their fresh safer vegetables from the on-farm (farm-gate) market. Though, the emergence of supermarkets provides convenient and quality environment for the selling of vegetables in Ghana, slightly above half (50.2%) of the consumers would want to buy their fresh safer vegetables from the supermarkets (Table 4.25). The low purchase of vegetables from supermarkets can be attributed to limited number of supermarkets selling vegetables in Tamale. Also, most consumers particularly have the perception that products sold at the supermarkets are expensive, and are often reputed to be of the middle and high-income class. Farm-gate/on-farm markets however, are not well established and have little orientation in Ghana (Gonzalez *et al*., 2016).

Table 4. 25: Results of Consumers' Purchasing Outlets for fresh vegetables

Market Points	Yes *n* (%)	No *n* (%)	Total *n* (%)
Open-market	253 (93.0%)	19 (7.0%)	272 (100)
Supermarket	116 (50.2%)	115 (49.8%)	231 (100)
Farm gate	180 (72.9%)	67 (27.1%)	247 (100)

Source: Author's Construct from Field Data, 2016

4.9.1 Empirical Regression Results of Determinants of Consumers' Choice of fresh safer Vegetable Markets

Using the multivariate probit (MVP) regression model, the study investigated the effect of twenty-seven (27) explanatory variables on the probability of consumers' choice of markets for buying fresh safer vegetables (Table 4.26). The explanatory variables included in the model were gender, age, education, marital status, income, household members earning monthly income, frequency of vegetable shopping, vegetable expenditure, salaried worker, self-employed, appearance, nutritional quality, source of irrigation water, use of agrochemicals, trust for farmers, trust for traders, health perception, nutrition perception, taste perception, quality perception, perception about hazard-free, labelling perception, price perception, packaging perception, certification perception, and overall food safety. The multivariate probit regression model results of three market outlets showed the estimated coefficients, the standard errors and the p-values for the three purchasing outlets (see Table 4.26).

Model fit Statistics from the multivariate probit regression model

The likelihood ratio (LR) chi^2 test (30.45) was statistically significant at 1%, indicating that there is a joint significant correlation/interdependency between the markets where consumers would want to buy their fresh safer vegetables (Table 4.26). This implies that the error terms in the consumers' place of purchase of fresh vegetable are not totally independent of each other, justifying that the use of the MVP model as a better specification for the data than mounting three separate independent binary models, which would have produced bias and inconsistent results. Moreover, possible significant correlations between the open-air market and supermarket, open-air market and farm-gate as well as supermarket and farm-gate show that there are unobservable factors affecting all choices. The Wald chi^2 test value of 1655.7 for the model was

statistically significant at 1% level, indicating that all coefficients of the explanatory variables in the model are significantly different from zero. In other words, at least one of the explanatory variables in the model explain has a significant influence on the probability of consumers' choice of markets for buying fresh safer vegetables.

Open Market

The results of the MVP model revealed that the coefficients of education and trust in farmers were significant and negatively related to the probability of consumers willing buy fresh safer vegetables on the open-air market whereas the coefficient of appearance and health perception positively and significantly affect the probability of consumers willing buy fresh safer vegetables on the open-market (see Table 4.26).

Education and choice of buying fresh safer vegetables on the open-air market

The coefficient of education was significant (at 10% level) and negative (see Table 4.26). The negative significant relationship between education and of consumers willing buy fresh safer vegetables on the open-air market means that, consumers with formal education have a lower probability of using the open-air market as their preferred purchasing outlet for fresh safer vegetables compared to non-educated consumers, holding all other variables constant. Meng *et al*. (2014) have already indicated that educated consumers are less likely to buy food frequently on the open-air markets, arguing an open-air market may not meet their high expectations for food quality. On the contrary, Slamet & Nakayasu (2016) revealed that educated consumers are more probable of buying food products on the open-air market or kiosk.

Appearance and choice of buying fresh safer vegetables on the open-air market

Appearance significantly (at 1% level) affects consumers' choice of buying fresh vegetables on the open-air market in a positive way, which relates to consumers who do not consider the appearance when buying fresh vegetables (see Table 4.26). This means that other things being constant, consumers who do not consider the appearance when buying fresh vegetables compared to those who do are less likely to use the open-air market as the preferred market for buying fresh safer vegetables. This result is surprising because of the large numbers of market vendors in the open-air markets selling possibly the same products that consumers can assess and choose between product attributes based on their freshness and appearance compared to the farm-gate and supermarket, which are airily scattered. Slamet & Nakayasu (2016) asserted that vegetables in traditional retail formats are perceived fresher by consumers because they are usually directly delivered from farmer to wholesaler markets or retail vendors.

Source of irrigation water and choice of buying fresh safer vegetables on the open-air market

The coefficient of source of irrigation water was significant (at 10% level) and positive, meaning that consumers who do not consider the source of irrigation water when buying fresh vegetables have higher probability of buying fresh safer vegetables from the open-air market (see Table 4.26).

Trust in farmers and choice of buying fresh safer vegetables on the open-air market

Regarding trust in farmers, the estimated coefficient was statistically significant (at 10% level) and negative (see Table 4.26). The negative significant effect of trust in farmers on the probability of buying fresh safer vegetables on the open-air market means that other things being constant, high consumer trust in farmers significantly

decreases the likelihood of using the open-air market as the channel for buying fresh safer vegetables. In other words, consumers with high trust for farmers have lower probability of using the open-air market as the preferred market for buying safer fresh vegetables. This may suggest that consumers with high trust in farmers have high assurance of lower contamination on the farm than on the open-air market. The literature showed that trust is built through individual relations, and that where there are good relations, there exist high trust. Banwell *et al*. (2016) mentioned that trust is a relatively unrecognized dimension that is supporting the continued existence of traditional food retail formats.

Health perception and choice of buying fresh safer vegetables on the open-air market

Surprisingly, health perception in relation to food safety was significant (at 10% level) and positively related to using open-air market as the preferred purchasing outlet for fresh safer vegetables, meaning that consumers who perceive food safety to mean healthy food have higher probability of using the open-air market as the preferred purchasing outlet for fresh safer vegetables, holding all variables constant (see Table 4.26). However, the study expected that consumers might rather perceive product sold on the open-air market to be unhealthy considering the unsatisfactory or unhygienic surroundings in the open-air market, and express lower patronage of fresh vegetables on the open-air market.

Supermarket

The results revealed that the coefficients of gender, nutritional quality and hazard-free perception were significant and positively related to consumers' choice of buying fresh safer vegetables at the supermarket whereas overall food safety knowledge has a

negative significant influence on consumers' choice of buying fresh safer vegetables at the supermarket (see Table 4.26).

Gender and choice of buying fresh safer vegetables at the supermarket

Regarding gender, female consumers are more "family oriented" and therefore more price-sensitive though they might have high food safety concerns, and are used to buying fresh vegetables frequently from the open-air market. The results found that male consumers are more likely to use the supermarket as the purchasing point for fresh safer vegetables compared to their female counterparts, holding all other explanatory variables constant. Interestingly, the probability of female consumers using supermarkets as their preferred purchasing outlet for fresh safer vegetables is low because females frequently buy vegetables in the open-air market and may already have strong relationships with vendors, which it is difficult for them to change. Moreover, females may have the notion that products sold at the supermarket are expensive compared to their male counterparts. Li & Houston (2001) in their study examining the factors affecting consumer preferences for major food markets in Taiwan revealed female consumers to have higher odds of using traditional markets for the purchase of fresh vegetables compared to supermarket.

Nutritional values and choice of buying fresh safer vegetables at the supermarket

The positive significant sign (at 1% level) of the coefficient of nutritional values, means that consumers who do not consider the nutritional qualities when buying vegetables have a higher probability of using supermarkets as the preferred purchasing outlet for fresh safer vegetables, holding all other variables constant. This result does not meet expected a *priori* because inferring from Bond *et al*. (2009), consumers purchasing decisions, especially with regards to fresh produce through direct market

channels are primarily determined by attributes such as vitamin and nutrient content higher in importance. The literature shows that purchase outlet affects consumer diet and nutrition through the food products they provided, and therefore, consumers might perceive supermarkets as providing a wide spectrum of quality and nutritious products (Hawkes, 2008; Tessier *et al*. 2010).

Hazard-free perception and choice of buying fresh safer vegetables at the supermarket

Regarding hazard-free perception, the significant negative sign (at 1% level) of its coefficient indicate that strong perception that safer foods are free from hazards increases the probability of using supermarkets as the purchasing outlet for fresh safer vegetables, holding all other variables constant. This finding is consistent with a priori due to the fact that fresh vegetables might be stored in a cooling system at the supermarket, and thus reduces their likelihood of getting contaminated, and even maintain their freshness for quite long.

Overall food safety knowledge and choice of buying fresh safer vegetables at the supermarket

Consumers' overall food safety knowledge was significant (at 5% level) and inversely related to likelihood of using supermarkets as the preferred purchasing outlet for fresh safer vegetables. This means that holding all other variables constant, consumers with high food safety knowledge have lower probability of using supermarkets as the purchasing outlet for fresh vegetables. This finding does not meet expected a *priori* of the study.

Farm-gate (On-farm) Market

The results further revealed that the coefficients of age, salaried worker, self-employed, nutritional quality, hazard-free perception and price perception were positive and significantly related to consumers' choice of buying fresh safer vegetables at the farm-gate whereas the coefficients of packaging perception, trust in farmers, certification and labelling perception vegetable expenditure, frequency of vegetable shopping and quality perception have a negative significant influence on the probability of consumers' choice of buying fresh safer vegetables at the farm-gate (Table 4.26).

Age and choice of buying fresh safer vegetables at the farm-gate

Age is positive and significantly (at 1% level) influences the probability of purchasing of fresh vegetables at the farm-gate. The positive significant relationship between age and purchase of fresh vegetables at the farm-gate means that older consumers have higher probability of using the farm-gate as the purchasing outlet for fresh safer vegetables, other things being constant. This result is not expected in that relatively lower age groups are expected to be involved in the purchase of fresh vegetables, which is a physical activity cum strength leading to a higher likelihood to purchase fresh vegetables at the farm-gate.

Salaried work and choice of buying fresh safer vegetables at the farm-gate

Regarding salaried work, its coefficient was significant (at 10% level) and negative, meaning that consumers who are not salaried workers have high probability of using the farm-gate as their purchasing point for fresh safer vegetables, holding all other variables constant. Proximity to market is a convenient factor. Considering salaried workers, they are busy with their work schedules, and therefore, it will inconvenient them to travel as far in farm areas to purchase their fresh vegetables.

Self-employed and choice of buying fresh safer vegetables at the farm-gate

Similarly, the coefficient of self-employed was significant and negatively related to consumers' choice of buying of fresh safer vegetables at the farm-gate. This result implies that, the segment of consumers who are not self-employed are more probable of using farm-gate as the preferred place of purchase of fresh vegetables, holding all other variables constant. This result is consistent with a *priori* expectation of the study because self-employed consumers may experience time constraint and therefore prefer proximity to price or other important attributes.

Nutrition values and choice of buying fresh safer vegetables at the farm-gate

The results revealed a positive significant sign (at 10% level) on the coefficient of nutritional values on the probability of using farm-gate for the purchase of fresh safer vegetables, means that consumers who do not consider the nutritional values when buying vegetables are more likely of use farm-gate as the preferred market for buying fresh safer vegetables compared to those who consider nutritional values when buying vegetables, holding all other variables constant. This is surprising, because most individuals consider vegetables harvested on-farm as fresh and highly nutritious compared to when they are transported to market centers (Qendro, 2015). This variable also influenced choice of using supermarket for the purchase of fresh safer vegetables positively, suggesting that there are complementarities between the 2 markets, other things being constant, in that consumers who do not consider nutritional values when buying fresh vegetables would want to buy their fresh safer vegetables from the farm-gate and supermarket.

Trust in farmers and choice of buying fresh safer vegetables at the farm-gate

Trust in farmers was a statistically significant (at 10% level) factor explaining consumers' choice of buying fresh safer vegetables at the farm-gate. The negative significant effect of trust in farmers on the probability of consumers' choice of buying fresh vegetables on the farm-gate market means that other things being constant, consumer trust in farmers significantly decreases the probability of using the farm-gate market as the preferred purchasing outlet for fresh safer vegetables. Also, open-air market was negatively influenced by trust in farmers, indicating that there are complementarities between the two markets, other things being constant in that consumers would want to buy fresh safer vegetables from the two markets based on trust.

Hazard-free perception and choice of buying fresh safer vegetables at the farm-gate

The results revealed that hazard-free perception is of significant importance in explaining consumers' choice of buying fresh safer vegetables at the farm-gate. The positive significant sign (at 1% level) on the coefficient of hazard-free perception means consumers with strong perception that safer foods means absence of hazards have higher probability of using farm-gate as their purchasing outlet for fresh safer vegetables, holding all other variables constant. This finding is consistent with the fact that individual think that once they visit farmer markets, they might acquaint themselves of the production process. Hazard-free was also positive significant for consumers' choice of buying fresh safer vegetables at the supermarket, suggesting that there are complementarities between the two markets, other things being constant, in that consumers would want to buy their fresh safer vegetables from the farm-gate and supermarket because of hazard issues.

Price Perception and choice of buying fresh safer vegetables at the farm-gate

The results also revealed that consumers' perception about price in relation to food safety and consumers' choice of buying fresh vegetables at the farm-gate are significantly (at 1% level) and positively related, which means that a strong perception that safer foods are expensive increases the probability of using farm-gate as the preferred purchasing outlet for fresh safer vegetables, holding all other variables constant. In other words, individuals who perceive safer foods to be expensive are more probable of buying their vegetables at the farm-gate. The result is consistent with the fact that, the price of fresh vegetables sold at the farm-gate is lower compared to those transported into market centers.

Packaging Perception and choice of buying fresh safer vegetables at the farm-gate

Also, in the farm-gate equation, the coefficient of packaging perception was significant (at 10% level) and negative. The negative significant effect of packaging perception on the probability of buying fresh vegetables at the farm-gate implies that strong perception about packaging in relation to food safety decreases the likelihood of using farm-gate as their market for sourcing fresh safer vegetables, holding all other variables constant. In other words, consumers who do not pay attention to food packaging have higher probability of using the farm-gate as their preferred purchasing point for fresh vegetables. Farm-gate markets are often known as "villagers" markets, and proper packaging materials may be lacking (Qendro, 2015). Terano *et al*. (2015) found packaging perception to significantly influence retail format choice for vegetables. However, this is in contrast with a *prior* expectation.

Certification Perception and choice of buying fresh safer vegetables at the farm-gate

In the farm-gate equation, the coefficient of certification perception was positive and significant (at 5% level). The positive significant relationship between certification perception and consumers' choice of buying fresh vegetables at the farm-gate, means that consumers who perceive that safer foods must necessarily be certified have higher probability of using the farm-gate for buying their fresh safer vegetables, other things being constant.

Labelling Perception and choice of buying fresh safer vegetables at the farm-gate

Similarly, the coefficient of labelling perception was significant (at 5% level) and negatively related to the consumers' choice of buying fresh safer vegetables from the farm-gate. This means that the strong perception about labelling in relation to food safety decreases the probability of using farm-gate as their market for sourcing fresh safer vegetables, holding all other variables constant. In other words, consumers who do not pay attention to food labelling are more probable to use the farm-gate as their preferred purchasing point for fresh safer vegetables. This finding is not consistent with a *prior* expectation of the study.

Table 4. 26: Results of multivariate probit model of factors influencing consumer choice of markets for the purchase of fresh vegetables

	Open-air market		Supermarket		Farm-gate	
Variable	*coeff*	*Se*	*coeff*	*se*	*coeff*	*se*
Gender	0.4441	0.2722	0.4912**	0.2275	-0.0711	0.2260
Age	0.0049	0.0082	-0.0002	0.0082	0.0260***	0.0077
Education	-0.4586*	0.2713	-0.0738	0.2696	0.1388	0.2499
Marital status	-0.1049	0.2189	0.0838	0.2285	0.2474	0.2289
Salaried worker	0.1984	0.3872	0.1711	0.3780	-0.7951*	0.3496
Self-employed	0.3122	0.3425	-0.2058	0.3448	-0.6067*	0.3120
Monthly income	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
Household incon	-0.1415	0.0928	-0.1288	0.1190	-0.0448	0.0900
Vegetable expen	-0.0021	0.0058	0.0077	0.0056	0.0045	0.0065
Frequency of veg	0.2662	0.2575	-0.3658	0.2321	-0.0953	0.2337
Appearance	3.8142***	0.4214	0.2168	0.5757	0.0961	0.6930
Nutritional quali	0.0952	0.3212	0.5975*	0.3175	0.6075*	0.3114
Source of irrigati	0.5013*	0.2791	-0.0832	0.2739	0.0709	0.2345
Use of Agrochen	0.3271	0.2745	0.0071	0.2524	0.0315	0.2293
Trust in farmers	-0.2594*	0.1463	-0.0868	0.1447	-0.2214*	0.1268
Trust in traders	0.1365	0.1566	-0.0643	0.1481	-0.1008	0.1277
Quality perceptic	-0.0959	0.1957	0.2383	0.2267	0.1466	0.1880
Price perception	0.1494	0.1740	0.1312	0.1653	0.3946***	0.1441
Packaging percep	0.0814	0.1991	0.2207	0.1783	-0.2961*	0.1608
Environment per	-0.0753	0.1955	0.1142	0.1991	0.2515	0.1928
Health perceptio	0.7731**	0.3607	0.0817	0.4348	0.4350	0.3629
Taste perception	0.3392	0.2335	-0.1916	0.2397	-0.0303	0.2065
Nutrition percept	-0.4389	0.3312	-0.0195	0.3385	0.3614	0.2454
Hazard-free	-0.2933	0.2605	1.3911***	0.3493	1.2294***	0.2924
Certification perc	0.3452	0.2912	-0.0372	0.2532	0.5671**	0.2889
Labelling percep	-0.3927	0.2766	-0.0140	0.2521	-0.6203**	0.2755
Overall knowled	-0.0283	0.0519	0.1032**	0.0495	-0.0023	0.0427
Constant	0.6886	0.7161	-1.5457	0.8309	-1.0877	0.6313

{ Obs ; Chi^2=1655.7; Prob>Chi^2=0.0000, Likelihood ratio test of rho21=rho31=rho32: chi2 (3) =30.4598; P-value = 0.000}

Significant Levels: *0.1 (at 10%), **0.05 (at 5%), **0.01 (at 1%)

Source: Author's Estimation results from Field Data, 2016

4.10 Possible challenges consumers anticipate to accessing safer vegetables

The Kendall's coefficient of concordance was employed in the analysis of possible challenges respondents who were willing to pay more anticipate in the future to accessing safer vegetables on the market. Reports indicate that the production of safer vegetables is very much limited in Ghana (Obuobie *et al*., 2014). From the results, it was revealed that increases in prices of safer vegetables were ranked the highest challenge respondents anticipate in accessing safer vegetables in Tamale (Table 4.27). Though consumers expressed higher WTP for safer vegetables, they are price-sensitive towards future increment. This suggests that if food safety is important to consumers, they would only pay higher prices in the future if incomes increases. In other words, income will play an important role for a high demand of safer foods (vegetables). The problem of low demand for safer foods in developing countries like Ghana relate substantially to low incomes so as incomes increases, the demand for food safety is likely to increase in these regions (Ordonez, 2016).

Lack of information on safer vegetables was rank the second most important challenge that respondents who were willing to pay more for safer vegetables anticipate to accessing safer vegetables in the Tamale Metropolis, and as Obuobie *et al*. (2014) reported producers and marketers refuse to provide consumers with the relevant information about vegetables which leaves a fear among consumers of not being able to distinguish safer vegetables from conventional vegetables on the market. This problem persistently generates information asymmetry in developing countries' markets, and as reported by Ordonez (2016), in developing countries the large part of our markets being informal even compound the problem of information asymmetry. It was also revealed that lack of trust in producers and marketers was rank the third most important

challenge consumers who were willing to pay more for safer vegetables anticipate, which again agrees with the findings of Obuobie *et al*. (2014). Though, not significant in the WTP model, it is suggested that certification schemes and information delivery will play an important part in the supply of safer vegetables. Also, respondents ranked limited access to safer vegetables as the fifth most important constraint. The least constraint was cultural barriers.

The Kendall's coefficient (0.314; 31.4%) shows a weak agreement level among the constraints by consumers though the level agreement among the constraints was statistically significant. The study found that the challenges consumers think they would face in accessing safer vegetables might be attributable to lack of production and marketing challenges of safer foods.

Table 4. 27: Results of Possible Challenges Consumers Anticipate to accessing safer vegetables

Perceived constraints	**Mean Scores**	**Rank**
Prices of safe vegetables	1.33	1st
Lack of adequate information on safe vegetables	1.84	2nd
Lack of trust in farmers and marketers	2.22	3rd
Limited access to market for safe vegetables	2.27	4th
Limited supply of safe vegetables	2.33	5th
Cultural barriers	2.48	6th

Note: N=256; Kendall's coefficient=0.314, Chi-square=33.92, Sig=0.0000

Source: Author's Construct from Field Data, 2016

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This last chapter consists of six sections; the forgoing section is Section 5.0. Section 5.1 presents a summary of key findings of the study based on which the conclusions are drawn in section 5.2. The recommendations (section 5.3) are formulated based on the conclusions in section 5.2. Finally, section 5.4 provides suggestions for future research on food safety.

5.1 Summary of Key Findings

There is an increasing concern from consumers about the safety of fresh because of the increased awareness of the misuse of pesticides and the use of untreated wastewater in vegetable production.

The main objective of the study was to examine consumers' knowledge, perceptions and WTP for safer vegetables in the Tamale Metropolis. Also, the factors that influence consumers' purchasing outlet for fresh vegetables was quantitatively assessed while the constraints consumers anticipated in accessing fresh safer vegetables in the Tamale Metropolis were identified and ranked.

The study conducted a survey to select 331 consumers using the systematic sampling technique. Data were gathered through personal interviews using a structured questionnaire. The contingent valuation method (CVM) was developed as the conceptual framework for eliciting the respondents' WTP, which was guided by the utility-maximization subject to budget constraint. Descriptive statistics such as means, std. deviations, minimum, maximum and coefficient of variation were employed to evaluate the data on knowledge and perceptions of food safety. The ordered logit

regression model was used to analyze the factors that influence consumers' WTP price premiums for safer vegetables while the multivariate probit regression model was employed to estimate the factors that influence consumers' place of purchase of fresh vegetables. The level of agreement in the constraints that consumers in accessing safer vegetables was revealed using the Kendall's coefficient of concordance.

From the findings, consumers had the highest knowledge on agrochemicals residues followed by micro-pathogens, heavy metals and physical materials. Also, consumers had the highest knowledge on foodborne diseases followed by deaths, malnutrition, loss of appetite and infertility.

Consumers' perceptions that safer foods are healthier was the highest followed by nutritious, hazard-free food, tastier, better quality, environmentally-friendly, certified, labelled, well-packaged and expensive.

Averagely, consumers were willing to pay between 128.6%, 197.3% and 189.0% for safer cabbage, ayoyo and okra respective.

The ordered logit regression model results revealed education, nutritional quality, source of irrigation water, trust in traders and price perception have a negative significant influence on WTP price premiums for safer cabbage whereas salaried worker, self-employed, trust in farmers, health perception and perception about hazard-free had a positive significant influence on WTP price premiums for safer cabbage. Weekly vegetable expenditure, trust in farmers and health perception had a positive significant influence on consumers' WTP price premium for safer ayoyo whilst frequency of vegetable shopping, nutritional qualities, trust in traders, packaging perception and perception about nutrition in relation to food safety had a negative

significant effect on consumers' WTP price premium for safer ayoyo. The findings also found that age, frequency of vegetable shopping, nutritional quality, use of agrochemical in vegetable production, purchase of vegetables from the farm-gate, trust in traders were significant and negatively related to WTP price premiums for safer okra whereas education, monthly income, trust in farmers and health perception were significant and positively related to WTP price premiums for safer okra.

The findings indicated that more than 90% of respondents bought their vegetables from the open-air market. Using the multivariate probit model, it was revealed that education and trust in farmers were significant and negatively related to the probability of buying fresh vegetables on the open-air market whereas appearance and health perception positively and significantly affected the choice of buying of fresh vegetables on the open-market. In the supermarket equation, the results that showed the coefficients of gender, nutritional quality and hazard-free perception were significant and positively related to the probability of buying fresh vegetables at the supermarket whereas overall food safety knowledge has a negative significant influence on the choice of buying fresh vegetables at the supermarket. In the farm-gate equation, the results further revealed that the coefficients of age, salaried worker, self-employed, nutritional quality, hazard-free perception and price perception were positively and significantly related to the probability of buying of fresh vegetables at the farm-gate whereas the coefficients of packaging perception, trust in farmers, certification and labelling perception, vegetable expenditure and frequency of vegetable shopping have a negative significant influence on the probability of buying of fresh vegetables at the farm-gate.

Additionally, the findings revealed that higher prices and lack of information about safer vegetables' markets were the two most important constraints affecting consumers' willingness to pay for safer vegetables.

5.2 Conclusions

The study reveals that consumers' knowledge in agrochemical residues and microbial pathogens as perpetual food hazards was high. Also, the study revealed that consumers have high knowledge in food-borne illnesses and deaths as resultant effects of food hazards. Respondents' perceptions about safer foods shows that they are healthier and nutritious were the two most important attributes. The study concludes that WTP price premiums for safer vegetables were high and encouraging on average. The differences in WTP price premiums was explained by factors such as education, age, salaried work, self-employed, income, expenditure, frequency of shopping vegetables, nutritional values, use of agrochemicals, trust in farmers, trust in and traders, price perception, health perception, hazard-free perception, packaging perception, nutrition perception and purchase of vegetables from the farm-gate. In all, the open-air market served as the marketing outlet for fresh vegetables for the top majority of the respondents compared to farm-gate and supermarkets. In addition, consumers' purchasing outlets for fresh vegetables was assessed quantitatively and found to be significantly affected by both socio-economic factors, frequency of vegetable shopping consumers' consideration for food safety and quality attributes when buying vegetables, trust in food actors and consumers' knowledge and perceptions of food safety. Based on the constraints identified and ranked by the respondents, higher prices and information asymmetry were the most important.

5.3 Recommendations

Based on the findings, the study made the following recommendations:

- The study recommends awareness creation and educational campaigns to broaden consumers' knowledge of a broad range of food safety concerns, including heavy metal and physical metals.
- Producers and potential investors should improve the health benefit of vegetables because it is identified as influencing consumers' perceptions about food safety and WTP.
- Producers and potential investors should improve the appearance and nutritional values of vegetables since they were identified as influencing consumers' WTP.
- In setting up prices for safer vegetables, producers and potential investors should take into account consumers' preference for the individual vegetables since the WTP for the three vegetables differs on average.
- Policy-makers should encourage farmers to use clean water for irrigation since it significantly affects consumers' WTP.
- The study recommends that open-air market vendors should target the less-educated because they are likely to buy their fresh safer vegetables from them in case it is available. Supermarket owners should target males because they are likely to buy their fresh safer vegetables from them in case it is available. Also, farm markets should target supplying fresh vegetables to the aging group because they are likely to buy their fresh safer vegetables from them in case it is available.

5.4 Suggestion for Future Research

- The study suggests a study to be done on producers' willingness to produce safer vegetables by adopting safer methods since the WTP price premiums suggest higher profitability for producing safer vegetables.
- Future research should estimate the market potential for the safer vegetables to guide the investment decisions.

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APPENDICES

Appendix I: Consumer Assessment Questionnaire

Survey Questionnaire

Consumers' Willingness to Pay for Safe Vegetables in Tamale, Ghana

N09……

W000……

Serial Number_____ Date of Interview _____

District _____

PART I

GENERAL HABITS OF CONSUMPTION AND FOOD-RELATED

In this section of the questionnaire, I am going to ask you few questions about your consumption habits

1. How much does your household spend on the following categories of food?

Food Item	***Average Frequency of Shopping*** **1** if Daily, **2** if Weekly, **3** if Fortnightly, **4** if Monthly, **5** if Once every 2 months **6** if Other(s)_____	***Average Amount per Shopping (GH₵)***	***Amount Spent per Week (GH₵)*** *[To be computed by interviewer]*
Staple Crops (e. g. rice and rice products)			
Meat			
Fish			
Beverages (non-alcoholic or alcoholic)			
Fruits			
Vegetables			
Other			
Total household expenditure on groceries/foodstuffs [computed by interviewer]			

.

2. Does the appearance (e. g. cleanliness, smell, colour, texture) of vegetables positively influence your buying decision?

Yes ☐ No ☐ Do not know ☐

3. Does the nutritional value of vegetables (e. g. amount of vitamins etc.) positively influence your buying decision?

Yes ☐ No ☐ Do not know ☐

4. Vegetable production involves using irrigation water from different sources, such as fresh water, piped water, water from the river/ponds/streams/wells etc. Depending on where the irrigation water comes from, your health and the health

of your family might be influenced in a negative way. Does the source of irrigation water for vegetable production influence your buying decision?

Yes☐ No☐ Do not know☐

5. The excessive use of agrochemicals, such as herbicides, pesticides and chemical fertilizer, might have a negative influence on your health and the health of your family. In purchasing vegetables, are you concerned as to whether or not they were produced using agrochemicals?

Yes☐ No☐ Do not know☐

PART II

ELICITATION OF HOW MUCH CONSUMERS ARE WILLING TO PAY FOR SAFE VEGETABLES

In this section, I would like to find out what you think about certain vegetable production methods. There are no correct or false answers. I will now give you some information on vegetable production methods and their consequences on human health.

Vegetable production in Ghana is often characterized by wastewater irrigation and excessive use of agrochemicals (chemical fertilizers and pesticides). Untreated wastewater may contain pathogens, such as pesticide residues, which may contaminate agricultural produce. The consumption of this produce (e. g. vegetables) may cause human health risks, such as diarrhea or typhoid.

Methods to clean wastewater, such as water filtration, will reduce pathogen load to a level where the consumption of agricultural produce is safe, i. e. not harmful to human health.

The cost of water filters will increase the production costs for farmers. These farmers would have to pass on part of that cost to the consumers, resulting in higher prices for safe vegetables compared to unsafe ones.

6. Please indicate your level of awareness and frequency of purchasing safe vegetables *[use the table below]*.

Category	Location	Safe Vegetables

Do you have any knowledge of the availability of safe vegetables in Tamale?	Market Supermarket Farm gate	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐
Have you ever purchased safe vegetables in Tamale?	Market Supermarket Farm gate	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐
Frequency of purchase		Daily ☐ Weekly ☐ Monthly ☐ Occasionally ☐
Where would you prefer to purchase safe vegetables in Tamale?	Market Supermarket Farm gate	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐

7. Would you be willing to pay more for vegetables that are safe and thus not harmful to your health? *[Before answering this question, please take into consideration that your budget is constraint. If you are willing to pay higher prices for safe vegetables, you may have to reduce the expenditures for your other needs.]*

Yes ☐ No ☐

8. If no to **7.**, why? [*multiple answers are possible*]

- I cannot afford buying the safe vegetables ☐
- I think that vegetables conventionally produced are safe ☐
- I know that my market vendor only sells me safe vegetables ☐
- Other reason **(**please explain***)***_____

[If yes to 7., please proceed with the following]

[The current market price for 1.5 kg of cabbage is GH₵_____]

[The current market price for 1 bundle of ayoyo is GH₵_____]

[The current market price for 0.5 kg of okras is GH₵ _____]

[Note to the interviewer: The current market prices of the vegetables above serve as a start-up price for the WTP elicitation. Top-up the current market price randomly by 125%, 150%, 175% or 200% and manually write the concrete amounts in the blank spaces provided in the table below. If the respondent answers "yes" to the first bid, the second bid is set higher by randomly assigning a price premium (10%, 20%, 30%, 40% or 50%) on the initial price premium. If the respondent answers "no" to the first bid,

the second bid is set lower by randomly assigning respondents a discount (10%, 20%, 30%, 40% or 50%) on the initial price premium.

Question	**Safe vegetable**		
	1.5 kg of cabbage	*1 bundle of ayoyo*	*0.5 kg of okras*
9. If safe, will you be willing to pay	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐
10. If yes to **9.**, will you be willing to pay	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐
11. If no to **9.**, will you be willing to pay	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐	*GH₵*_____ Yes ☐ No ☐
12. If you answered yes to **10.**, what is the most you are willing to pay for safe vegetables?	*GH₵*_____	*GH₵*_____	*GH₵*_____

13. Please indicate why you are willing to pay more for safe vegetables. *[Please tick the appropriate option for each statement]*.

Statement	**Yes**	**No**	**Do not know**
I can afford buying safe vegetables			
Safe vegetables are more nutritious (e. g. vitamins, minerals) than the conventional ones			
Safe vegetables are tastier than conventional ones			
Safe vegetables are healthier for me and my family than the conventional one			

14. Please rank the three constraints which are most pressing in accessing safe vegetables (1 = most pressing).

Constraint	**Rank the three most pressing constraints**
Prices of safe vegetables	
Lack of adequate information on safe vegetables	
Lack of access to markets for safe vegetables	
Lack of safe vegetables	
Lack of trust in the certification institution	
Cultural barriers	

PART III

ELICITATION OF TRUST

15. How much trust do you have in the following persons/institutions? Please rate your level of trust. [*Please tick the appropriate for each institution/person.*]

Institutions/ Persons	***Do not trust at all*** *(1)*	***Do not trust very much*** *(2)*	***Neutral*** *(3)*	***Trust somewhat*** *(4)*	***High trust*** *(5)*
government					
public authorities					
farmers					
traders					
private institutions					
scientific institutions					
strangers					
ethnicities: Dagomaba					
Gonja					
Mamprusi					
Akan					
Other:					
neighbour					
friends					
family					

PART IV

DEMOGRAPHIC CHARACTERISTICS

16. Religion of Respondent:

Traditional ☐ Christian ☐ Muslim ☐ Other ☐

17. Marital Status of Respondent:

Single ☐ Married ☐ Divorced ☐ Widowed

Please indicate the composition of your household (resident household members only!) *[use the table below]*

HH members *(first names only)*	**Relationship to the respondent**	**Age**	**Sex M/F**	**Highest Education**[1]	**Major occupation**[2] *(Activity you spend most of your time on)*	**Earnings/ Month (***GH₵***)**
Respondent						
Household Head						

[1] [(1) None, (2) Koranic school, (3) Non-formal (can read and write but never went to school), (4) primary class (1-6), (5) Junior High School (JHS1 – JHS3) (6) Secondary (SHS1-SHS3, Vocational or Technical School, (7) Tertiary (Training college, university, polytechnic)]

[2] [(1) Own farm, (2) daily wage labour (farming or non-farm activities), (3) salaried worker (e. g. teacher, police man), (4) petty trading, (5) craftsman (e. g. bricklayer, carpenter, tailor), (6) Student, (7) Other **(***Please specify:*)]

18. What is your ethnicity? Dagomba ☐ Gonja ☐

Mamprusi ☐ Kasena/Nankana ☐ Fafra ☐ Akan ☐

Other **(***Please specify* _____ **)**

PART V

ELICITATION OF RISK PREFERENCES

19. Please indicate whether you are willing to take risk. [*Please tick the appropriate option for each category.*]

Category	***No*** *(1)*	***Neutral*** *(2)*	***Yes*** *(3)*
financial matters			
your occupation			
your health			

20. Consider the following situation: Suppose that your child has a whole in his heart which leads to death within the next few months. An international donor organization gives you money for a surgery. There is a chance that the surgery

will fully cure your son's heart. Nevertheless, there is also a chance that your son will be dying immediately after the surgery. How would you decide? Please indicate the lowest probability you would consider acceptable for doing the surgery.

It is nearly certain that the surgery will be successful ☐

There is a 50-50 chance that the surgery will be successful ☐

There is small chance that the surgery will be successful ☐

PART VI: CONSUMERS' FOOD SAFETY KNOWLEDGE AND PERCEPTIONS

21. **General questions about safer vegetables food**

The following can cause contamination of vegetables	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. *Micro-pathogens*					
2. Agro-chemicals (e.g. pesticides)					
3. Heavy metals					
4. Physical materials					

Contamination of vegetables can cause the following diseases	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. illness					
2. deaths					
3. Infertility (impotency)					
4. Malnutrition					
5. Loss of appetite					

Perceptions about food (vegetable) safety	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. If a vegetable is devoid of any of the following (e.g. dirt, insect bites etc.), it is of good quality and safer					
2. If a vegetable is more expensive, it is safer					
3. If a vegetable is well-and neatly packaged, it is safer					
4. Safer foods (vegetables) are environmentally friendly					
5. Safer foods (vegetables) are healthier					

6. Safer foods (vegetables) are tastier					
7. Safer food (vegetables) are more nutritious than conventional ones					
8. Safer food (vegetables) are hazard-free					
9. Safer foods (vegetables) must necessarily be certified					
10. Safer foods (vegetables) must necessarily be labelled					

22. **Do you have any further comments on the topic of safe vegetables?**

23. **Do you have any questions for me?**

…….Thank You Very Much for Your Co-operation…….

Appendix II: Market Prices and Estimation Outputs

II.1 Market Prices for Conventional Vegetables

		CABBAGE	AYOYO	OKRA
WEEK 1				
	SELLER 1	4	1	1
	SELLER 2	3	1	1
	SELLER 3	3	1	1.5
	SELLER 4	4	1.5	1
	SELLER 5	3.5	1	1
	SELLER 6	3	1	1
	AVERAGE MKT_PRICE	3.375	1.125	1.125
WEEK 2	SELLER 1	3.5	1	1
	SELLER 2	4	1	1
	SELLER 3	3	1	1
	SELLER 4	4	1	1
	SELLER 5	4	1	1
	AVERAGE MKT_PRICE	3.7	1	1
WEEK 3	SELLER 1	3	1	1
	SELLER 2	3	1.5	1
	SELLER 3	4	1	1
	SELLER 4	3	1	1
	SELLER 5	3.5	1	1
	AVERAGE MKT_PRICE	3.3	1.1	1
	AVERAGE MKT_PRICES FOR 3 MARKET	**3.475**	**1.066176471**	**1.0347**

II. 2: Summary Statistics of WTP Responses

Variable	Obs	Mean	Std. Dev.	Min	Max
mp_cabbage	268	3.5	0	3.5	3.5
mp_ayoyo	268	1.1	0	1.1	1.1
mp_alefu	268	1	0	1	1
first_bid_~e	331	4.262538	2.387198	0	7
decision_f~e	258	.7170543	.4513058	0	1
second_bid~e	184	6.6625	1.211311	4.8	10.5
decision_s~e	184	.7119565	.4540871	0	1
no_fist_bi~e	74	3.913514	.8621929	2.2	6.3
decision_n~e	74	.7567568	.4319694	0	1
max_cabbage	242	6.110331	1.900692	3.5	15
first_bid_~o	331	1.348036	.7670214	0	2.2
decision_f~o	256	.8164063	.3879109	0	1
second_bid~o	209	2.155024	.4344383	1.5	3.3
decision_s~o	209	.8899522	.3137008	0	1
no_fist_bi~o	47	1.323404	.1832233	1	1.8
decision_n~o	47	.8723404	.3373181	0	1
max_ayoyo	248	2.389113	.7781963	1.2	5
first_bid_~a	331	1.245619	.7052211	0	2
decision_f~a	257	.8871595	.317015	0	1
second_bid~a	257	1.909728	.4321353	.9	3
decision_s~a	257	.9182879	.27446	0	1
no_fist_bi~a	0				
decision_n~a	0				
max_okra	254	2.277165	.7603503	1	5
can_afford	263	1.475285	.5003409	1	2
more_nutri~s	263	1.212928	.5597029	1	3
tastier	261	1.241379	.5399185	1	3
healthier	264	1.007576	.0868732	1	2
constrain~ce	189	1.333333	.6684374	1	3
constraint~n	235	1.838298	.7391822	1	3
constraint~s	182	2.274725	.7216607	1	3
constraint~g	170	2.329412	.7279417	1	3
constraint~t	187	2.224599	.7779448	1	3
constrain~re	25	2.48	.6531973	1	3
WTP_bids_c~e	331	2.465257	1.572828	0	4
WTP_bids_a~o	331	2.719033	1.654077	0	4
WTP_bids_o~a	331	2.854985	1.661543	0	4

II 3: Summaries of Variables Used in the Models

Variable	Obs	Mean	Std. Dev.	Min	Max
pref~_market	329	.768997	.4221164	0	1
pref~rmarket	329	.3525836	.4785022	0	1
prefer_pur~e	329	.5471125	.4985337	0	1
sex	331	.2809668	.4501518	0	1
Age	328	38.42683	12.55888	16	78
Educat	331	.3232628	.4684302	0	1
marstat	331	.7492447	.4341041	0	1
Salaried_w~r	331	.1963746	.3978566	0	1
Self_emplo~d	331	.6827795	.4660987	0	1
earnings	283	1239.948	1388.358	20	15400
HHmembers	331	2.410876	1.103879	1	9
amountpw_v~b	331	22.00906	19.73288	.375	140
freq_shopp~g	331	.7039275	.4572145	0	1
appearance~g	329	.0273556	.1633659	0	1
nutrit_value	324	.1450617	.3527078	0	1
irrigation~e	326	.2944785	.4565087	0	1
agrochemic~e	329	.3404255	.4745741	0	1
farmers	325	3.003077	1.260752	1	5
traders	323	2.922601	1.23241	1	5
perc_veg_q~y	331	.5045317	.5779882	-1	1
perc_expen	331	.0090634	.6639478	-1	1
perc_packa~g	331	.0634441	.6232069	-1	1
perc_envir~e	331	.3202417	.5628778	-1	1
perc_health	331	.8323263	.2857426	-1	1
perc_taste	331	.5830816	.5133528	-1	1
perc_nutri~n	331	.6329305	.522671	-1	1
perc_conta~n	331	.5861027	.4978623	-1	1
perc_cert	331	.1555891	.6553675	-1	1
perc_label	331	.0966767	.6672112	-1	1
overal_knwl	331	5.442598	2.614881	-5	9

II4 Stata Output for WTP price premiums for safer cabbage

```
. doubleb first_bid_cabbage second_bid_cabbage decision_fb_cabbage decision_sb_cabbag

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -13008.782
rescale:       log likelihood = -210.27575
rescale eq:    log likelihood = -191.65405
Iteration 0:   log likelihood = -191.65405  (not concave)
Iteration 1:   log likelihood =  -164.4972  (not concave)
Iteration 2:   log likelihood = -142.32346
Iteration 3:   log likelihood = -131.56141  (backed up)
Iteration 4:   log likelihood =  -130.7842
Iteration 5:   log likelihood = -130.71195
Iteration 6:   log likelihood = -130.71183
Iteration 7:   log likelihood = -130.71183

                                                Number of obs     =        184
                                                Wald chi2(0)      =          .
Log likelihood = -130.71183                     Prob > chi2       =          .
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Beta						
_cons	8.007617	.2123923	37.70	0.000	7.591335	8.423898
Sigma						
_cons	1.686729	.173112	9.74	0.000	1.347436	2.026023

```
First-Bid Variable:             first_bid_cabbage
Second-Bid Variable:            second_bid_cabbage
First-Response Dummy Variable:  decision_fb_cabbage
Second-Response Dummy Variable: decision_sb_cabbage
```


```
Iteration 0:   log likelihood = -379.49438
Iteration 1:   log likelihood =   -326.674
Iteration 2:   log likelihood = -325.26739
Iteration 3:   log likelihood = -325.26182
Iteration 4:   log likelihood = -325.26181

Ordered logistic regression                     Number of obs     =        261
                                                LR chi2(30)       =     108.47
                                                Prob > chi2       =     0.0000
Log likelihood = -325.26181                     Pseudo R2         =     0.1429
```

WTP_bids_cabbage	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	-.1206404	.3361237	-0.36	0.720	-.7794309	.53815
Age	-.0115018	.0107437	-1.07	0.284	-.032559	.0095554
Educat	-.7137559	.361128	-1.98	0.048	-1.421554	-.0059581
marstat	-.0900984	.3039914	-0.30	0.767	-.6859106	.5057137
Salaried_worker	.9522052	.5484893	1.74	0.083	-.122814	2.027224
Self_employed	.8508361	.4571272	1.86	0.063	-.0451168	1.746789
earnings	.0002651	.0001372	1.93	0.053	-3.68e-06	.000534
HHmembers	-.1850575	.124053	-1.49	0.136	-.428197	.058082
amountpw_vegetab	.006219	.0088376	0.70	0.482	-.0111023	.0235403
freq_shopping	-.0410787	.3222835	-0.13	0.899	-.6727428	.5905853
appearance_veg	-.0216143	.8407047	-0.03	0.979	-1.669365	1.626137
nutrit_value	-.8651242	.4078849	-2.12	0.034	-1.664564	-.0656845
irrigation_source	-1.14693	.3469425	-3.31	0.001	-1.826924	-.466935
agrochemical_use	-.0889544	.323525	-0.27	0.783	-.7230518	.5451429
prefer_purchase_safe_market	-.1848643	.328212	-0.56	0.573	-.8281479	.4584194
prefer_purchase_safe_supermarket	.0660204	.3081417	0.21	0.830	-.5379262	.6699671
prefer_purchse_safe_farmgate	-.1820642	.319019	-0.57	0.568	-.8073299	.4432015
farmers	.3864692	.1820097	2.12	0.034	.0297368	.7432017
traders	-.4944327	.189434	-2.61	0.009	-.8657165	-.1231489
perc_veg_qlty	-.0419967	.2812075	-0.15	0.881	-.5931533	.5091599
perc_expen	-.3846993	.2249206	-1.71	0.087	-.8255355	.056137
perc_packaging	-.1131284	.2437579	-0.46	0.643	-.590885	.3646283
perc_envir_frie	.3763121	.265754	1.42	0.157	-.1445562	.8971804
perc_health	1.012322	.5056415	2.00	0.045	.0212827	2.003361
perc_taste	.1048137	.305333	0.34	0.731	-.493628	.7032554
perc_nutrition	.2121675	.3564597	0.60	0.552	-.4864807	.9108157
perc_contamination	.6408328	.3642268	1.76	0.079	-.0730387	1.354704
perc_cert	.1712709	.3784588	0.45	0.651	-.5704948	.9130366
perc_label	-.3802452	.3629776	-1.05	0.295	-1.091668	.3311778
overal_knwl	-.0480423	.0681029	-0.71	0.481	-.1815215	.0854369
/cut1	-1.610093	.9603739			-3.492392	.2722048
/cut2	-1.216479	.9570889			-3.092339	.6593807
/cut3	-.1100922	.9540309			-1.979958	1.759774
/cut4	.8679492	.955784			-1.005353	2.741251

II5 Stata Output for WTP price premiums for safer ayoyo

```
. doubleb first_bid_ayoyo second_bid_ayoyo decision_fb_ayoyo decision_sb_ayoyo

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -1581.1624
rescale:       log likelihood = -139.70858
rescale eq:    log likelihood = -127.01524
Iteration 0:   log likelihood = -127.01524  (not concave)
Iteration 1:   log likelihood = -121.90289  (not concave)
Iteration 2:   log likelihood = -117.76304  (not concave)
Iteration 3:   log likelihood = -111.17594  (not concave)
Iteration 4:   log likelihood =  -107.1503  (not concave)
Iteration 5:   log likelihood =   -101.986  (not concave)
Iteration 6:   log likelihood = -97.896116  (not concave)
Iteration 7:   log likelihood = -93.758988  (not concave)
Iteration 8:   log likelihood = -87.733023  (not concave)
Iteration 9:   log likelihood = -85.405269
Iteration 10:  log likelihood = -80.848009
Iteration 11:  log likelihood = -80.674796
Iteration 12:  log likelihood = -80.673892
Iteration 13:  log likelihood = -80.673892

                                                Number of obs     =        209
                                                Wald chi2(0)      =          .
Log likelihood = -80.673892                     Prob > chi2       =          .
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Beta						
_cons	3.269407	.1725599	18.95	0.000	2.931196	3.607618
Sigma						
_cons	.7699643	.115214	6.68	0.000	.544149	.9957796

```
First-Bid Variable:              first_bid_ayoyo
Second-Bid Variable:             second_bid_ayoyo
First-Response Dummy Variable:   decision_fb_ayoyo
Second-Response Dummy Variable:  decision_sb_ayoyo
```


```
Iteration 0:   log likelihood = -324.01355
Iteration 1:   log likelihood = -286.05346
Iteration 2:   log likelihood = -284.55438
Iteration 3:   log likelihood = -284.54162
Iteration 4:   log likelihood = -284.54162

Ordered logistic regression                     Number of obs     =        261
                                                LR chi2(30)       =      78.94
                                                Prob > chi2       =     0.0000
Log likelihood = -284.54162                     Pseudo R2         =     0.1218
```

WTP_bids_ayoyo	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	-.0669628	.3534564	-0.19	0.850	-.7597246	.625799
Age	-.0191695	.011747	-1.63	0.103	-.0421932	.0038543
Educat	.0244802	.3770697	0.06	0.948	-.7145627	.7635232
marstat	-.2403884	.3268368	-0.74	0.462	-.8809767	.4001998
Salaried_worker	.8194805	.5992066	1.37	0.171	-.354943	1.993904
Self_employed	.6385667	.4867195	1.31	0.190	-.3153859	1.592519
earnings	.0002045	.0001488	1.37	0.169	-.0000871	.0004961
HHmembers	-.1548882	.1384311	-1.12	0.263	-.4262081	.1164317
amountpw_vegetab	.0222101	.0103575	2.14	0.032	.0019098	.0425104
freq_shopping	-.928318	.3563639	-2.60	0.009	-1.626778	-.2298575
appearance_veg	.6733927	1.044705	0.64	0.519	-1.374191	2.720976
nutrit_value	-1.457183	.44893	-3.25	0.001	-2.33707	-.5772967
irrigation_source	-.5865995	.3710351	-1.58	0.114	-1.313815	.1406159
agrochemical_use	-.0945997	.3488035	-0.27	0.786	-.7782421	.5890427
prefer_purchase_safe_market	-.3692626	.3472811	-1.06	0.288	-1.049921	.3113959
prefer_purchase_safe_supermarket	.2822617	.3188504	0.89	0.376	-.3426735	.9071969
prefer_purchse_safe_farmgate	-.4438456	.343205	-1.29	0.196	-1.116515	.2288239
farmers	.521455	.2016939	2.59	0.010	.1261422	.9167678
traders	-.3724535	.2049415	-1.82	0.069	-.7741316	.0292245
perc_veg_qlty	-.0858569	.3234998	-0.27	0.791	-.7199048	.548191
perc_expen	-.0361255	.2404481	-0.15	0.881	-.5073951	.435144
perc_packaging	-.5237218	.2623906	-2.00	0.046	-1.037998	-.0094456
perc_envir_frie	.0857354	.2868468	0.30	0.765	-.4764741	.6479449
perc_health	1.025912	.5760915	1.78	0.075	-.1032063	2.155031
perc_taste	.3317804	.3510121	0.95	0.345	-.3561906	1.019751
perc_nutrition	-.7617656	.4461489	-1.71	0.088	-1.636201	.1126702
perc_contamination	.1579408	.4134736	0.38	0.702	-.6524526	.9683343
perc_cert	.290671	.3826267	0.76	0.447	-.4592635	1.040606
perc_label	-.4540972	.3660821	-1.24	0.215	-1.171605	.2634106
overal_knwl	-.0929043	.0733417	-1.27	0.205	-.2366513	.0508427
/cut1	-2.661323	1.062817			-4.744406	-.5782392
/cut2	-2.471158	1.06106			-4.550798	-.3915181
/cut3	-1.538684	1.051791			-3.600156	.5227887
/cut4	-1.122251	1.048523			-3.177318	.9328158

II6 Stata Output for WTP price premiums for safer okra

```
. doubleb first_bid_okra second_bid_okra decision_fb_okra decision_sb_okra

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -1585.9576
rescale:       log likelihood = -225.15587
rescale eq:    log likelihood = -215.87234
Iteration 0:   log likelihood = -215.87234  (not concave)
Iteration 1:   log likelihood =  -203.9081  (not concave)
Iteration 2:   log likelihood = -185.96234  (not concave)
Iteration 3:   log likelihood = -179.11431  (not concave)
Iteration 4:   log likelihood = -171.83147
Iteration 5:   log likelihood =  -165.0398
Iteration 6:   log likelihood = -164.95094
Iteration 7:   log likelihood = -164.95093

                                                Number of obs     =        257
                                                Wald chi2(0)      =          .
Log likelihood = -164.95093                     Prob > chi2       =          .
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Beta						
_cons	2.885375	.1382027	20.88	0.000	2.614503	3.156248
Sigma						
_cons	.9031523	.1087026	8.31	0.000	.6900991	1.116206

```
First-Bid Variable:             first_bid_okra
Second-Bid Variable:            second_bid_okra
First-Response Dummy Variable:  decision_fb_okra
Second-Response Dummy Variable: decision_sb_okra
```

Ordered logistic regression — Number of obs = 261
LR chi2(30) = 91.66
Prob > chi2 = 0.0000
Log likelihood = -235.19609 — Pseudo R2 = 0.1631

WTP_bids_okra	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	.561372	.4026542	1.39	0.163	-.2278157	1.35056
Age	-.033323	.0133169	-2.50	0.012	-.0594236	-.0072224
Educat	.7034287	.4212291	1.67	0.095	-.1221653	1.529023
marstat	-.3802733	.3571347	-1.06	0.287	-1.080245	.3196979
Salaried_worker	.6084756	.6203218	0.98	0.327	-.6073328	1.824284
Self_employed	.762723	.5104859	1.49	0.135	-.2378108	1.763257
earnings	.0003345	.0001742	1.92	0.055	-7.01e-06	.0006759
HHmembers	-.1322608	.1653836	-0.80	0.424	-.4564066	.1918851
amountpw_vegetab	.0174539	.0113132	1.54	0.123	-.0047195	.0396273
freq_shopping	-1.090391	.3971313	-2.75	0.006	-1.868754	-.3120277
appearance_veg	.7599414	1.005854	0.76	0.450	-1.211495	2.731378
nutrit_value	-1.792071	.4808183	-3.73	0.000	-2.734458	-.8496848
irrigation_source	.0971387	.4027488	0.24	0.809	-.6922344	.8865118
agrochemical_use	-.7660589	.3748701	-2.04	0.041	-1.500791	-.031327
prefer_purchase_safe_market	-.4901827	.4027906	-1.22	0.224	-1.279638	.2992724
prefer_purchase_safe_supermarket	.2639872	.3582334	0.74	0.461	-.4381373	.9661117
prefer_purchse_safe_farmgate	-.7050534	.3782981	-1.86	0.062	-1.446504	.0363973
farmers	.638386	.226664	2.82	0.005	.1941328	1.082639
traders	-.6723065	.2364118	-2.84	0.004	-1.135665	-.208948
perc_veg_qlty	-.1229605	.3572578	-0.34	0.731	-.8231728	.5772519
perc_expen	-.2883218	.2712629	-1.06	0.288	-.8199874	.2433437
perc_packaging	.0131939	.2887298	0.05	0.964	-.5527061	.579094
perc_envir_frie	.0565115	.3120678	0.18	0.856	-.5551302	.6681532
perc_health	2.201796	.6039115	3.65	0.000	1.018151	3.385441
perc_taste	.0667394	.3737522	0.18	0.858	-.6658014	.7992803
perc_nutrition	.2439049	.4602588	0.53	0.596	-.6581858	1.145996
perc_contamination	-.578639	.4629869	-1.25	0.211	-1.486077	.3287987
perc_cert	-.1430701	.4207916	-0.34	0.734	-.9678066	.6816663
perc_label	-.0871138	.3972034	-0.22	0.826	-.8656182	.6913906
overal_knwl	-.0755985	.0777085	-0.97	0.331	-.2279044	.0767073
/cut1	-2.724563	1.101793			-4.884038	-.5650888
/cut2	-2.66202	1.100842			-4.819632	-.5044087
/cut3	-1.992807	1.092963			-4.134975	.1493608
/cut4	-1.554174	1.088799			-3.68818	.5798325

II7 Stat Output for Consumers' Choice of Market for Fresh Vegetables

```
Iteration 0:   log pseudolikelihood = -349.75359
Iteration 1:   log pseudolikelihood = -335.65813
Iteration 2:   log pseudolikelihood = -334.10466
Iteration 3:   log pseudolikelihood = -334.07289
Iteration 4:   log pseudolikelihood = -334.06738
Iteration 5:   log pseudolikelihood = -334.06635
Iteration 6:   log pseudolikelihood = -334.06614
Iteration 7:   log pseudolikelihood =  -334.0661
Iteration 8:   log pseudolikelihood = -334.06609

Multivariate probit (MSL, # draws = 5)          Number of obs   =       261
                                                Wald chi2(81)   =   1655.74
Log pseudolikelihood = -334.06609               Prob > chi2     =    0.0000
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
prefer_purchase_safe_market						
sex	.4440933	.2721592	1.63	0.103	-.0893289	.9775155
Age	.004926	.0081997	0.60	0.548	-.011145	.0209971
Educat	-.4586483	.2712811	-1.69	0.091	-.9903495	.0730528
marstat	-.1049494	.2188607	-0.48	0.632	-.5339085	.3240096
Salaried_worker	.1983755	.3872492	0.51	0.608	-.560619	.9573699
Self_employed	.3122294	.342483	0.91	0.362	-.359025	.9834838
earnings	.0000464	.0000805	0.58	0.564	-.0001113	.0002041
HHmembers	-.1414913	.0927777	-1.53	0.127	-.3233323	.0403497
amountpw_vegetab	-.002132	.0058366	-0.37	0.715	-.0135714	.0093075
freq_shopping	.2661634	.2575418	1.03	0.301	-.2386092	.7709359
appearance_veg	3.814231	.4213933	9.05	0.000	2.988315	4.640147
nutrit_value	.0952274	.3211599	0.30	0.767	-.5342344	.7246893
irrigation_source	.5013018	.2791196	1.80	0.072	-.0457626	1.048366
agrochemical_use	.3270969	.2745158	1.19	0.233	-.2109442	.8651379
farmers	-.2594192	.1463022	-1.77	0.076	-.5461662	.0273279
traders	.1365073	.1565961	0.87	0.383	-.1704155	.4434301
perc_veg_qlty	-.0958913	.1957077	-0.49	0.624	-.4794714	.2876889
perc_expen	.1493993	.1739675	0.86	0.390	-.1915707	.4903693
perc_packaging	.081427	.1990542	0.41	0.682	-.3087119	.471566
perc_envir_frie	-.0753185	.1955194	-0.39	0.700	-.4585295	.3078925
perc_health	.7730762	.3606683	2.14	0.032	.0661793	1.479973
perc_taste	.3391832	.233524	1.45	0.146	-.1185154	.7968819
perc_nutrition	-.4389016	.3312435	-1.33	0.185	-1.088127	.2103237
perc_contamination	-.2932619	.2604931	-1.13	0.260	-.803819	.2172953
perc_cert	.3452241	.2911895	1.19	0.236	-.2254968	.915945
perc_label	-.3927058	.2766164	-1.42	0.156	-.934864	.1494525
overal_knwl	-.0282579	.0518985	-0.54	0.586	-.1299772	.0734614
_cons	.6886493	.7161103	0.96	0.336	-.714901	2.0922
prefer_purchase_safe_supermarket						
sex	.4912028	.2275105	2.16	0.031	.0452904	.9371152
Age	-.0002047	.0082351	-0.02	0.980	-.0163453	.0159358
Educat	-.0737891	.2695699	-0.27	0.784	-.6021365	.4545582
marstat	.08381	.2284527	0.37	0.714	-.3639491	.531569
Salaried_worker	.1710728	.3780235	0.45	0.651	-.5698396	.9119853
Self_employed	-.2057975	.3447687	-0.60	0.551	-.8815317	.4699368
earnings	.0000489	.0001009	0.48	0.628	-.000149	.0002467
HHmembers	-.1287984	.1189878	-1.08	0.279	-.3620102	.1044133
amountpw_vegetab	.0076818	.0055631	1.38	0.167	-.0032217	.0185853
freq_shopping	-.3657987	.2321046	-1.58	0.115	-.8207153	.0891179
appearance_veg	.216813	.5757208	0.38	0.706	-.911579	1.345205
nutrit_value	.597525	.3175157	1.88	0.060	-.0247942	1.219844
irrigation_source	-.0831845	.2739263	-0.30	0.761	-.6200701	.4537011
agrochemical_use	.0070672	.2524368	0.03	0.978	-.4876999	.5018343
farmers	-.0867917	.144673	-0.60	0.549	-.3703455	.1967622
traders	-.064303	.148132	-0.43	0.664	-.3546363	.2260303
perc_veg_qlty	.2383181	.2266745	1.05	0.293	-.2059558	.682592
perc_expen	.1312189	.1652804	0.79	0.427	-.1927247	.4551625
perc_packaging	.2207447	.1782731	1.24	0.216	-.1286642	.5701535
perc_envir_frie	.1141945	.1990931	0.57	0.566	-.2760207	.5044098
perc_health	.0817191	.4348462	0.19	0.851	-.7705639	.9340021
perc_taste	-.191626	.2396643	-0.80	0.424	-.6613594	.2781073
perc_nutrition	-.0194733	.3385276	-0.06	0.954	-.6829753	.6440286
perc_contamination	1.391095	.3493007	3.98	0.000	.7064781	2.075712
perc_cert	-.0372041	.2531791	-0.15	0.883	-.5334259	.4590178
perc_label	-.0139588	.2520948	-0.06	0.956	-.5080556	.480138
overal_knwl	.1031783	.0495147	2.08	0.037	.0061313	.2002253
_cons	-1.545714	.8308764	-1.86	0.063	-3.174202	.0827733
prefer_purchse_safe_farmgate						
sex	-.0711277	.2260481	-0.31	0.753	-.5141737	.3719184
Age	.0259626	.0077371	3.36	0.001	.0107981	.0411271
Educat	.1388061	.2498948	0.56	0.579	-.3509787	.6285908
marstat	.2473562	.228879	1.08	0.280	-.2012385	.6959509
Salaried_worker	-.7951439	.3496035	-2.27	0.023	-1.480354	-.1099337
Self_employed	-.6067152	.312009	-1.94	0.052	-1.218242	.0048111
earnings	9.43e-06	.0000613	0.15	0.878	-.0001107	.0001296
HHmembers	-.0447939	.0899534	-0.50	0.619	-.2210992	.1315115
amountpw_vegetab	.0044692	.0065215	0.69	0.493	-.0083128	.0172512
freq_shopping	-.0952617	.2336844	-0.41	0.684	-.5532747	.3627513
appearance_veg	.0961295	.6930319	0.14	0.890	-1.262188	1.454447
nutrit_value	.6074815	.3114211	1.95	0.051	-.0028927	1.217856
irrigation_source	.0708638	.2344599	0.30	0.762	-.3886691	.5303968
agrochemical_use	.031507	.229329	0.14	0.891	-.4179695	.4809836
farmers	-.2214435	.1267792	-1.75	0.081	-.4699262	.0270391
traders	-.1007651	.1277224	-0.79	0.430	-.3510965	.1495663
perc_veg_qlty	.1465757	.1879735	0.78	0.436	-.2218457	.514997
perc_expen	.3945523	.1441139	2.74	0.006	.1120942	.6770103
perc_packaging	-.2961309	.1608212	-1.84	0.066	-.6113348	.0190729
perc_envir_frie	.2515457	.192762	1.30	0.192	-.1262608	.6293523
perc_health	.4349677	.3628722	1.20	0.231	-.2762486	1.146184
perc_taste	-.0302605	.2065195	-0.15	0.884	-.4350314	.3745103
perc_nutrition	.361375	.2453916	1.47	0.141	-.1195836	.8423336
perc_contamination	1.229369	.2924057	4.20	0.000	.6562647	1.802474
perc_cert	.567123	.2889182	1.96	0.050	.0008537	1.133392
perc_label	-.6203336	.2754748	-2.25	0.024	-1.160254	-.080413
overal_knwl	-.0023197	.0427395	-0.05	0.957	-.0860877	.0814483
_cons	-1.087741	.6312755	-1.72	0.085	-2.325018	.1495362
/atrho21	-.2116778	.1147713	-1.84	0.065	-.4366254	.0132698
/atrho31	-.38449	.1215589	-3.16	0.002	-.622741	-.146239
/atrho32	.7399628	.1895037	3.90	0.000	.3685423	1.111383
rho21	-.2085719	.1097785	-1.90	0.057	-.4108434	.0132691
rho31	-.3666004	.1052219	-3.48	0.000	-.5530336	-.1452054
rho32	.6291227	.114499	5.49	0.000	.352716	.8045508

```
Likelihood ratio test of   rho21 = rho31 = rho32 = 0:
            chi2(3) =   30.4598    Prob > chi2 = 0.0000
```

II7: Raw Map of 1,220 Waypoints