CONSUMER'S WILLINGNESS-TO-PAY FOR PESTICIDE FREE FOOD PRODUCTS IN THE ACCRA-TEMA METROPOLITAN AREAS

BY

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DECLARATION

This to certify that this thesis is the result of research undertaken by Konde Jein Joshua towards the award of the Master of Philosophy (MPHIL) degree in Economics at the Department of Economics, University of Ghana.

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ABSTRACT

In Ghana, as in many developing countries, farmers depends largely on pesticides to control pest and weeds. Unfortunately, residues of this pesticides in the soil, crops and vegetables poses a great harm to the environment and human health which has the ability to erode the marginal developmental gains that have been made.

This study seeks to investigate how much households in the Accra-Tema Metropolitan areas are willing to pay for selected Pesticide Free Products that are more environmentally friendly and does not pose any danger to environment and human health. The study also examined factors that influence household's willingness to pay for PFP products using contingent valuation method and the ordered probit regression model.

The results indicates that, factors such as education, environmental consciousness, household income and being a member of association increases the likelihood of households paying for PFP, whiles the number of aged persons in a household, residing in low income communities and employment were found to decrease the likelihood of households paying for PFP. Analysis of WTP suggest that, majority (99.6%) of the inhabitants in the Accra-Tema Metropolitan areas are willing to pay a premium of GH₵ 0.88) for the selected PFP. This represents 17.5% increase over the prevailing average price of the non PFP.

The study recommends that, government advocate for the adoption of pesticide free production techniques and also intensify education and sensitization on the importance of maintaining a clean and healthy environment. It is also recommended that, there should be increase in general income if government want to increase WTP.

DEDICATION

I dedicate this work to the Almighty God who has made it possible for me to go through this programme successfully.

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I finally wish to take full responsibility for any inadvertent errors, errors or misrepresentation that may be found this thesis.

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LIST OF ACRONYMS

ABM	Averting Behaviour Method
CEM	Choice Experiment Method
CS	Capsule Suspension
CV	Contingent Valuation
CVM	Contingent Valuation Method
DP	Dustable Powder
EC	Emulsifiable Concentrates
EPA	Environmental Protection Agency
EPC	Environmental Protection Council
FAO	Food and Agriculture Organization
FDA	Food and Drugs Authority
FRE	Fully Registered
GEPA	Ghana Environmental Protection Agency
GR	Granules
GSS	Ghana Statistical Service
HCB	Hexachlorobenzene
HPFM	Household Production Function Method
HPM	Hedonic Pricing Method
IPM	Integrated Pest Management
LI	Legislative Instrument
MMDAs	Metropolitan, Municipal and District Assemblies
MOFA	Ministry Food and Agriculture
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NOAA	National Oceanic and Atmospheric Administration
NPAS	Northern Presbyterian Agriculture Science

NUV	Non Use Value
PAN	Pesticide Action Network
PCL	Provisional Clearance
PFP	Pesticide Free Products
PHC	Population and Housing Census
PNDC	Provisional National Defence Council
RP	Revealed Preference
RPM	Revealed Preference Method
SDG	Sustainable Development Goal
SDS	Sustainable Development Solution
SHS	Senior High School
SP	Stated Preference
SPM	Stated Preference Method
TCM	Travel Cost Method
TEV	Total Economic Value
UN	United Nations
USA	United States of America
UV	Use Value
VIF	Variance Inflation Factor
WHO	World Health Organization
WP	Wettable Powders
WTA	Willingness-To-Accept
WTP	Willingness-To-Pay

CHAPTER ONE

1.1 Background of Study

Sustainable Development Goal two (SDG2), which focuses on ending Hunger, Achieve Food Security and Improved Nutrition and Promote Sustainable Agriculture has been given priority attention by policymakers in most developed and developing countries. The role of safe and wholesome food in human development as well as its contribution to the sustainability of other vital development goals cannot be underestimated. In view of this, ensuring good agriculture farming practices which is devoid of food borne diseases have become paramount. Nutrition which is the basic human need is obtained from agriculture. The world's population depend on agriculture for the supply of valued cultural foods, nutrients, fibers and other products. The linkage between safe agriculture food crops and healthy life is essential for human development.

According to the World Health Organization (WHO, 2015), consumption of nutritious and safety food is one of the basic source of good human health for a productive life. A study by Hawkes and Ruel (2006), revealed that, almost 50 percent of the health problems of malnutrition is ascribed to unsafe food crops, poor quality water, unimproved sanitation and hygiene. This shows how essential the consumption of safe and good food is to human development. Hawkes and Ruel (2006), therefore recommended that, food, water and environmental quality be given the necessary attention to ensure healthy life style and also to achieve the Sustainable Development Goals (SDGs). Food and Agriculture Organization (FAO, 2015), defined Food safety as, giving assurance that damage will not be caused by food to the consumer when it is prepared and/or eaten according to its planned use. Food and nutrition security on the other hand, occurs when all citizens, at every moment have social, physical and economic access to adequate, harmless and nutritious food to

match their dietary requirements and food preference for an energetic and healthy life (FAO, 2015). Nutrition, food safety, and food security are inseparably linked. The reason being that, vicious cycle of sicknesses and undernourishment is often caused by the consumption of unwholesome food. The most affected especially, are the sick, infants, the elderly and the young children (FAO, 2015).

The projections that, the world population will grow to about 9.3 billion in the year 2050, have raised a lot of anxieties about the world's capability to feed and sustain the estimated human population with safe and nutritious food (SDS, 2013). The Food and Agriculture Organization also estimated that, the world food production capacity demands an increase of about 70%, so as to keep pace with the growing population demand (Harsimran and Garg, 2014). About 795 million persons of the world population are undernourished and therefore calls for pragmatic measures so as to ameliorate the situation (FAO, 2015).

Cranfield and Magnusson (2003) posits that, massive use of pesticides can be attributed to three critical factors. Firstly, an attempt to attain SDG2 policy objectives by most countries, secondly, efforts to meet the 70% projected rate of increase in the world food production capacity by FOA, and finally the quest to obtain effective economies of scale by farmers, has led to the increased in conventional crop production methods like, large scale monoculture farming practices which make use of massive pesticides aimed at increasing yield in both developed and developing countries. Monoculture is aimed at increasing yield and profit margins for farmers. The philosophy behind this farming practice is that, the farmer only cater for the need of a single species which is less expensive. According to the 2010 population and housing census statistics (PHC, 2010), 45.8 percent of the total households in Ghana are engaged in agriculture. Out of these households, those in monoculture or mono cropping farming practice forms the greater proportion representing 58.3 percent of the total farmers in Ghana.

The vulnerability of monoculture to insects, weeds and diseases have become a major concern in recent times. Pathogens spread more readily, epidemics tend to be more severe when the host plants are genetically uniform and crowded. Pathogens encounter less resistance to spreading than they do in mixed stands.

One major concern about large size monoculture crop farming practice is its dependence on massive pesticides inputs to shield the food crops against insects, weeds and disease destructions. According to the Pesticide Action Network International (PAN, 2012), between 2005 and 2010 global sales of pesticide increased from US$31 billion to US$38 billion. The steady rise in the volumes of pesticides marketed for agricultural purposes has become a worrying situation in view of the adverse effect it has on both human and the environment, especially if not well used.

Notwithstanding the positive functions of these pesticides in controlling insects and weeds, one cannot underestimate the negative consequences of these pesticides on the environment and human health. These conventional or traditional crop production methods has brought about fewer, but greater farming operations (Cranfield and Magnusson, 2003). Farmers lost control of the production system resulting from massive pesticide usage and the cost associated with the numerous farm operations. Non-availability of large farm lands to famers is among the major factors cited by scholars to have contributed to massive use of pesticide. According to Drechsel and Dongus (2010), analysis on the use of lands in Ghana for the period between 2001-2008 revealed that, the same parcel of land is used by 80% open-space urban farmers throughout the year and 70% of the farmers continued cultivating those plots for about 10 to 20 years. Pest and diseases attack these lands due to the continuous and rigorous cropping system.

To regain the biodiversity lost and also safeguard the crops against pest and disease pressures by urban farmers in Accra, led to intensive use of pesticides (Avicor et al, 2011; Drechsel and Kunze,

2002). Extensive use of pesticide, and in several situations misapplication, has characterized urban agriculture in Accra (Fianko et al, 2011). Another dangerous practice which raised the concerns of many consumers, especially the Ghanaian consumers is a situation known as pesticide cocktail. This has to do with the combination of different pesticides to increase their efficacy due to pest resistance to certain pesticide (Williamson, Ball, and Pretty, 2008). This post potential danger to the environment and human health. Furthermore, application of pesticides at the wrong seasons, especially spraying crops close to harvesting is another major problem.

The use of these expensive pesticides for pest control impact negatively on the ecological system of the earth and human health. Pesticide poisoning estimated by the World Health Organization (WHO, 2009), indicates that between 2 to 5 million pesticide applicators and rural communities are affected annually leading to over 20,000 fatalities. Food and Agriculture Organization also estimated that 30% of industrialized countries population are affected yearly by foodborne illnesses and 2.1 million deaths in less developed nations (WHO, 2008). A study by Van (2000), indicated that, food-borne disease or problems is expected to increase in the next 20 years because all elements responsible for the current situation still exist. Van further revealed that extensive pesticide usage on food crops is a major contribution factor. In 2010, the then Minister for the Upper East region of Ghana, Mark Woyongo, declared that farmers who died as a result of eating food infected with pesticides, number 12 and that further 63 farmers had been treated and discharged from the hospital (NPAS, 2012). Another survey conducted in the Upper East region of Ghana by Northern Presbyterian Agricultural Services, showed that out of 183 farmers in 14 villages, over half of them had suffered from directly inhaling chemicals and one fifth from spillage of chemicals on the body (NPAS, 2012). General body weakness, headaches, dizziness, skin irritations, and breathing difficulties are among the commonly reported symptoms

1.2 Statement of research problem

Pesticides are essential in several economic activities and plays an important role in our daily endeavors. Society derive varied benefits from pesticides, which include enhancement in diseases control, and increased agricultural and industrial yield. Notwithstanding these benefits, pesticides could cause a lot of environmental and health hazards through storage, production to disposal. The consequences inherent in misapplication or refusal to adopt the best practices are enormous. Residues of pesticides in the soil, water, air, and food crops affect their quality and post great danger to the environment and human health.

A study conducted by Pesticide Action Network (PAN, 2010), in West Africa revealed that 75% of the poisoning issues recorded in the cotton districts in Senegal and Benin resulted from drink and food contamination by the re-use of containers rather than spraying exposure phenomenon.

The financial cost or implications to farmers and the nation resulting from the misuse of pesticides cannot be underestimated. A study by PAN (2003) revealed that, cowpea and cotton subsistence farmers in Ghana on average loses 15-21 days of work in a year due to illness caused by pesticides. According to (PAN, 2003), the monetary equivalent of the above lost days of work by farmers ranges between 17-35 US dollars using daily labour rates charge by farmers. Pesticides Action Network further showed that, more than a third of Ghanaian farmers in the cotton sector suffer illness resulting from pesticides misuse and this cost Ghana $90 for their medical treatment and loss of work. A study by NPAS (2012), also found that 12 farmers died in the Upper East Region of Ghana as a result of eating food infected with pesticides and a total of 246 had suffered from various kinds of pesticides injuries. General body weakness, headaches, dizziness, skin irritations, and breathing difficulties are among the commonly reported symptoms.

The most alarming situation is that, the harmful impacts resulting from the misuse of pesticides is not limited to the poor farmer. Consumers of products with pesticide residues resulting from misapplication and spraying of crops close to harvesting are also affected. Several academic works in Ghana such as Essumang et al (2009), over the years have revealed that, most of the vegetables, meat, water, sediments fish, and human fluids contains residues of pesticides. A study by Fianko et al (2011), shows that fish from River Densu showed that, four kinds of pesticides surpassed the reference prescription in children between the ages of 0-1 year, demonstrating a great potential for systemic toxicity in children who are considered to be the most vulnerable population subgroup. A study by Bempah and Donkor (2011), on pesticides residues in fruits within Accra Metropolis revealed that 23.8% of the sample used contained endosulphin, DDT, aldrin and endrin above the permitted levels. The continue consumption of these fruits may lead to fatal chronic effects due to accumulation of these chemicals in the body.

Darko and Akoto (2008), have carried out a study within Kumasi Metropolis to determine the level of pesticide residues in milk, yoghurt, cheese, and vegetables using chromatography. The result showed that DDT residues in cheese was above the permitted levels by WHO. Organochlorine residues in milk and yoghurt also exceeded the maximum levels allowed by WHO and FAO. Organophosphorus pesticide in tomatoes and eggplant exceeded the recommended levels. These are deadly pesticides and bioaccumulation of them in human beings and other higher organisms could result in serious health problems. The presence or residues of endosulfan and chlorpyrifos pesticides in tomatoes could cause cancer in children and adults (Esusmang, 2008).

To ameliorate this canker, various alternative crop production methods have been developed and among these methods include, organic farming and Integrated Pest Management (IPM). Lately, Western Canada agronomists have advanced a new production system that found itself between

Integrated Pest Management (IPM) and Organic agriculture practices. Pesticide Free Production (PFP) is the new technology and it emphasis on less inputs application such as pesticides on the production of field crops. In this new system, Chemical pest control practices are not used during crops growing season. The use of pesticide whiles crops are still growing, during harvest and even in storage are avoided. Specific fertilizers may be allowed the whole year and certain pesticides can be used before seeding. PFP crops however, cannot be grown in areas where commercial quantities of pesticides continue to be active in the soil. This is aimed at substituting pest chemical use with dependence on farmer's knowledge of alternative agronomic practices that alleviate insect, disease and weed pressures.

Pesticide Free Production system has the capacity to eliminate the problems connected to the traditional crop production methods. Minimizing the dependence on intensive pesticide inputs and replacing agronomic information to prevent pests is one of the vibrant ways farmers could regain control over their production systems. PFP crops growing technology demands the use of varied cropping systems and pest prevention practices. Agro-ecosystems can be more stable and sustainable due to large diversity in the cropping system. PFP production technology comes at a cost and provide commodities that are less harmful and may be attractive to consumers, who are willing to pay a premium for those commodities. Research questions provoke by the topic are:

1. Are consumers willing to pay a premium for these commodities
2. How much are consumers' willing to pay (WTP) for Pesticide Free Production food products?
3. What factors influence consumers' willingness to pay for Pesticide Free Production food products?
4. What is the economic cost of consuming pesticide residue food products?

1.3 Objective of the study

The prime objective of this study is to investigate the willingness to pay for Pesticide Free Production food products by inhabitant of Accra-Tema Metropolitan areas. The specific objective of the study include;

1. Ascertain if consumers are willing to pay for pesticides free food products
2. If yes, how much are they willing to pay?
3. Determine the factors that influence consumers' willingness to pay (WTP)
4. Estimate economic cost of consuming pesticide residue food products

1.4 Significance of the study

This study have also become imperative in view of the renewed interest in Ghanaian consumers for safe food products. Residues of pesticides in our food crops, water, fish and vegetables pose a potential harm to human health. A study by Ackerson et al (2011), investigated pesticides residues in fruits at market levels in Accra Metropolis. A sample of 350 Vegetables and fruits were gathered and analyzed to determine the concentration of some specific pesticides. The study found that 22% of the sample used contained endosulphin, DDT, aldrin and endrin above the permitted levels. PFP food products are devoid of pesticide residues and offers attractive commodities to consumers. The outcome of this study will give policy makers a fair knowledge of the premium consumers in Tema-Accra Metropolis and Ghana at large are willing to pay to avoid health hazards resulting from the consumption of pesticide residue food products.

Similar studies in this area have been carried out in more advanced countries like Canada, United States of America, Taiwan and Italy to inform policy. Some have investigated the willingness of consumers to pay for reduced pesticide fresh produce (Eom, 1994; Huang and Ott, 1991; Baker, 1999 and Buzby et al, 1998) and others investigated the consumer willingness to pay for agricultural

products cultivated using IPM technology (Govindasamy, Italia & Adelaja 2001 and Mullen et al, 1997). The result in general demonstrated that, consumers' willingness to pay is modest, with five to ten percent recording the most premiums. In our part of the world, little can be said about literature in this area of research. The study therefore comes to fill the research gap that exist in this area between developed and developing countries such as Ghana, Sub-Saharan Africa and African as a whole.

1.5 Organization of the study

This study is structured into six chapters. The first chapter provides the background to the study, presents the statement of the research problem and the research questions that arise, the objectives of this research work and significance of this research. The second chapter gives an overview of pesticides management in Ghana. The third chapter reviews relevant literature on the topic under study. Both empirical and theoretical literature in the areas of non-market valuation, willingness to pay or accept (WTP/WTA), Consumers demand for pesticide free products and organic food products are reviewed. Chapter four presents the theoretical framework and methodology use for this study. The fifth chapter discusses the results and findings from the study. Chapter six concludes the study and gives recommendations to inform policy based on the findings of this study. This chapter further details the challenges encountered in the course of this study and suggestions for future research.

CHAPTER TWO

OVERVIEW OF PESTICIDE MANAGEMENT IN GHANA

2.0 Introduction

Ghana took a conscious and concerted efforts to attain sustainable environmental protection standards and economic development way back in 1974 and this was after the Stockholm conference in 1972. United Nations (UN) called organized this conference with the main objective of discussing Human settlement and the Environment. In fulfilment of environmental concerns which came up during the conference, Environmental Protection Council (EPC) was established in 1974 and charged with the responsibility of advising the Government of Ghana on all matters regarding Health and the Environment. The United Nations having established a conscious on the vital roles that sound environmental conditions plays in promoting sustainable growth and development, another conference was held in Rio de Janeiro, Brazil in 1992, to deliberate again on issues pertaining to environment and development and also to review the objectives of the previous conference. During this conference, "Agenda 21" was adopted which seeks among other salient objectives, to promote effective chemicals and pesticides management (National Chemicals Management Profile-Ghana, 1997). Issues on chemicals and pesticides management has been duly addressed in chapter 19 of the Agenda 21. In furtherance of this, Ghana developed a policy framework and other important legal instruments to deal with toxic and hazardous pesticides.

Though sufficient legislations such as the Pesticides Control and Management Act," 1996 (Act 528) meant for controlling the importation, manufacture and the use of pesticides and chemicals in Ghana are in place, enforcement is the key issue (Gerken et al, 2001; GEPA, 2007). According to Probst et al, (2012), nonexistence of effective state regulatory mechanisms couple with lack of technical capability to efficiently execute their mandatory functions assigned to them by the state, contributed

to the misuse of pesticides. Ghanaian farmer's knowledge on Integrated Pest Management (IPM) which is a substitute to pesticide use is limited and hence another contribution factor to the proliferation of pesticides on the Ghanaian market. Varied views have been advanced by experts as being the reasons for the misapplication, illegal importation of substandard and improper handling and disposal of pesticides in Ghana. This chapter thus, review the policy and regulatory framework for pesticides management in the country.

2.1 The 1992 Constitution of Ghana

Bearing in mind, the vital role that sound and healthy environment plays towards sustainable economic growth and development of a country, the framers of Ghana's constitution which is the supreme law of the land, thought it prudent to include provisions in the constitution to guide and protect the environment and human health. Article 36 (6), (10) and Article 41 (K) are the significant portions of the 1992 constitution that talks about the responsibilities of the state in protecting the environment and safeguarding human health, so as to promote sound economic development. Article 36 (6), state that "The State Shall take the appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek co-operation with other states and bodies for the purposes of protecting the wider international environment for mankind". In line with this provision, Article 41 (K) of the 1992 constitution has to say and I quote "The exercise and enjoyment of rights and freedoms is inseparable from the performance of duties and obligations, and accordingly, it shall be the duty of every citizen to protect and safeguard the environment". In view of this, concerns raised by a section of the Ghanaian populace pertaining to pesticides residues in crops, vegetables and the environment is a step in the right direction. The 1992 constitution, gave birth to a broad policy framework or statement upon which all necessary regulations, laws and by-laws required to protect the environment and safeguard human health against potential toxic

chemicals emanates from. The state therefore is required to embark on a rigorous comprehensive policy on toxic substances such as pesticides, which has adverse effect on the environment and human health resulting from their misapplication, disposal and handling.

2.2 Other Relevant Pesticides Policy and Legal Framework in Ghana

In line with promoting sound environmental management aimed at achieving sustainable development, in 1991 Ghana formulated and adopted its environmental management legal framework known as the National Environmental Action Plan (NEAP). NEAP then served as the foundation upon which the first National Environmental Policy (NEP) was enacted in 1995. NEP 1995, was repealed by 2012 National Environmental Policy (NEP, 2012). One of the key reforms in 2012 NEP has to do with the inclusion of car waste and e-waste legal frameworks in order to have a formidable and holistic view of combating environmental pollution. All the realignment is geared towards redirecting the functions and responsibilities of the state in maintaining a clean environment in the country. What NEP 2012, seeks to achieve among other things include;

1. Adopting appropriate processes to safeguard critical ecosystems, as well as the fauna and flora they have against destructive or damaging practices
2. Establishing unambiguous explanation of national environmental plan or agenda and its linkages to economic growth and poverty reduction and weak legal, financial, regulatory, human, technical and institutional capacity.
3. Adopting appropriate actions, regardless of prevailing levels/intensities of environmental pollution and magnitude of degradation to regulator pollution and the importation and use of potential harmful chemicals
4. Reverse the present inadequate commitment to environmental goals, interventions and policies.

5. Improve information flow and quality
6. Create proper comprehension of the causes and nature of environmental difficulties or teething trouble.
7. Guarantee comprehensive management of natural resources and the environment; effectively safeguard humans, animals and plants, their biological communities and habitats against damaging effects and negative practices, and preserve biological diversity.

Looking at the National Environmental Policy and its objectives in a broad perspective, it contains a lot of vital information which is relevant for the control of pesticides and hazardous substances in Ghana. However, it does not rigorously tackle the dangers posed to humans and environment by the pesticides under consideration. In view of this, Environmental Protection Agency Act, 1994 (Act 490) was enacted to deal comprehensively with the pesticides and chemical management in the country. Section 10 of the Environmental Protection Agency Act, 1994, further established a committee known as Hazardous Chemical Committee and handed the committee with the following functions;

1. Monitor the use of harmful pesticides or chemicals by gathering information with regards to the export, import, manufacture, sale, distribution, use and disposal of such pesticides
2. Advise the Executive Director and Board on the regulation and administration of hazardous pesticides and chemicals
3. Perform such other functions relating to such pesticides and chemicals as the Board or the Executive Director may determine.

Considering the potential negative ramifications and the proliferation of illegal pesticides in the country, the Environmental Protection Agency Act, 1994 was further amended to include a whole section that deals with pesticides control and management. Amendment of the Act was aimed at

consolidating the existing laws in regulating the use and import of pesticides in Ghana. The amended Act, known as Environmental Protection Agency Act, 1994 (Act 490) devoted the second section of the Act to Pesticides Regulation and Administration in Ghana. This is done to empower the necessary Ministries, Agencies and Departments to have a holistic overview and control of pesticides management in the country. The Act specifically articulated the rules for registration, classification, licensing, importation, manufacture, formulation, labelling, transportation, distribution and reporting. Others include; disposal, non-disclosure of information and inspections of pesticides in the country. The Environmental Protection Agency Act, did not limit its functions and jurisdictional powers on pesticides management to Environmental Protection Agency (EPA). The Act went further to establish a framework that ensures inter-sectorial collaboration with regards to pesticides control and management in the country. A committee comprising all Ministries, Departments and Agencies which are legally mandated to have oversight control and responsibility on pesticides had also been formed with EPA being the lead collaborating institution. The inter-sectorial committee is further broken down to constitute sub-committees with the requisite expertise aimed at maintaining a comprehensive pesticides and chemicals management in the country. The key institutions that formed the inter-sectorial committees include; Ghana Standard Authority, Customs, Exercise and Preventive Service, Ghana Atomic Energy commission, Plant Protection and Regulatory Service Directorate under Ministry of Food and Agriculture, Food and Drugs Authority, Universities and Research Institutions, Relevant Non-Governmental Organization and Ministry of Health.

Besides the above institutional and policy framework, there are other relevant laws in the country, design purposely to curb the negative impact resulting from mishandling and misapplication of pesticides in the country. Starting with the Food and Drugs Law, 1992, (PNDCL, 305B) was

enacted to regulate the use, distribution, sale, export, import, manufacture and advertisement of drugs, cosmetics, pesticides and household chemicals. The legislation was formulated to ensure that, pesticides and chemicals are properly regulated to minimize and if possibly, eliminate the negative impact they have on the environment and human health emanating from improper usage and disposal. Other relevant legislations that deals with environment and hazardous substances include;

1. The Mercury law, 1989.
2. Infectious Disease Ord. Cap 78
3. The Prevention and Control of Pest and Diseases of Plants Act, 1965 (Act 307).
4. Prevention of Damage by Pest Decree, 1968 (NLCD 245)
5. Environmental Impact Assessment Regulations, 1999 (LI 1652)
6. Local Governance Act, 2016 (Act 936)
7. Management of Ozone Depletion Substances and Product Regulations, 2005 (LI 812)

The review above shows clearly that, all the institutional, legal and policy framework required for sound pesticides management had been put in place to mitigate their negative consequences on both the environment and human health. Ghana as a nation, had always given priority attention to pesticide management and control. The establishment of Environmental Protection Council (EPC) which was later changed to Environmental Protection Agency (EPA), all attest to that fact. A lot of technical and administrative assistance regarding pesticides management and control had also been extended to the responsible institutions by international organizations like Food and Agricultural Organization (FAO). For instance, FAO played an influential role in the promulgation of the Pesticides Control and Management Act, 1996 (Act 528). Act 528, is in consonance with EPA Act 1994, (Act 490) and therefore give the EPA the sole obligation and authority to ensure that

pesticides imports, registration, usage and disposal in Ghana are properly taken care of to safeguard environment and human health.

2.2 Accreditation of Pesticides Merchants in Ghana

Provisions in the EPA Act, (Act 490), requires that people who intend to embark on pesticides business in Ghana, register with Environmental Protection Agency. Section 28, subsection 1 of the Act directs all manner of persons with the aim of dealing in pesticides to register with EPA. A successful applicant is offered a business operating permit or license which allows him or her to undertake the venture in Ghana. The motive behind the formal registration and licensing of pesticides dealers, is to afford EPA the opportunity to assess, train and properly regulate the business. To ensure effective execution of these responsibilities, Environmental Protection Agency Act (Act 490) went further to established Pesticides Licensing and Enforcement Unit which is under the direct supervision of the Pesticides Department. They are mandated to license and regulate the following types of pesticides dealers in the country; Manufacturers, Importers and formulators, Distributors and retailers, Transporters of restricted pesticides and Commercial or Pest control operators. Through this process, a lot of information concerning the company and individual who applied for a license to deal in pesticides is obtained. For instance, name, address, pesticides handling facility of the company and qualification of the individuals are compulsory requirements. The Act further requires that, both applicators and operators of regulated hazardous pesticides be trained by Environmental Protection Agency in the correct handling and usage of such pesticides after which a license is issued to them. People who apply pesticides in commercial quantities, especially the farmers must be properly tested to ascertain their capabilities before giving them a license. EPA is empowered by the Act to revoke or suspend the license of any individual or company that does not follow the laid down procedures in pesticides application and handling.

At the Metropolitan, Municipal and District Assemblies (MMDAs) level, Act 490 gives room for the appointment of Pesticides Inspectors. The first paragraph of Section 31 of the Environmental Protection Agency Act, 1994 (Act 490), permits a member of the appropriate sub-committee of the MMDAs so authorized with the requisite knowledge take control and management of pesticides. In other jurisdictions MMDAs employs pesticides inspectors appointed in accordance with section 15 of the Environmental Protection Agency Act, to regulate and manage pesticides at the local level. They are mandated by the Act to perform the following functions; inspect any land truly, or reported to be exposed to pesticides, inspect equipment used in pesticides applications, Inspect facilities and areas used for storage and disposal pesticides, examine complaints of injury and damage to human beings, animals, water and air pollution resulting from pesticides usage, monitor use and sales of pesticides and finally have samples of pesticides to applied. They are also empowered by Act 490 to seize equipment and arrest those involved in illegal pesticides activities. The veterinary officers under the department of agriculture and the environmental officers in the Metropolitan, Municipal and District Assemblies are responsible for pesticides control and management at the local levels.

2.3 Public education and sensitization on Pesticides usage

To consolidate the provisions in Pesticides Control and Management Act, 1996 (Act 528), which later became part two of the Environmental Protection Agency Act, 1994 (Act 490), Section 2 (m) of Act 490, requires Environmental Protection Agency and all collaborating institutions to embark on regular sensitization and education exercises on pesticides usage and disposal. According to section 2, subsection (m), EPA shall initiate and pursue formal and non-formal education programmes for the creation of public awareness of the environment and its importance to the economic and social life of the country. Furthermore, section 2, subsection (p), also require EPA and other collaborating institutions to conduct seminars, training programmes and publish reports

and information relating to the environment. These are broad provisions which covers educating and sensitizing the public on pesticides and chemicals usage which are hazardous to the environment and human health. I would like to lay more emphasis on the non-formation education and sensitization on pesticides usage and its positive effects. This is very crucial considering the proportion of Ghanaian population that did not have formal education especially the farming population.

According to 2010 population and housing census (PHC2010), 2 out of every 10 Ghanaians aged 11 years and older can read and write in English language. In other words only 20.1% of Ghanaians can read and write in English language whiles 25.9% of the population is not literate. An empirical study further showed that 82% of Ghanaian farmers are uneducated and therefore do not know the significance of putting on protective clothing during pesticides spraying (Yeboah et al 2004 and Mensah et al 2004). A rigorous education and sensitization especially, non-formal is therefore needed to ensure that the citizenry both consumers and farmers understand the negative effects of pesticides resulting from misapplication and handling.

A multi-billion questions that worth asking are, upon all these legal enactments and policy framework aimed at empowering the responsible institutions to effectively handle pesticides, why are incidents of pesticides misapplication, poisoning and proliferation of illegal pesticides on the increased. A large portion of the agrochemicals employed by Ghanaian farmers are the banned and constrained pesticides due to their harmful nature and they include; aldrin, dichlorodiphenyltrichloroethane and dieldrin chlordane (Ntow et al, 2006).

A study conducted by NPAS (2012), in 14 villages with a sample of 183 farmers in the Upper East Region showed that only 43% of them had education on the safe uses of pesticides. The study further indicated that 50% of those trained, had their training from Non-Governmental

Organizations (NGOs).The rise in environmental and health problems resulting from pesticides usage is predominantly due to lack of knowledge on their hazardous nature, lack of protective clothing, illiteracy, labeling challenges pertaining to language, misleading information, inefficient regulatory authorities and lack of enforcement (Fianko et al, 2011). Though sufficient legislations to control importation, manufacture and the use of pesticides broadly known as chemicals in Ghana are in place, (Gerken et al, 2001). Abate (1996), indicated that even though there exist regulations with regards to the use of pesticides, there are still pesticides being used in the country which have been constrained in developing countries. According to Probst et al, (2012), nonexistence of effective state regulatory mechanisms couple with lack of technical capability to efficiently execute their mandatory functions by responsible state agencies contributed to the misuse of pesticides. Ghanaian farmer's knowledge on Integrated Pest Management (IPM) which is a substitute to pesticides use is limited and hence another contributing factor to the proliferation of pesticides on the Ghanaian market.

2.4 Pesticides Usage

2.4.1Global Perspective

Globally, it was estimated that between 2006 and 2008, roughly 5.2 billion pounds of pesticides were used with majority of the category used being herbicides representing 40%. This was followed by insecticides which recorded 17% and the least being fungicides with a percentage of 10 (US-EPA, 2007). According to Northern Presbyterian Agricultural Services and Partners NPAS (2012), approximately 5 billion pounds of pesticides are used annually in world trade with a monetary value of over $40 billion. They further revealed that, 89% of the global sales comes from 10 big companies which include BASF and Bayer from Germany and DuPont, Dow and Momsanto also from USA. The worse scenario presented by WHO and FAO is that, 30% of $900 million worth of

pesticides marketed in developing countries are not up to international standards and thus post severe harm to the environment and human health. Table 2.0 shows the most commonly used pesticides globally.

Table 2.0: Categories of commonly used Pesticides

TYPE OF PESTICIDES	CHEMICAL
Fungicide	Dithiocarbamate, captan, captofol, pentachlorophenol, iprodione, sulphur
Herbicides	Chlorophenoxyl (2,4-D, 2, 4, 5-T and MCPA), urea derivatives triazines (atrazine), amid (propanil), bipyridils (paraquat and diquat), glyphosate.
Insecticide	Organochlorines [dichlorodiphenylethanes (DDT, DDD, diclofol)], chlorinated cyclohexanes and benzenes (lindane HCB), cyclodienes (aldrin endosulfan, chlordane and toxaphene), chlordecone (mirex), organophosphates (chlorpyifos, diazinon, parathion, malathion), carbamates (adicaeb, aminocarb), pyrethroids (pyrethrins, permethrin, deltamethrin, cypermethrin) rotenone, Bacillus thuringiensis (protein product)
Bactericide	Triazine-S-triones, chlorine-releasing agents, chlorine, dichloronitrobenzene
Fumigant	Methyl bromide, aluminium/zinc phosphide, sulphur
Rodenticide	Coumadin and derivatives, anticoagulants, strychnine, sodium fluoroacetate

Source: Ming et al. 2013

2.4.2 The use of Pesticides in Ghana

Ghana as a country attained lower middle income status in 2009, with agricultural sector contributing significantly to that trajectory. Prior to that status and even now, the use of pesticides to control pest and boost the yield of crops have been so phenomenal. Since pesticides usage is not limited to only crops but extend to the treatment of certain human diseases in the field of public health, it has contributed significantly to sustainable growth and development. Table 2.1 shows the total registered and temporally cleared pesticides in Ghana by Environmental Protection Agency. Table 2.1 shows that, Fully Registered (FRE) pesticides across the categories as at 2015 stood at 391 and those that received Preliminary Clearance were 117 as at the same period. Banned pesticides across all the categories also recorded 32 as at 2015

Table 2.1: Registered Pesticides as of May 2015

CATEGORY	Full Registration (FRE)	Provisional Clearance Permit (PCL)	BANNED	TOTAL
Insecticides	171	34	32	237
Fungicides	53	11	0	64
Herbicides	143	69	0	212
Plant Growth Regulators	6	1	0	7
Molluscicide	1	0	0	1
Rodenticides	2	0	0	2
Nematicides	4	1	0	5
Adjuvants	4	0	0	4
Biocides	7	1	0	8
TOTAL	**391**	**117**	**32**	**540**

Source: EPA (2015)

According to Ministry of Food and Agriculture (2003), Ghana has recorded a continuous growth in pesticides usage as a result of the expansion in the areas under cultivation for food, vegetables and cash crops. The oil palm, cereals, fruits, vegetables and cocoa sectors in Ghana registered high concentration of pesticides application (FAO, 2004, 2006). The 2004 report further revealed that, about 21 different types of pesticides were imported into the country between the years 1995 and 2000. Within the same period, it was estimated that an annual average of 814 tons of pesticides were imported into the country with insecticides constituting the majority, 70% (FAO, 2004). Using pesticides to boost yield have been given high attention by both rural and urban farmers in Ghana, especially cash crops.

Table 2.2: Pesticide import to Ghana in from 2013-2016

Type of Pesticides	Quantity in Tons 2013	Quantity in Tons 2014	Quantity in Tons 2015	Quantity in Tons 2016	Cumulative
Insecticides	1,539	6,513	3,695	5,742.2	17,489.2
Herbicides	4,723	7,889	294,009	32, 947.1	339,568.1
Fungicide	4,599	1,167	1,328	4,706.9	11,800.9
Rodenticide	0.00	0.02	0.018	0.174	0.212
Total	**10,861**	**15,569.02**	**299,032.02**	**43,396.37**	**368,858.41**

Source: EPA (2016)

Table 2.2 shows the quantities of pesticides imported into Ghana from 2013 to 2016. All the categories in general depicted an increasing trend of imports with some few isolated cases of marginal drops. Total imports of pesticides across all the categories from 2013-2016 stood at 368,858.41 Metric Tons. Herbicides category formed majority of pesticides imports into Ghana over the period under review representing 92.05% whiles Insecticides recorded the second majority of the imports with a percentage of 4.74%. Rodenticide category registered the least imports. This shows how intensive Ghanaian farmers have become with regards to pesticides usage.

According to Ntow (2001), about 87% of the farmers in Ghana apply pesticides to crops and vegetables prior to or immediately after harvest with one or a combination of the following chemical content; Organochlorines, pyrethroids, carbamates and organophosphates. The most commonly used pesticides among Ghanaian farmers, are those with Organochlorines chemical content due to their economical nature and the wide spectrum activity. In 1998 Ministry of Food and Agriculture indicated that Benzenes (Lindane, HCB) pesticides was largely employed to control pest on cocoa, vegetable and maize stem borers. Endosulfan was also extensively being used in cotton, coffee plantations and vegetable farms in Ghana (FAO, 2004). The most worrying

aspect is the use of pesticides such as DDT and lindane to control ectoparasites which are no longer recommended and registered for use in Ghana by EPA (Ntow et al., 2006). According to Cudjoe et al. (2002), the commonly used pesticides to control foliar pest in the country includes diazinon, chlorpyrifos, dimethoate, fenitrothion and cymethoate. Fungicides on the other hand which are mostly used for post-harvest purposes include; carbendazim, imazil, copper and hydroxide whiles cypermethrin, endosulfan, lambda-cyhalothrin and dimethoate are used by farmer to control pest in egg-plant, tomato, pepper, lettuce, okra and cabbage. Most of these pesticides are not more in use and therefore have been banned to their hazardous content.

Table 2.3: **List of Banned Pesticides in Ghana**

No.	Name of Pesticide
1.	2,4,5-T and its salts and esters
2.	Aldrin
3.	Binapacryl
4.	Captafol
5.	Chlordane
6.	Chlordimeform
7.	Chlorobenzilate
8.	Dichlorodiphenyltrichloroethane (DDT)
9.	Dieldrin
10.	Dinoseb and its salts and esters
11.	Dinitro-ortho-eresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)
12.	Endrin
13.	HCII (mixed isomers)
14.	Heptachlor
15.	Hexachlorobenzene
16.	Parathion
17.	Pentachlorophenol and its salts and esters
18.	Toxaphane
19.	Mirex
20.	Methamidophos (Soluble liquid formulations of the substance that exceed 600g active integredient/l)
21.	Methyl-parathion (emulsifiable concentrates (EC) with at or above 19.5% active ingredient and dust at or above 1.5% active ingredient)

22.	Monocrotophos (Soluble liquid formulations of the substance that exceed 600g active ingredient/l)
23.	Parathion (all formulations – aerosols, dustable powder (DP), emulsifiable concentrate (EC), granules (GR) and wettable powders (WP) – of this substance are included, except capsule suspensions (CS))
24.	Phosphamidon (Soluble liquid formulations of the substance that exceed 1000g active ingredient/l)
25.	Dustable powder formulations containing a combination of Benomyl at or above 7% Carbofuran at or above 10% and Thiram at or above 15%
26.	Methyl Bromide
27.	Chlordecone
28.	Alpha hexachlorocyclohexane
29.	Beta hexachlorocyclohexane
30.	Lindane
31.	Pentachlorobenzene
32.	Technical endosulfan and its related isomers

Source: EPA (2015)

Environmental Protection agency in 2008, found 71 tons of banned pesticides in Ghana. Large portion of this pesticides were found in Ghana Cocoa Board, Twifo Oil Palm Plantation and Benso Oil Palm Plantation warehouses.

2.5 Conclusion

There exist sufficient legal, regulatory and policy framework on pesticides management and control relating to manufacture, sales, distribution and usage in Ghana. However, lack of enforcement and technical capabilities of the state agencies mandated to execute them is the main challenge. Referring to the 1992 constitution of Ghana, Environmental Protection Agency Act, 1994 (Act 490), Pesticides Control and Management Act," 1996 (Act 528) and other relevant enactments shows that Ghana has the necessary legal, regulatory and policy framework to combat the misuse and proliferation of illegal pesticides in the country. Considering the high illiteracy rate (82%), among farmers in Ghana, as reported by Yeboah et al (2004), non-formal education is needed to educate them on pesticides usage, handling and disposal.

Furthermore, Section A, of Ghana National Environmental Policy (NEP, 2012), attributed the main challenge that undermines the attainment of proper environmental management in the country to be ineffective and inefficient enforcement of existing laws and policies. This that not lead to the achievement of the desired results.

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

This chapter analyses the relevant theoretical and empirical literature on Willingness to pay and the valuation of non-market values. The first section deals with the theoretical review underpinning the topic under study.

3.1 Theoretical Review

3.1.1 Concept of Value by Renowned Environmental Economist

The concept of value can be view broadly from two ethical perspectives or basis and these are the Deontological and Anthropocentric views (Michael Hanemann, undated). According to Deontological view, nature in its own right has value whether valued or not while the anthropocentric view on the other side argues that nature can only be assigned value to the extent that it is valued by people. The latter view justifies the valuation of environmental goods by economists. Furthermore, there exist two schools of thought on the concept of value within the field of environment from anthropocentric view. Ecologists have different perspective of what constitute an environmental value from that of economists. The differences in their perspective is manifested in the way they define what an environmental value is. To ecologist, environmental goods and services have an intrinsic or inherent value, which means by virtue of its existence, it has a value. Their main concern is not about the contribution environment makes towards achieving some end or purpose (Neil, 2007). Economists on the other hand, define an environmental value as an instrumental value. According to Neil (2007), an instrumental value refers to a value something has with regards to its contribution to attaining some particular purpose or objective. Instrumental value has therefore formed the basis for valuation of non-market goods and services. Valuation of a

coastal estuary by economists may be to determine its contribution towards biomass of fish, or the estuary capacity to assimilate waste. These two functions represent goods and services utilized or consumed by humans (Neil, 2007). Services rendered by environmental for developments are instrumentally valuable in terms of their capability to advance human well-being (Freeman, 2003a).

3.1.2 Economic theory of Value

The theory of value in economics dates back in the late 17th century, where keen interest in the area of increase in the production of goods and service were developed in order to minimize emphasis on the conditions of their exchange. According to O' Brien (2004), this marked the beginning of classical political economy. Since then, there had been varied approaches as to how to determine economic value of goods and services including non-market goods. In 1776, Adam Smith in his book titled "The Wealth of Nations" contributed in this area using three different perspectives. The 'simple labour embodied theory' was the first to be developed, followed by the 'adding-up theory' and his last theory on value was the 'toil and trouble' experienced by the producers (King and Michael, 2012). David Ricardo developed on the previous theories of Adam Smith and came out with the 'Labour Theory of Value' and subsequent theories pertaining to the determination of economic value of non-market goods and services. Theory on value actually gained prominence in the late 80's where individual subjective valuations or preferences for goods and services became the center point.

As mentioned earlier, there are different theories or concepts that underpins how and why value of goods and services are measured. For the purposes of this research, instrumental theory of value will be employed. Scholars in this field outlined three vital fundamental principles of welfare economics to underpin the theory of instrumental value (Pearce and Moran 1994; Pearce, Atkinson and Mourato; 2006; Neil 2007 and Freeman III 2003). According to them the Willingness to Pay

(WTP) of an individual is determined by welfare or benefit he/she derives from the good or service in question. The principles include;

1. improving human well-being or welfare is the core objective of economic activity,
2. Individuals are the best judges of how well off they are in a given moment
3. Social welfare is finally measured by summing up individual well-being across society (use and non-use values).

The three principles mentioned above all centers on the welfare of the individual consumer. According to Freeman III (2003a) well-being is defined as individual's preferences, and their willingness to pay (WTP) for the improvements or agree to take compensation (WTA) for losses. An individual or a consumer preference for a particular level well-being over another underpin the basis for valuation. Tradeoffs and choices are the channels through which an individual expresses his/her preference of one state over another given certain constraints such as income (Neil, 2007). Considering the theoretical underpinnings of instrumental valuation, determining the willingness to pay for pesticides free food products and pesticides free agronomic practices has become very important considering the negative impact of pesticides residues on environment, human health and subsequently consumers welfare.

3.2 Non-Market Valuation

3.2.1 Non-Market Valuation and Policy Relevance

There had been an increasing demand from policy makers to incorporate non-market values of the environment and ecosystem into national policy formulation or decision making process across the world. In their view, giving priority attention to non-market values and services in decision making will ensure proper management and their sustainability over time (Neil, 2007). Limited recognition of the significance of non-market goods and services in decision making contributed to the

difficulties in their sustainability. According to Neil (2007), many of the non-market goods and services offer benefits across multiple scales: Global, national, regional and local. The depletion of non-market environmental resources or ecosystems in Ghana, is attributed to the fact that, there is no a clear cut policy on their preservation and sustainability. A clear example is the littering of our recreational centers (beaches, parks etc) without any punitive measures being meted out to the culprits. The reason for non-existence of policy in this area could be attributed to the fact that, policy makers do not know their economic value. A rigorous econometrics or economic valuation analysis is therefore required to inform policy direction since the normal market price may not accurately measure their economic value.

3.2.2 Economic Valuation of Non-market Values and Services.

Integrating non-market values of goods and services in decision making demands the adoption of appropriate valuation framework that captures both market and non-market values (Neil, 2007). The combination of the market and non-market values of natural and environmental resource is known as Total Economic Value (TEV) in economics literature. Non-market value and services are those commodities which are not traded directly in the market or limited market exist for which people do not pay money before benefiting from them. The characteristics of most environmental goods and services are such that, they fall into the non-market category. Environmental and ecosystem are public goods and services and therefore exhibit non rivalry and non-excludability in consumption (Ndebele, 2009). The consumption of a good by an individual which does not diminish the consumption of that particular by others is known as non-rivalry in consumption whiles inability to exclude someone from consuming or using a particular good or service is refer to as non-excludability. In view of this, even if there exist a market for environmental goods and services, prices will be very low due to free-riding. For instance, everyone can have a scenic view

of Achimota forest or Aburi gardens. A visitor to Aburi gardens can have a lovely view of the garden without diminishing the view of others or excluding them from enjoying it provided there is no congestion.

Moreover, those with prices does not reflect the maximum amount (true value) for which consumers and suppliers are willing to trade. This result in surpluses either at the consumer or producer side. Economic valuation of non-market goods and services therefore takes care of the surpluses which hitherto where not accounted for in the price. Through economic valuation of such goods and services, individuals revealed their maximum amount which leads to WTP going beyond the market price to include the non-market value. In view of this, taking economic valuation of Pesticide Free Food Products will be a step in the right direction since it will incorporate both the use and non-use values. As mentioned earlier, the use and non-use values together is called the Total Economic Value (TEV).

3.2.3 Use Values

This constitutes the benefits a society or an individual obtains from using the economic resource. The use value, according to Perman et al. (2003) is further sub-divided into direct and indirect values whiles Pearce, Atkins and Mourato (2006) on the other hand, subdivided it into three categories. They added optional value to the direct and indirect values in their literature. This study employ that of Perman et al (2003). Direct use value of a resource refers to the benefits obtained from the direct use or its contribution to the current production or direct consumption of services provided by the resource. For instance, taking fish from the river or lake for food is a direct use value from it. Indirect use value of a resource on other hand, refers to the regulating services the resource provide to the production system. The functional or regulatory services provided by the forest in climate control and waste assimilation in the case of ecosystem are samples of indirect use

value. In the case of pesticides free production system, elimination of human issues through poisoning is a direct use value. The potential capacity of PFP to preserve ecosystem and the environment which provide services to human and other species are indirect values.

3.2.4 Non-Use Value

Non-use values also known as passive use, refers to values obtained from benefits connected to the resource or ecosystem-based and environmental services. In other words, the appreciation value an individual ascribes to a resource and not by virtue of using it, is non-use value. Furthermore, the individual's demonstration of WTP for a resource irrespective of his/her ability to benefit from it either now or in the future is termed as non-use value (Perman et al., 2003). The divisions in the non-use value category include; existence value also known as intrinsic value, bequest value and option value. Existence value is the benefit or value derived from a resource for the mere fact that it exist even though the intention of using it is not certain. Individual's WTP to maintain a resource without prior intention of using it either now or in future shows the non-use value they attached the resource. In Ghana for instance, a story was told about an individual who donated funds to maintain or preserve the Kakum National Park for the mere fact that he want it to exist but have never used and do not have the intension of using it a typical example of existence value. This person is clearly demonstrating existence value he ascribe to the park.

Bequest value is the value an individual derived from his/her ability to pass on resource to the next generation. It indicates the satisfaction one obtains from being a self-sacrificing patriot with the aim of leaving a resource for the future generations (Neil, 2007). The preservation of Nkrumah museum using public funds with the aim of passing it on to the next generation is a bequest value. Option value refers to the value or utility, an individual ascribes to a resource considering the potential benefits that might be taken from it in the future. According to Perman et al. (2003, cited in Mantey

2013), the value attached to a resource even though, it may not be producing any paybacks currently but its future capacity to produce is certain, then an individual prefers to keep it rather than destroying it.

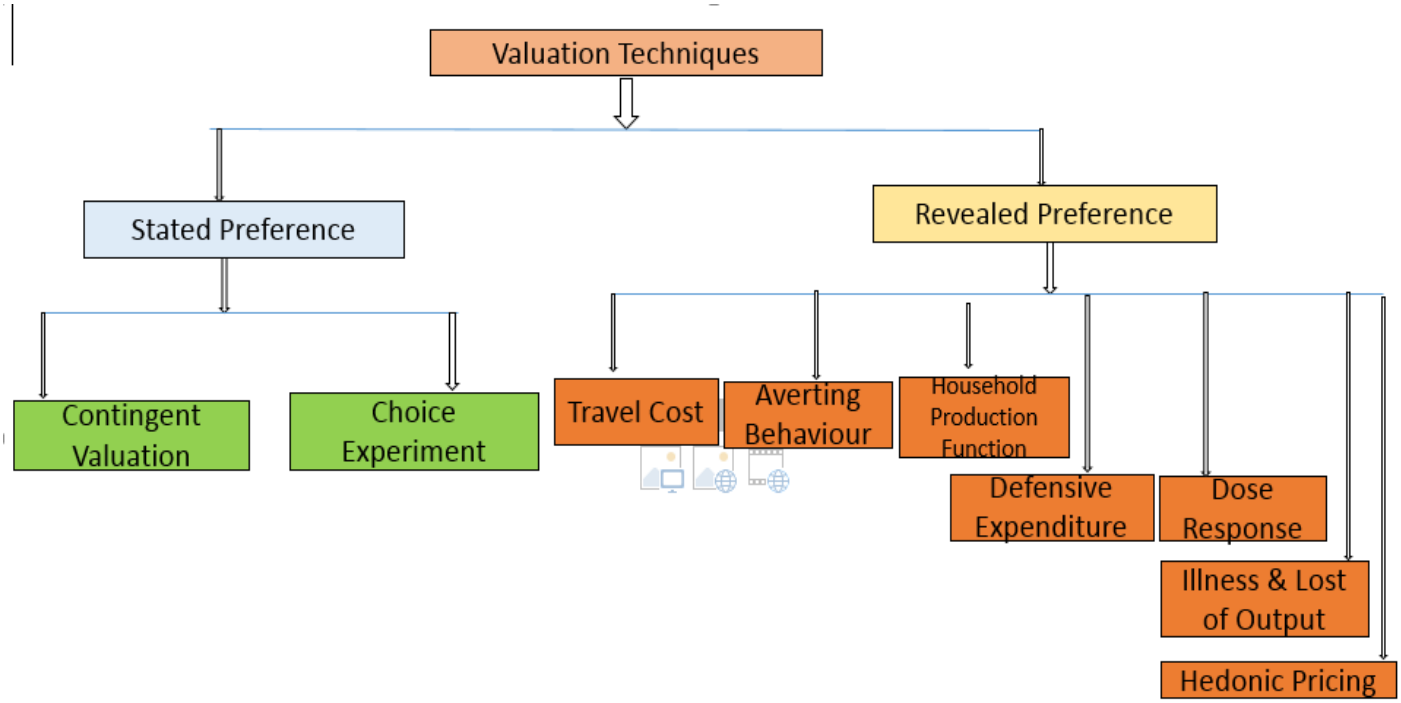
3.2.5 Non-Market Valuation Methods

There exist varied theoretical techniques that can be employed to investigate into the willingness to pay (WTP) or willingness to accept (WTA) of individuals and the valuation of non-market goods and services provided by ecosystem and the environment. These valuation techniques can be categorized broadly into two, conditioned on how preferences are inferred. They are; Revealed Preference techniques (RP) and the Stated Preference techniques (SP) (Hadley D. et al, 2013 and Owusu, 2009).

However, in other related literatures they are categorized into three using pecuniary and non-pecuniary (monetary and non-monetary) as the basis for classification (Botchway, 2011; and Mantey, 2013). They include; Revealed Willingness to Pay methods, Imputed Willingness to Pay and Expressed Willingness to Pay. This study will employ the former classification as adopted by (Owusu, 2009 and Hadley D., 2013). The reason being that the three categories are further classified into two base on how the responses are elicited.

- **Stated Preference techniques (SP)**: They are employed to elicit individual's direct preferences for non-market goods and services via surveys which are based on stimulated markets (Hadley D., 2013).
- **Revealed Preference techniques (RP**): These methods on the other hand, make use of individuals' actual choices or stimulated markets to deduce the value of non-market goods and services (Asafu-Adjaye, 2000).

Figure 1: Graphical exposition of valuation techniques



(**Source:** Authors design)

From the flow chart above, revealed preference techniques are made up of the Hedonic Pricing Method (HPM), Travel Cost Method (TCM), Averting Behavior Method (ABM), Defensive Expenditure Method, Household Production Function, Dose Response Method and Cost of Illness and Lost of Output Method whiles the stated preference techniques on the other hand consist of Contingent Valuation Method (CVM) and Choice Experiment Methods (CEM). Although, the revealed preference methods are very useful in measuring some aspects of the non-market values of commodities but they are not without limitations. They are limited in the requirement for the valuation of non-market goods and services. First and foremost, respondents are restricted to give information concerning values they have tested or experience and therefore cannot provide information on unexperienced goods and services (L. Hicks, 2002). Revealed preference techniques

therefore become inefficient in circumstances like this, where the topic under study uses hypothetical scenario with a new product which is not yet on the market but information is needed on it to inform policy.

Stated preference techniques are comparatively less complicated in eliciting respondents' valuations of non-market environmental goods and services (Owusu, 2009). Another salient point about the stated preference methods is that, unlike the revealed preference techniques, they require less theoretical assumptions (Asafu-Adjaye, 2000). Furthermore, their flexibility made them more applicable in a wide range of research in estimating both the use and non-use values of an environmental good or service.

3.2.5.1 Revealed Preference Methods (RPM)

3.2.5.1.1 Hedonic Pricing Method (HPM).

This approach is often employed in the labour and property markets for valuations. Labour economists call it Wage Differential Technique and in the property area it is known as Property Value Technique. Hedonic pricing method is used to assess the non-market components or attributes of a marketed good. The fundamental assumption of this technique is that, the price of a good is reliant on the attributes of the good or commodity being used and that individuals consumers do value the physical characteristics that constitute the commodity more than the commodity itself. Most commodities as part of their attributes, have environmental components which cannot be easily measure or value with normal analysis. HPM therefore, comes to solve this problem by valuing the non-market aspect of the commodity.

The hedonic pricing technique operates by using the magnitude of the price change as a result of the change in any of the commodities attributes. The value of each non-market attribute of the commodity is therefore determined using the effect of the attribute on price change. Functionally,

it is written as $P = f(A_i s)$. Where P=V represent the value of the commodity determined via price and $A_i s$ are the attributes. The function indicates how a marginal change in the attributes affects the price. Weak complementarity assumption of HPM is one of its shortfalls. The meaning of weak complementarity being that, if an individual does not consume the good/commodity or pay for it, then the value of the attributes to that particular individual becomes zero (Mantey, 2013). These attributes includes the non-market environmental components of the good/commodity. With regards to property valuation, HPM applicability to valuing environmental quality is limited to the neighborhood within which the property situates and cannot be extended to other places. The WTP by an individual in this method is dependent on only the use values of the environment and not the non-use values since it considers changes of environmental and its effects on price. HPM does not value the non-use components and therefore cannot be employ for this research.

3.2.5.1.2 The Household Production Function Method (HPFM).

This particular method is used to assess how output levels from household's economic activity are influenced by environmental quality and therefore, infer the value of the environment through it. The fundamental principle/assumption in this method is that, certain natural resources and environmental qualities are inputs in households' production functions. Therefore fluctuations in these natural resources or environmental qualities subsequently leaves some significant effects on household production and the value of the effects/impact observed via altering of market prices. HPFM actually seeks, to assess the impact of changes in the attributes of nature on households economic activities production function (costs) and output.

Household production function method for valuation has undergone severe criticism with regards to society welfare and loses associated to production. According to Neil (2007), the losses emanating from the cost of production as a result of fluctuations in natural resources quality

(ecosystems & environment) might not significantly and truly represent the value society ascribe to ecosystem and environmental quality. Added to this, averting behavior techniques may be adopted by some producers to mitigate the impact of reducing in environmental quality on household's economic activities output. In view of this, assessing production losses due to changes in environmental quality cannot be accurately determined. For instance farmers adopting measures such as mulching to mitigate the impact of climate change on yam production is a typical situation which does not show actual losses. One reason for non-market valuation of the environment is to account for the surplus which the market price could not offer. This method is not able to do that because its limited to production losses and issues of consumer surplus which is the prime objective is not considered. Total economic value cannot be assessed through this technique and hence not suitable for this study.

3.2.5.1.3 The Replacement Cost Method

This is another valuation technique which basic principle is deep rooted in replacement cost of the resource. In this technique, the economists determine the value of an environmental resource or good by using the cost incurred to replace the good in situations such as complete depletion of a forest. In other circumstances, where the resource exist but non-functional in the provisional of required services, economist use the total cost incurred to replace or rejuvenate the services hitherto being provided by the resource. Without arguing further, this clearly indicates that market price of the resource is used in this scenario as the replacement cost. For instance, buying chemicals to purify water for the purpose of replacing its quality and nutrients lost through inappropriate use of pesticides, then the cost of pesticides in this scenario is the market price used to value the resource (water bodies). The shortfall of this method is that, it does not account for consumer surpluses,

cannot determined total economic value of an environmental resource/good and hence cannot be employed in this study.

3.2.5.1.4 The Averting Behavior Method (ABM)

The value of an environmental resource in this case is determine by taking the total cost associated with the activities and actions adopted by individuals to avert or mitigate the risk that they might suffer in case the resource depletes in quality or extinct of a particular species. As the name connotes, the technique simply involves the actions and inaction adopted by individuals and the cost they incurred in the process to avert a particular risk resulting from the destruction of an environmental good. Usually, this technique is used to value environmental quality with the basic hypothesis or assumption that, individuals know the adverse consequences associated with the destruction or depletion of environmental quality. Having complete knowledge on the negative implications that activities such as air and water pollution by pesticides and the depletion of ozone layer by greenhouse gas, individuals will take proactive measures aimed at averting or mitigating their impact. The cost incurred through the measures adopted is used as the value of the environmental resource concerned. Willingness to pay for pesticides free food products in this instance, will be derived from the measures they adopted to avoid pesticides residues in food crops and pesticides poisoning. Another example is the purchase of air conditioners to mitigate the risk they face by the heat emanating from the sun as a result of the depletion of the ozone layer. The cost of these air conditioners indicates the value uphold for environmental quality.

A lot of criticism have been advanced against this method in question. The first critic of ABM is that, the cost incurred as a result of activities, actions and inactions adopted to mitigate the impact of environmental resource depletion, might not be the true reflection of how much they value environmental quality. For example, cost of air conditioners may not reflect how much individual's

value environmental quality. Furthermore, another salient reason being that, for the mere fact that individuals did not adopt any measure to mitigate the depletion of environmental quality does not indicate that they do not have value for environmental quality. Ghanaians consumers as well as farmers know dangerous pesticides residues in food crops and the usage of pesticides in general are but could not purchase or adopt measures to avert it because they may be constrained either economically or other areas and hence leads spurious or bias results.

The third shortfall of this technique is that, people might purchase items that avert environmental quality depletion but their aim is not to avert them but because of fashion or other purpose. In this case they do not even know how environmental quality is preserved through those items and therefore cannot be used to value it. Total economic value cannot be obtain from this technique since it does not include non-use values. In view of these shortfalls, ABM cannot be used for this study.

3.2.5.1.5 The Travel Cost Method (TCM)

Valuation of recreational sites and parks is efficiently executed via this particular technique. The basic operational principle or assumption behind this methodology is that, individual willingness to incur a travelling cost to a recreational site and the gate fees charge in order to permit him/her have access to the site, indicates the value that individual places on the site. In simplicity, this technique values an environmental resource by using the transportation cost to the site and the admission fees into the site. The prices in this situation represents the use values of the resource and not the non-use values.

Though very useful but not without limitations. The first major limitation being that an individual decision function to visit a recreational site is not only dependent on the travel and admission cost

to the site. The decision function includes variables such as the risk to the place, availability time to individual, religious beliefs and among others. In view of this, using travel cost and gate fees of visitors to the site to quantify the value an individual places on an environmental resource will not reflect the true value. This is because others who values the particular resource but could not visit due to reasons best known to them are not accounted for. Furthermore, individuals sometimes visits the site without prior knowledge of the full benefits they derived from the resource and the total cost to be incurred before embarking of the visit. Thus using travel cost and gate fees will be misleading because cost might 9*not be the key factor for their visit.

The next significant factor to be considered using TCM in valuation of environmental resources has to do with multipurpose visit or trip. A situation whereby a person visits a particular recreational site for multiple or different reasons is referred to as a multipurpose trip. For instance the combination of official visit with family visits affect the outcome negatively. The reason attributed to this is that, the value place on this resource by the visitor with reference to travel cost is inappropriate because the travel cost is not just for recreation but for work. The person might not be willing to pay such travel cost and gate fees for recreational purpose only. Travel cost method does not measure total economic value of an environmental good since the intrinsic values visitors have for the resource are not accounted for and hence not suitable for this study.

3.2.5.2 Stated Preference Methods (SPM)

3.2.5.2.1 The Choice Experiment Method (CEM)

As mention earlier, techniques under stated preference uses direct mechanisms via surveys to elicit information from consumers. CEM uses hypothetical choices (tradeoffs) to infer WTP of an individual for the environmental resource. In this valuation method, consumers are presented with a set of alternatives of a particular good and are ask to make their most preferred choice. It

demonstrate a real life situation where a consumer is confronted with two or more commodities with similar attributes but with varied utility levels of the attributes. The consumer is asked to either choose one of the commodities or none at all. Stated differently. Choice Experiment is a contingent valuation technique which is rooted in the random utility theory and Lancaster's characteristic theory of value which assumes that, the value of a good is determined by the attributes that makes up the whole (Garrod and Willis, 1999; cited in Mantey, 2013). What CEM seeks to achieve, is to value each of the attributes a particular environmental resource or good presents by offering consumers or respondents with alternative choices of the attributes that have different levels satisfaction or utility. The alternatives includes the current situation of the consumer and he/she is either required to maintain the status quo or make a different choice. The choice or trade-off made by the consumer is used in analysis to derive the WTP of an individual. One strong advantage of Choice Experiment technique is that, it reflects market decisions by consumers in real life and also gives a lot of information about the environmental resource through the attributes.

3.2.5.2.2 The Contingent Valuation Method (CVM)

This is one of the most widely used evaluation method especially in determination of willingness to pay by an individual for ecosystem and environmental services. The proponents of Contingent Valuation Technique for non-market goods and services can be attributed to Bowen (1943) and Ciriacy-Wantrup (1947). It was first applied in a rigorous survey research by an economists known as Davis (1963a and 1963b) to elicit economic value of recreational sites. Contingent Valuation Method is often employed by economists to calculate the WTP or the Willingness to Accept (WTA) a compensation for the destruction of an environmental resource. CV survey is implemented by asking consumers or households to directly indicate their WTP for an improved environmental good or service or WTA for the depletion of an environmental good or service. Hypothetically individuals

are presented with a good or service with certain characteristics and are asked through a survey or questionnaire to indicate how much the household will pay for it (WTP).

In this situation, consumer surplus is accounted for and the maximum amount individual consumers/households are WTP for the particular service represents the value they places on it. The name Contingent Valuation arises because, consumers state their preferences or choices and the WTP contingent upon a hypothetical description of a scenario and the particular service or good. Total economic value (TEV= UV + NUV) of the resource is calculated using average values indicated by each individual and generalize for the population. CV survey can either be open ended or close ended. In open ended, respondents are allowed to indicate any range on their own. In this approach most respondents finds it difficult to indicate an appropriate value for the good or service especially the non-literate. Open ended approach on the other hand, is a dichotomous or discrete choice questions where respondents are offered a particular value and are asked to either indicate 'yes' for their WTP the amount or 'no' if they disagree. This shows a vivid real market situation where an individual consumer is confronted to make a choice for a commodity. They either say 'yes' to buy the good at the going market price or 'no' to demonstrate their alternative choice. They are several ways of executing Contingent Valuation survey (elicitation technique) depending on how information is inferred, resource in question and sample size. They include; payment card technique, bidding game technique, discrete choice technique and the discrete choice with follow up technique

1. **The payment card technique:** This particular elicitation technique was design as an alternative to the bidding game and gives respondents opportunity to make a choice that best matches their maximum WTP from a range of values. The starting point bias associated with the bidding game technique is solved by this approach since it provides varied starting

point values. The technique is believed to have originated from Carson and Mitchell (1981 & 1984). The range of values used on the card can lead to bias estimate.

2. **The bidding game technique:** In this technique, a respondent is provided and taken through a series of bids pending the generation of a negative value or bid and a threshold established. In this scenario, there exist a starting bid introduce to a respondent for which he/she is required to either accept or fail to accept (disagree). If the respondent says yes to the starting bid, the interviewer continue to increase the bid till he/she says 'no' or if the respondent says 'no' to the first bid, the interviewer keeps reducing it until he/she says 'yes' to it. The maximum WTP/ WTA by an individual consumer is indicated by the last bid accept. The weakness here is the starting point bias. A starting bid that has the potential to influence the final judgment or bid of the respondent is termed as the starting point bias.
3. **The discrete choice technique:** The discrete choice technique operates by offering a respondent with a bid or amount by the researcher upon which the respondent either accept or disagree with the bid. In view of this, in certain economics literature the technique is referred to as take-it-or-leave-it or the single bounded dichotomous choice. This is a familiar situation because most consumers especially those that shop at health stores experience it in real life. They either purchase the commodity or leave it since opportunity will not be given to them to bargain. The technique is simple and easy since no iterative bidding is required. The limitation is that, more observations are needed for the same level of statistical exactness in a sample estimate (Botchway, 2011).
4. **The discrete choice with a follow up approach:** In this technique, there are follow up question to either 'yes' or 'no' answer. Here a respondent is require to make a choice with regards to their readiness to pay a particular amount. If the respondent says 'yes' to the

amount, it draws out a follow up questions with higher amount whiles a 'no' answer brings up a follow up questions with a lower amount. Notwithstanding the improvement in efficiency in the survey technique, it still surfers a limitation associated to discrete choice approach. This approach has the same limitation to that of the bidding game due to their similarity.

The topic under study employs the Contingent Valuation Method (CVM) with discrete choice with the follow up elicitation technique.

3.2.5.2.3 Justification for the use of CVM

Market for Pesticide Free Products (PFP) in Ghana is non-existent and therefore, a hypothetical scenario was adopted for the study. Considering the fact that market is not available for PFP products, a Stated Preference (SP) valuation technique becomes an appropriate tool for assessing WTP for PFP instead of Revealed Preference (RP) method which is suitable for assessing environmental resources that has market values. The Stated Preference technique allows respondents to value and placed premiums for changes (alternative) from their status quo. Aside this, Stated Preference methods values both the use and non-use values of environmental services which is in line with the study objectives while RP values only used values.

As explained earlier, within the Stated Preference category, there are two valuation techniques known as Contingent Valuation Method (CVM) Choice Experiment Method (CEM). The study however, chose CVM over CEM because Choice Experiment assesses each attributes of the environmental good whiles CVM does total economic valuation. Willingness-to-pay for PFP demands total economic valuation and not individual attributes. Moreover, Contingent Valuation method has certain analytical advantages or benefits which makes it suitable or appropriate for the topic under study. Unlike Choice Experiment Method, Contingent Valuation Method provide

quality and practical statistical feasibility when large sample size are used (Christophe, 2009). Furthermore, CVM makes fractional, factorial design and the use of random effects probit technique for data analysis very simple and quite understandable (Christophe, 2009 and Asafu-Adjaye, 2000). The CVM also give accurate and more reliable predictions when small sample size are used. Lastly, CVM is very simple to use and able to estimate robust statistical models. In view of this, the study employed CVM as an appropriate analytical tool in evaluating WTP for pesticide free products within Accra-Tema Metropolitan areas.

However, there are some biases CVM is likely to surfer ranging from the survey design to implementation. Bias of hypothetical scenario description, sample selection, elicitation procedure, choice of bid, and the design and implementation of the survey (Bishop and Heberlein, 1979; Boyle et al., 1986; Thayer, 1981 & Botchway, 2011).

1. **Starting point Bias:** This represents a situation where the starting bid or amount given by the researcher or interviewer has a greater potential to influence the final judgment or bid of the respondent. This is minimized by changing the starting bid among the sample size (Mantey, 2013). Through this, the researcher is able to identify the starting bid impact on the final WTP.
2. **Hypothetical Bias:** This arises when the interviewer is not able to demonstrate the hypothetical scenario and the questions thereafter to the understanding of the respondent. The slightest misunderstanding of the scenario by the respondent resulting from a poor explanation by the interviewer leads to answers which does not match the hypothetical scenario in question. The responses is termed as hypothetical bias. The researcher will reduce the biases and their impacts on the final results through well explanation of the hypothetical scenario to the respondent to alley any ambiguity.

3. **Strategic Bias:** This represents a situation where a respondent intentionally or consciously underestimate their WTP or overestimate their WTA. Strategic bias (overestimation of WTP) could also occur when a respondent is made to understand he/she will not made to pay for the good or service and that resource will be provided by government. In this case, they know their responses will only be used to place a value on an environmental resource and hence overestimation. Furthermore, situation where respondents wants the good or service to supplied by the state, they overestimate their WTP and reduce it if they do not need it. Closed ended answers such as 'yes' or 'no' will resolve this challenge.
4. **Interview and Compliance Bias:** A bias response resulting from the way interview is conducted is termed as interview bias. The behavior of interviewers such as their dress code and personal relation ethics which potentially influence the answers given by a respondent is an example of interview bias. On the other hand, respondents attempt to offer responses to please the researcher is termed as compliance bias. This can be minimized or eliminated through the strict adherence to the laid down ethical considerations for interviewers.
5. **Information Bias:** A situation where respondents are required to give answers or value environmental resources of which they have little or no knowledge on is refer to as information bias. Insufficient information influences their responses and subsequently the final result.
6. **Non Response Bias:** This arises when the values of a section of the respondents from the sample who did not respond is different from those who actually responded. It has the potential to influence the final result or value placed on the resource.

3.3 Willingness to Pay (WTP) versus Willingness to Accept (WTA)

Contingent valuation methodology in principle stems from two theoretical perspectives. The compensating variation which indicates the amount an individual is willing to accept to maintain his/her utility or equivalent variation which also shows the amount an individual is willing to forego or sacrifice to keep his/her utility unchanged. Practitioners in the field of economic valuation, until recent times use to perceive the expected variation between WTP and WTA was small and insignificant. According to Russell (1982), the variation in the techniques during an empirical analysis is by chance and thus must not be accorded with any importance. However, the latest empirical research have demonstrated that the two methods might lead to varied values for the same good. Usually, higher numerical values are associated with willingness to accept than willingness to pay for the same service or good (Bishop and Heberlein, 1979; Rowe et al., 1980 and Hanley, 1998). Knetsch (1993), show in his empirical analysis that consumers attach more values to losses than equivalent gains, and in the vein like more discounts in losses than forgone gains.

The argument on the two techniques producing difference results for the same service or good have undergone a wide range of empirical and theoretical test and analysis (Hanemann, 1991 and Horowitz & McConnell, 2002). The results for WTP and WTA can vary from zero to infinity conditioned on the level of substitutability amidst the goods and income elasticity which is positive. Goods which have close substitutes may lead to convergence among WTP and WTA estimated values whiles commodities with imperfect substitutes, will have their values divergent and will enlarge as the degree of substitution reduces.

Using WTA in contingent valuation surveys is faced with a lot of challenges and could lead to inaccurate results. It is however, appropriate valuation technique when there is a damage and there is the need to estimate WTA of the individual concern. Empirical evidence of this have been

demonstrated by Bishop et al. (1983), when it showed clearly that WTA compensation for quasi-private goods (hunting licenses) in contingent valuation surveys exceeded real WTA for the same commodity. Researchers taking a reflective analysis of this, focused their attention on WTP as a technique for estimating values in contingent valuation surveys. Respondents show a lot of emotions in their answers (WTA) and thus make it difficult and problematic. Hence since the topic under study is a contingent valuation research, WTP will be used.

3.4 Empirical review

3.4.1 Definition of Pesticides

With reference to the Pesticides Control and Management Act of Ghana (Act 528), the term pesticides has to do with any 'substance, mixture of substances intended for prevention, destroying, repelling or reducing the destructive effects of any pest'. In other words, it is 'any substance or mixture of substances intended for use as a plant regulator, defoliant, desiccant or wood preservation'. Food and Agricultural Organization (FAO, 2002), also defined pesticides as substance or blend of substances planned for preventing and controlling any pest including vectors of human or animal diseases, unwelcome species of plants or animals causing damage during marketing of food, processing, and production of agricultural commodities. Pesticides are usually applied to crops before, during or after harvest to prevent it from harm. There are different categories of pesticides meant for varied purposes such as treatment of human health, food preservation and among others.

3.4.2 Pesticides Residues in Vegetable and Food Crops in Ghana

Pesticides residues in crops, vegetables, water and soil have received a lot of attention in the recent past from the field of academics and professional environment. Pesticides residue refers to the accumulation or presence of minute particles of pesticides in or on food, water, crops, soil, and

vegetables after they are applied and thus, has the potential to cause diseases, sickness, death and harm to human health and the environment when eaten. A lot of empirical research both within and outside Ghana indicated the presence of pesticides in water, fish, vegetables and crops.

Tawia (2011), conducted a research in Ashanti Region of Ghana to determine the incidence of pesticides use, farmer's sources of information on pesticides and pesticides residue levels in tomatoes at Akumadan. A total of 200 samples of tomatoes from 10 farms were taken to examine pesticides residue levels. The study revealed that, all the 200 sampled tomatoes contained seventeen (17) pesticides residues which include aldrin, HCH, Hexachlorobenzene, chlordane and trans p-DDT and among others. Organochlorines pesticides residues concentration in tomatoes were found to be between 0.0079 to 40.97 ug/kg range which is above the permissible limits recommended by the World Health Organization. Accumulation of these pesticides residues as a result of a consumer's continuous consumption of the good could lead to harmful chronic health effects.

A study by Acquaah (2008), also investigated the levels of Organochlorines pesticides residues in Diary Products using abattoir in Kumasis, the Ashanti Region of Ghana. The study found that Beef fat contains residues of lindane, endosulfan, aldrin, DDE, DDT and dieldrin pesticides with the levels of concentration being 4.04ug/kg, 21.35ug/kg, 2.06ug/kg, 118.45ug/kg, 544.24ug/kg and 5.25ug/kg respectively. The study work further showed that, Beef meat from the same abattoir contains the same pesticides residues and thus the continuous consumption these food could lead to lung cancer. Other related studies detected that breast milk of nursing mothers in certain areas Accra contains fourteen different kinds of Organochlorine pesticides (Blankson-Arthur et al., 2011).

A study by Ntow (2001), was conducted to investigate into the degree of Organochlorine Pesticides residues in human fluids, crops, food, water and sediment at Akumadan a farming community in

Ghana. Overall, 208 samples comprising water, blood, tomato, sediment and breast milk from mothers were taken. Findings from the study revealed that, water and sediment contained residues of lindane and endosulfan whiles hexachlorobenzene (HCB), heptachlor epoxide and P,p'-DDE were further detected in sediment. The study also found that, blood and milk samples collected contains residues of HCB and P,p'-DDE. These are harmful pesticides and the accumulation of them in human health could be cancerous and other defects.

Fianko et al., (2011), investigated the level pesticides residues in some selected crops and cooked food in Akumandan a farming community in the Ashanti Region of Ghana. Six out of eight samples of cooked rice and beans locally known as waakye contains chlorpyrifos pesticides residues. Added to the above, the study further showed that, pesticides residues were found in one out of the eight samples of fufu prepared from cassava, yam and plantain. Analysis on crop found that, crops in the community contains significant levels of DDT, endosulfan, chlorpyrifos, lambda-cyhalothrin and lindane residues. The vegetables were onion, tomatoes, cabbage and lettuce. This revelation is clarion call on policy makers to take up pragmatic and immediate steps to resolve the situation. The most vulnerable to this bad incident are children between the ages of one to six years.

Buah-Kwofie et al. (2011), researched into pesticides residues in fruits in markets within Accra Metropolis. A sample of Organochlorines pesticides such as endosulphin, DDT, aldrin and endrin were monitored in fruits using 5 markets in Accra. The result showed 23.8% of the fruits had residues above the internationally accepted standards by WHO and 48.7% also contains residues which were below the recommended levels. Accumulation of these pesticides in the human body could lead to harmful chronic effects. Ministry of Food and Agriculture (MOFA, 2006), also conducted an investigation into pesticides residues in shallots in the Keta District, Volta Region of Ghana. The findings indicated that, 90% of the study samples on shallots contains residues of

chlorpyrifos and DDT beyond the recommended levels whiles 50% of the total samples revealed chlorpyrifos residues above the maximum levels.

International Water management Institute and Water Research Institute (2005), conducted a joint research into Pesticides and Pathogen Contamination of Vegetables in Ghana's urban markets. Vegetables from 9 markets were sampled from twelve specialized sales points in Accra, Tamale and Kumasi and the result showed that, 78% of lettuce contains chlorpyrifos, 31% contains lindane, 36% contains endosulfan, 11% contains Karate and 33% contains DDT. The residues levels in most of them exceeded the accepted standards and considering their potential danger to human health, immediate pragmatic measures needed to be taken to address the situation. This will guarantee food safety consumers.

Essuman et al., (2008), also investigated into pesticides residues in tomatoes within the Cape Coast Municipality, in the Central Region of Ghana. The result from the study concurred with most of the studies. Chlorpyrifos (dursban) and endosulfan were detected in tomatoes which can result in cancer in children and adults when eating.

In view of the above findings, there is the need to adopt farming practices and other methodologies that minimizes if not to eliminate the use of massive pesticides in farming.

3.4.3 Pesticides poisoning/ infections in Ghana

Pesticides are important as of human life ranging from agriculture to public health. However, their negative consequences on human health are enormous if they are misuse or mishandle before, during and after spraying. Incidence of pesticides poisoning in Ghana have reported across the length and breadth of Ghana. The most commonly reported harmful side effects of pesticides in

Ghana include; headaches, dizziness, body general weakness, irritations of skin, sexual weakness, breathing difficulties and sometimes deaths.

According to NPAS (2012), fifteen farmers died in the Upper East Region of Ghana from suspected pesticides poisoning in 2010. The report further showed that most the deaths are attributed to improper storage, disposal and residues in food crops as a result of misapplication. In Garu Tempeni District, 3 persons died and 7 persons poisoned in one household and another household recorded 9 poisoning and 3 deaths all resulting from contaminated foods. In Bawku West District, the study revealed that, 54 persons were poisoned and 5 died in a single village as a result of food contaminated with pesticides. Talensi-Nabdam District were not left out of this bad incident. A single household recorded 8 poisonings and 2 deaths whiles another household registered 21 poisonings from contaminated foods. Still in the Upper East Region, 12 deaths and 63 poisoning cases were reported by then Regional Minister, in 2010 resulting from residues of pesticides in food crops. The director of health services in the region by then, Dr. Awoonor- William says the figures reported is just a tip of the iceberg and that he believe a lot of people as a result of pesticides poisoning.

Furthermore, five household members were reported dead in Kadjebi in the Volta Region of Ghana after using okra sprayed with insecticides. This sad incident occurred because the spraying was done prior to harvesting which left huge chunk of residues on the okra. Another similar incident occurred in the Central Region of Ghana in July 2004, Tarkwa to be precise, where a lot of residents were hospitalized as result of eating cabbage with excessive residues of pesticides known as organophosphates (Daniel, Winfred and Jacinter, 2014). Few cases of deaths were later reported and most of them were children. A study by Fianko et al. (2011), revealed that, four kinds of pesticides residues which is above the recommended levels by WHO were found in children

between 0-1 years age range. This poisoning can lead to serious chronic diseases in children considering their vulnerable nature.

3.4.4 Willingness to Pay for Pesticides Free Food Products

Unlike developing countries such as Ghana, there exist several studies in developed countries on demand and willingness to pay for pesticides free food products by consumers. Cranfield and Magnusson (2003), conducted a study in Canada to determine the willingness to pay (WTP) for pesticides free food products by consumers. A Contingent Valuation method was employed by the study to elicit information from respondents. Impact of socioeconomic variables was determined through ordered probit regression model. The research work found that, more than 65% of the respondents indicated their willingness to pay a premium ranging between 1-10 percent for pesticide free food product as compare to conventional or conservative food products. The study further revealed that 5% of the consumers interviewed were willing to pay a premium above 20% for pesticides free food products.

A study by Serefoglu and Serefoglu (2016), investigated into Turkish consumers' willingness to for reduced pesticide on potatoes using a Contingent Valuation Method. Information was solicited from a sample of 393 respondents across all the regions in Turkey. Ordered probit regression model was used to determine the impact of socio economic variables on willingness to pay. Online interview method of data collection was adopted by the study. Findings from the study revealed that, 83% of the respondents indicated their willingness to pay for reduced pesticides in potatoes. The study further sought the knowledge of respondents on the harmful effects of pesticides misuse. The result showed that 75% of the respondents have no clue of pesticides and their harmful effects whiles as 20% demonstrated limited knowledge. The study further found that, gender significant influence the willingness to pay for pesticide free products especially, being a female increase the

willingness to pay by 21%. Health factors or variable also prove to significantly impact willingness to whiles income and education variables other hand, were not significant.

Boccaletti and Nardella (2000), also conducted a study on consumers' willingness to pay for pesticides-free fruit and vegetables in Italy through an ordered logit analysis. They found that, 11 percent of the respondents were willing to pay a premium above 20 percent for pesticides free fruit and vegetables to avoid the risk and health hazards associated with pesticides residues food. The study also found that respondents who were not willing to pay premiums above 10 percent numbered almost 70 percent. Those who were not ready and willing to pay any additional premium for pesticides free fruit and vegetables recorded 11 percent.

A study by Misra, Huang and Ott (1991), also conducted a contingent valuation survey to determine the willingness to pay for pesticide free fresh produce by consumers in Georgia a state in US. The findings in this paper is not different from the previous work concerning the interest shown by consumers for pesticides free food products. The result from the study revealed that, out of a sample numbering 379 respondents, 46 percent were willing to pay higher premiums for tested and certified pesticide free fruit and vegetables. Those who answered 'no' to the willingness to pay higher premiums for pesticides free fruit and vegetables were 26% whiles 29% of respondents were indifferent. Majority of the consumers (54%) were willing to pay 10% premium more than what they usually pay for conventional food products and respondents who indicated WTP more than 10% premium also recorded 9%.

In Ghana and African, a few studies concerning this topic have been carried out to determine WTP by consumers for pesticides free food products.

A study by Coulibaly (2011), examined the willingness of consumers to pay for pesticide free products and also assessed market potential for organically grown vegetables in the Republic of Benin and Ghana, West African. The hedonic pricing model was employed by the study to ascertain the factors that influence consumers WTP for organic vegetables. Contingent Valuation method was used to elicit information from consumers through face to face interview. A sample of 200 respondents used comprising 100 from each country. In Ghana the survey was carried out in Accra-Tema Metropolis and in Benin it was done in Cotonou. Findings from the study showed that, consumers are fully aware of massive use of pesticides on vegetables. The study further found that, consumers are willing to pay a premium above 50% for pesticides free vegetables.

A study by Anifori (2009), investigated into market potential and prospects for organic vegetables in the Kumasi Metropolis. The result of showed that 87.7% of the respondents indicated their willingness to pay higher premium above 20% for organic vegetables relative to the conventional vegetables. Consumers willing to pay 20% premium for organic vegetables also recorded 19.6% whiles 14.2 % of the respondents are not ready to pay any premium for organic fruits and vegetables.

Faustin et al., (2015), investigated into households' willingness to pay for pesticides free vegetables in Southern Benin. A contingent valuation method was adopted to collect information on determinants of willingness to pay. Ordered probit model was used to analyzed the data elicited from respondents in order ascertain the significance of socioeconomic variables influencing willingness to pay. The result from the study revealed that, most households are willing to pay higher premiums for cabbage with minimized pesticides with an average premium of 38%. Respondents who were willing to pay 10% more premium than the conventional cabbage prices registered 47% whiles 16% were willing to offer 10% premium threshold. Individual consumers

who were willing to pay a premium less than 5% recorded 37 percent out of the total interviews. The findings from this study is in line with the previous reviewed papers which indicated that most consumers in recent times understand the negative consequences of pesticides to human health and the environment. Socioeconomic variables identified to significantly impact WTP were age, gender and consumers levels of education.

Obayelu et al. (2014), employed a contingent valuation method to investigate households' willingness to pay for leafy vegetables in urban Oyo State in Nigeria. Analyzing using logit model, their investigation indicated that, about 58% of consumers preferred organic fluted pumpkin vegetables and therefore are willing to pay higher premiums for pesticides free vegetables. The study further revealed that, 49% of the respondents had prior information about organic leafy vegetables. In this research, unlike income, health status, and employment status of individuals' consumers, household size showed a negative relationship to WTP. This implies that, large household's size reduces consumers' willingness to pay.

From the reviews above, it showed that consumers are now aware of the potential hazards of pesticides residues in their food crops and thus are ready to adopt measures that will minimized those hazards.

3.4.5 Socio-economic Variables Affecting Consumers WTP.

There exist several personal factors proven by both theory and empirical studies to have potential effects on the willingness to pay by an individual. Cranfield and Magnusson (2003), revealed that young people below 36 years of age are willing to pay higher premiums for pesticides free food products. The study also showed that individual consumers who are conscious about environmental and health impacts of pesticides had their willing to pay positively influenced. Households with more children which are below 17 years, reduces willingness to pay whiles households with higher

annual income increases their willingness to pay premium for pesticides free food products. Gender variable on the other hand showed that females are unlikely to pay higher premium as compared to their male counterparts. Educational variable also showed a positive relationship to WTP higher premium. Individual consumers with higher level of education such as university degree are willing to pay higher premium.

However, the study done by Boccaletti and Nardella (2000), showed opposite result for the educational and sex/gender variables. Their result indicated that female's consumers are likely to offer higher premium for pesticides free food products relative to their male counterparts. The reason attributed to this is that, females are more family oriented than males and hence very conscious of what they consume. They found negative relationship between educational variable and WTP. This implies that individuals with higher level of education are less likely to pay higher premiums for pesticides free food products. This support the findings from Buzby et al. (1995), which showed that higher education have negative influence on willingness to pay of a consumer. According to Boccaletti and Nardella (2000), individuals with higher education do not recognize the recent food safety problems and that could be a reason behind the negative relationship. Income of household, number of children in a household and individuals within their youthful ages (35-49) all showed positive relationship between a consumer's willingness to pay. Higher annual household income, households with higher number of children and the youth are more likely to pay higher premiums whiles the opposites have is true.

Furthermore, Misra, Huang and Ott (1991), also investigated the impact of socio-economics variables on willingness to pay of consumers. The result showed that individuals between the ages of 36-60 are less likely to pay higher premiums whiles those with 65 years and above on the other hand are more likely to pay higher premiums. That is in contradiction to the findings from Boccaletti

and Nardella (2000). The reason here is that, old people are more conscious of their health than the young ones. Education variable indicated negative relationship to WTP. This means higher education reduces the willingness to pay of individuals whiles income variable showed positive relationship to WTP.

Similar research by Anifori (2009), revealed that individuals between the ages of 35-55 years are willing to pay higher premiums to avoid risk associated with pesticides food relative to consumers with ages above 55 years. The gender variable showed higher premiums for females as compare to their male counterparts. In addition, the results showed positive relationship between household size and WTP. This implies that, larger households will be willing to pay higher premiums more than smaller households. Education and income variables both indicated positive signs, implying higher education increases willingness to pay of a consumers and households with higher annual income also are willing to offer premiums higher than lower income households. Environmental and health concerns also revealed positive impacts on willingness to pay for organic fruits and vegetables.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter discusses the methodology employed in this study. The objective of the study was to empirically assessed consumers' willingness to pay for pesticide free products. The chapter vividly shows the various tools and estimation procedures used to achieve its objective. The first section of this chapter covers the theoretical underpinning, empirical model specification and reasons for the choice of variables in the model. The second section details data sources and type, instrumentation, sampling technique and information elicitation procedure. The last section presents data analysis and Estimation Methods.

4.2 Theoretical outline

The theoretical framework underpinning the topic under study is the Random Utility Model (RUM) which broke new grounds in the 1920s. This model was subsequently improved to integrate the technique of utility estimation developed by Lancaster (1966) and McFadden (1974). The RUM assumes that, the utility an individual *j* derived from the *ith* alternative good (U_{ij}) is a function of observed characteristics of the individual, the commodity being consumed, and the unobservable random component ε_i. The Random Utility function to this type of utility estimations may be expressed as;

$$U_{ij} = X_i'\beta + \varepsilon_i \qquad \ldots\ldots 1$$

Where U_{ij} is the utility derived from the *ith* alternative by individual *j*, $X_i\beta$ is the deterministic component of the utility function and ε_i represents the unobserved error term of the utility function.

Let us assume the disposable income of the individual household is Y_d which is part of the deterministic ($X'_i\beta$) component of the utility function. Then equation one (1) metamorphoses into;

$$U_{ij} = U_i(Y_d, X_i\beta) + \varepsilon_i \quad \text{.....1B}$$

In a contingent valuation survey, if a premium (ie payment bid Y_p*) is introduced which alters the features of the (environmental) good, for instance quality of the good. The consumer will accept to pay the supposed premium if and only if the utility obtained from choosing the ***ith*** alternative is higher than the utility derived from other alternatives available to him/her or status quo. Mathematically, if

$$U_i^*\left(Y_d - Y_p^*, X_i\beta\right) + \varepsilon_i > U_i(Y_d, X_i\beta) + \varepsilon_i \quad \text{.....2}$$

Where Y_d is the disposable income of the individual household and Y_p***** is the premium placed on placed on the good.

Equation 2 is written in additive form because the appropriate technique for estimating a Random Utility Model is to transform it into an Additive Random Utility Model (ARUM) (Cameron and Trivedi, 2005). The intuition here is that, utility function is additively separable into deterministic and stochastic inclinations. Alternatively, a consumer will accept payment if the change in utility from the *ith* alternative is sufficient enough to merit the premium.

$\Delta U = U_i - U_j > 0$ for all $J \neq i$ 2b

The amount of premium the consumer is willing to pay (WTP) for the recommended improvement in the resource is Y_p***.** The respondent is required to indicate his/her preference by choosing either 'yes' or 'no' to the premium being offered. The preference of a respondent to the suggested premium is the probability that he choose 'yes'. Mathematically represented as,

$$\Pr(yes) = U_{1i}^{*}(Y_d - Y_i^{*}, X_i\beta) + \varepsilon_{1i} > U_{0i}(Y_d, X_i\beta) + \varepsilon_{0i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

4.2.1 Empirical model

Let WTP* represent the unobserved premium the consumer is willing to pay for pesticide free products. Using consumer demand theory as the foundation, WTP_i is assumed to be a function of the change in utility, household socioeconomic characteristics and the commodity physical appearance (Greene, 2008). Household and consumer characteristics are introduced to capture the variation in WTP among individuals. WTP in most empirical studies takes the form of multiple response variables that has intrinsic order. Using the ordered qualitative response model, willingness to pay can be written as,

$$WTP_i^{*} = \delta + X_i'\beta_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where δ is a constant, β_i is a vector estimate parameter, X_i is a vector of commodity and household socioeconomic characteristics, ε_i is the error term which absorbs all the factors that influence consumer willingness to pay which have been omitted from the model and WTP* is the unobserved WTP of the consumer. The stochastic term is assume to follow a normal distribution with a mean of zero and variance of one. In line with the above explained framework, this study therefore estimate the following equation to unearth the significance and impact of the socioeconomic variables that affects WTP of an individual:

$$\begin{aligned} WTP_i = {} & \beta_1 Age_i + \beta_2 HHSIZE_i + \beta_3 HHINC_i + \beta_4 EDU_i + \beta_5 MEXP_i + \beta_6 NUMAGED_i \\ & + \beta_7 EMPLS_i + \beta_8 ENVCONS_i + \beta_9 LOCALITY_i + \beta_{10} SEX_i + \beta_{11} SHOPPING_i \\ & + \beta_{12} ASSEDU_i + \beta_{13} KNOWLEDGE_i + \varepsilon_i \end{aligned}$$

Age = age of respondent

SEX= Sex of respondent

HSIZ = Household size

HMINC = Household monthly income

EDU = Level of respondent education

MEXP= Monthly expenditure on food items

NUMAGED= Number of aged in household

SHOPPING = Frequent shopping place of household

EMPLS= Employment status of respondent

ASSEDU= Belonging to association that educate food safety

KNPFP = Knowledge on Pesticide Free Products

ENV = Environmental friendliness of respondent

LOCALITY= Respondent permanent place of residence

4.2.2 Description of Explanatory Variables

Age of Respondents

This is a continuous variable and measures the age of the respondent in completed years. A positive relationship is anticipated between WTP of an individual and the age of respondent. The reason being that individuals becomes very cautious of what they consume as they advances in age. In view of this, they are willing to pay higher premium for products that guarantees their food safety. Thus, respondents in the older age category are expected to pay more for pesticide free products.

Sex of Respondents

This is a dummy variable with 0 assigned to males and 1 assigned to their female counterpart. Notwithstanding the fact that males are heads of most households, females determines what the households consumes. They stand the chance to offer a higher premium than their male counterparts. A positive relationship is anticipated between WTP for pesticide free products and

sex. The reason being that, female are more health and environmentally conscious than their male counterparts.

Household Size

Household size is a continuous variable and represents the total number of persons in a household who have the same catering arrangement. Household with higher number of members face budget constraints and thus are likely to pay less premium for pesticide free products. Another school of thought are of the view that households with large size are very cautious of what they eat since food poison could wipe the whole family and hence a higher premium. In view of this explanation, an ambiguous relationship is therefore expected to exist between WTP and household size.

Household Monthly Income

This is the summation of all streams of income of household earners in a month and it is a continuous variable. The study adopted the monthly summation of all earners in a household because, pesticides free products comes with a premium and if the household head could not afford, other members of the household will be willing to contribute to afford PFP. Economic theory postulates that, the higher the disposable income of an individual, the higher the demand in a situation of a normal good. Food is a necessity and thus, consumers with higher incomes will be willing to pay higher premium for pesticide free products to guarantee their safety. A positive relationship is therefore anticipated.

Monthly Expenditure on food

This is a continuous variable and measures the proportion of household monthly income spent on food. An ambiguous relationship between monthly expenditure and WTP is expected. The reason being that, a household that already spends a lot on food will be willing to pay more for PFP to

guarantee their safety whiles some will not be willing to pay a little more for PFP since their expenditure on food is already high. Furthermore, certain households with less expenditure on food items will be willing to offer higher premium to guarantee their food safety whiles others will find it difficult to offer a little higher premium because they are used to the status quo.

Employment Status of respondent

This a dummy variable and measures whether the respondent is employed or not. Respondents who are employed and are assured of constant flow of income will be willing to pay higher premium for PFP than those who do not have constant flow of income. A positive relationship is expected.

Knowledge on Pesticide Free Products

This is a dummy variable with 1 representing 'yes' and 0 representing 'No'. Households or respondents with prior knowledge on pesticide free products and their health benefits will be willing to pay higher premium for PFP than first time respondents. A positive relationship is thus anticipated.

Environmental concern of respondent

This is a categorical variable and measures whether a respondent has a good attitude towards the environment and its inherent benefits. A positive relationship between WTP and environment friendliness or concern is expected. The reason being that, a respondent that attaches importance to the environment and is concern about its protection will promote farming practices that ensures environmental safety. Thus, such respondents will be willing to offer higher premium for PFP which guarantee environmental safety.

In a gist, table 4.1 summaries the variable definitions and expected signs.

VARIABLE	CLASSIFICATION	EXPECTED SIGN
age of respondent (Age)	Continuous	+
Sex of respondent (Sex) (Male =0 Female =1)	Dummy	+
Household size (HSIZ)	Continuous	+/-
Household monthly income(HMINC)	Continuous	+
Highest level of respondent' education (EDU) (NFEDU=0, BEDU=1, SEDU=2, TEDU=3)	Categorical	+
Monthly expenditure on food items (MEXP)	Continuous	+/-
Number of aged in household (NAGED)	Continuous	+
Belonging to association that educate food safety (ASSEDU) (Yes=1 No=0)	Dummy	+/-
Employment status of respondent (EMPLS) (NOT EMP=0, EMP=1)	Dummy	+
Shopping center of respondents (Mall/Super market=1, Traditional = 0	Dummy	+/-
Knowledge on Pesticide Free Products (NO=0 , YES=1)	Dummy	+/-
Permanent place of residence (LOCALITY) (Ayewaso West Wagon=1, Osu Klottey=2, Tema West=3)	Categorical	+/-
Environmental concern of respondent (ENV) NTR=0, SDA=1, DA=2, SAG=3, AG=4	Categorical	+

Table4.1: Variable definition and expected sign

Source: Constructed by Author, 2016

4.3 Data Sources and Type

Both primary and secondary data had been employed by the study for its analysis. Primary data was sourced from the selected districts within the Accra-Tema Metropolitan areas whiles the secondary data was sourced from Environmental Protection Agency (EPA) and Ghana Statistical Service (GSS). Data from GSS was on Ghana poverty mapping and 2010 Population and Housing Census which aided in the sampling of districts and households to be interviewed. Data on pesticides import to Ghana, banned pesticides, and registered pesticides was sourced from EPA.

4.3.1 Survey Instrumentation and data collection method

The study employed one main instrument for data collection. A well designed questionnaire comprising of four sections was administered to households within the study area through face-to-face interviews. The first section of the questionnaire contained a hypothetical scenario of the Pesticides Free Products. The hypothetical scenario presented food products which are devoid of pesticides residues and its associated health hazards. The scenario further presented a farming technique which is devoid of massive pesticides use on the environment and the inherent benefits. In line with this respondents were asked to indicate the maximum premium they are willing to offer for PFP. The second section was on environmental attitudinal questions, third section on institutional capability questions and the final section was on socio-economic questions. This was aimed at eliciting information on socio-economic variables that affect WTP of an individual or household.

4.3.2 Pilot Survey and Training of Enumerators

Pilot survey in most empirical researches such as the topic under study are conducted to validate the content of the survey instrument in order to minimize inaccurate responses. This is often done in Contingent Valuation (CV) surveys so as to make the scenario more practical which respondents could easily identify, understand and appropriately indicate their maximum WTP. In view of this, a pilot survey was executed prior to the substantive survey. The researcher sampled 20 households each from the study areas for the pilot exercise. A mock questionnaire was given to respondents who are literate in English language to answer according to the way he/she understands and seek clarification when necessary. In the case of non-literate, the researcher facilitated the interviews. Feedbacks from the pilot survey and interactions with respondents were incorporated into the main survey instrument to make it more practical and understandable.

Biasness in research does not only emanate from the design of the survey instrument, but also from the way enumerators administered the questionnaire, especially in the case of hypothetical scenario like the topic under study. Proper explanation of the scenario to respondents' couple with the adoption of the right elicitation techniques are very crucial in minimizing bias responses from respondents. In view of this, extensive capacity building for enumerators or interviewers was carried out in Golden beach conference room at Prampram. One of the key focused areas during the training section, was to get the enumerators understand the hypothetical scenario and communicate same to respondents. Other areas was communication skills and ethical considerations in empirical research. The final section was the strategies they should adopt to probe further without imposing their own views on respondents.

4.3.3 Sampling Technique

The study employed multiple sampling techniques in order to obtain the right respondents for interview. Firstly, the study used purposive sampling technique to select Accra-Tema Metropolitan areas as the study area. This area was chosen because Accra-Tema is the largest Urban Area settlement with diverse income levels, ethnic groups, religious and cultural backgrounds. Cosmopolitan nature of Accra-Tema made it more suit for the study. According to Neuman (2007), purposive sampling is appropriate in situations where the topic under study demands some category of respondents to fulfil the objectives of study.

Secondly, cluster sampling technique was used to classify the whole study area into three clusters based on income namely; upper income area, middle income area and lower income area. Poverty mapping data for Ghana was sourced from Ghana Statistical Service (GSS, 2015) which aided in the classification of the study area into three clusters.

Convenience sampling technique was further employed to select one sub-metros from each cluster for the implementation of the study. The sub-metros include; Ayewaso West Wagon (upper income area), Osu Klottey (middle income area) and Tema West (lower income area). Considering the financial and time constraint of the researcher, these sub-metros were therefore deemed convenient.

With regards to systematic sampling technique, an interviewer enters a suburb and interviews 10 households (10) at an interval of five households (5) and move to another suburb. The choice of towns ensure that, the sample cut across the geographical sub areas in the Sub-Metros.

4.4.2 Sample Size

The sample size for the study was selected using the following scientific approach $n = \frac{N}{1+N(e^2)}$ as adopted by Niles (2006). Where; n =sample size, N = Population (households) and e^2 = Error margin. An error margin of 4.26% was used to determine the right sample size of 550 households out of 599, 552 households within Accra-Tema Metropolis for the survey.

In totality, 550 questionnaires were administered within the three sub-metros. Ratios was used to calculate the right sample size for each sub-metro based on their respective population using 2010 Population and housing census. Sub-metros with higher population received more questionnaires than others because much wider spread of households with more even characteristics is anticipated in these sub-metros. Based on the methodology, Ayawaso West wagon received 94 questionnaires, 208 questionnaires for Osu Klottey and 248 questionnaires was sent to Tema west. However, the correct questionnaires coded and captured for analysis was 500 registering 90.9 percent response rate.

4.3.5 Quality Control Consideration and Elicitation Format

There exist quality control framework to reduce biases and errors or considerations within which empirical studies must be carried out, especially CV surveys due to its complex and sophisticated nature. In view of this, National Oceanic and Atmospheric Administration (NOAA) in 1993, espoused certain criteria which must followed to authenticate CV surveys. The recommendations include; designing a CV survey questionnaire to precisely and clearly fit the hypothetical scenario, ensuring that WTP is about future event and not past event and finally CV should be executed through face-to-face interviews. All these quality considerations was duly followed in the design and implementation of the survey. Other quality issues concerning empirical studies had been considered. The hypothetical scenario was simple, precise and clear on the attributes and benefits of pesticides free products so as to aid respondents in indicating their WTP.

The elicitation method adopted for the study was discrete choice questions. Prices of a unit of frequently consumed vegetables and crops on the Ghana markets were collected in order to obtain the average price of those commodities in the local markets to inform the choice of initial bid price. Data on prices were collected from Ashaiman market, Madina, Tema, Agbogbloshie, Makola, Nungua, Osu and Haatso for analysis. Respondents were therefore, asked to indicate the premium they will be willing to pay to obtain the same quantity of products which is devoid of pesticide residues. This done to eliminate biases that emanates from too many follow up questions and also make the research more practical. In this way enumerators cannot impose their own view on respondents. The premium was also in nominal figures and not in percentages so as to save time and also help respondents who are not good in percentages.

4.3.6 Field Operation/Work

Implementation of the study started on the 3rd of March, 2017 and ended on 27th of April, 2017. Enumerators identified households which fell within the sample frame and sampling design chosen in each community. Purpose of the study was vividly explained to head of household or any capable person delegated to respond to the questions after which the interview was conducted. Administered questionnaires were retrieved and undergone cleaning, consistency, accuracy checks and for further coding.

4.3.7 Profile of the Study areas.

The Accra-Tema Metropolitan can be found in the Greater Accra Region of Ghana. Tema Metropolis is a coastal district situated about 30 kilometers East of Accra, the Capital City of Ghana. Accoding to Ghana poverty mapping report by GSS (2015), the total households' population in the Greater Accra Region was 3, 888,237 and out of this, Accra-Tema Metropolis recorded 1,884,789 representing 48.47% of the regional household population. Accra Metropolis has the highest household population among the two metropolis. Out of the total household population of 1,884,789 registered for the two metropolis, 84.87% (1,599,650) of them are found in the Accra Metropolis. In view of the strategic location of the Tema Metropolis in the Greater Accra Region and its specific location as an industrial hub of Ghana and other neighbouring countries, most giant factories in Ghana are situated in the metropolis. Notable among them are; Tema Oil Refinery, Cocoa Processing company, and Nestle Ghana Limited. Accra Metropolis on the other hand, is the host of Ministries and the seat of Government and other notable economic ventures.

This consists of 139,958 males representing 47.8% and 152,815 females representing 52.2%. Accra Metropolitan Assembly has a population of 1,665,086 as at 2010 population and housing census

(GSS, 2010). Out of this figure, males are 800,935 and females 864,151 representing 48.1% and 51.9% respectively.

4.3.7.1 The Built Environment.

The built up area of the Metropolis is made up of the well planned communities, beach fronts and the industrial area. The residential areas (both well planned and squatter settlements) form about 60% of the total land area with industrial and commercial areas making up the remaining 40% of land cover. The squatter settlements are usually found in areas such as Tema Manhean, parts of Community 1, and the industrial areas.

4.3.7.2 Economically Active Population.

The 2010 Population and Housing Census (PHC) define the economically active population as that part of the population 15 years and above but less than 65 years. In Tema Metropolis, 72% of the total population falls within the economically active group. About 90.4% of the economically active population are economically engaged, whiles 9.6 percent are unemployed. Accra Metropolitan has 70.1% of its population being economically active group and out of this, 92.8% are employed whiles 7.2% are unemployed. With regards to economically not active population, 29.9% are pensioners/retired officers, 52% are into fulltime education and 18.1% being the remaining minor categories.

4.3.7.3 Occupation Distribution.

According to 2010 Population and Housing Census (GSS, 2010), the major occupations in the Tema Metropolitan area are service and sales workers representing 31.5%, craft and related trades workers scoring 20.2% and those engaged in other minor occupations constituting 48.3%. In the Accra Metropolitan area, occupational structure shows that, 38.5% of residents are engaged in sales and service, 22.5% in transport sector and 20.1% into craft and related trade works. Professional and

technical workers category recorded 17.2% and other minor sectors constituting the remaining 1.7%.

4.3.7.4 Ethnic Diversity

The original settlers of Tema are the Ga-Dangme's and that of Accra being Ga's. The capital city of Ghana is Accra, which is growing exponentially including Tema. In view of this, several ethnic groups can be found here. The dominant ethnic groups are the Akan, Ga/Ga-Dangme and Ewe. Other fairly well represented groups are the Mole-Dagbani and the Guans. The diverse nature of the inhabitants fosters interethnic tolerance and social solidarity that has promoted peace and harmony in the district.

4.3.7.5 Religious Groups

The religious composition of the Accra-Tema Metropolis is diverse in nature since the inhabitants are of varied backgrounds. The prominent amongst them are Christians, Moslems and Traditional religion. Against this background, the churches and mosques are known to be a good mobilization grounds for information dissemination for development.

4.4 Data Analysis and Estimation Approach

4.4.1 The Ordered Probit Model

Important variables that influence the willingness to pay (WTP) for Pesticide Free food products was analyzed using Ordered Probit Model. It is chosen as the favorite model because the revealed WTP by consumers might not reflect their correct maximum WTP. According to Cranfield & Magnusson, (2003) and Greene (2006), their true WTP may fall within a certain interval of the next highest value and the maximum value the respondent revealed or is willing to pay. In view of this, employing unordered multinomial logit or probit model would lead to spurious result because it would fail to account for the ordinal nature of the response variable, even though the outcome of

the occurrence is disconnected or discrete. Unordered multinomial logit and probit models does not account for the ordinal attribute of the dependent variable where the nature of the dependent variable matters (Twerefour et al., 2015). This gives the ordered probit model an advantage over the unordered multinomial conditional or nested logit or probit model. According to Maddala (1983), employing linear regression model to analyze ordinal dependent variables is not also the best technique. The reason being that, the assumption underpinning the specification of the stochastic term in a linear model will be disrupted. Furthermore, the preference of the ordered probit model to linear regression and unordered probit and logit models is due to the fact that, it accounts for the uneven differences between the ordinal categories in the dependent variable (Greene, 2006; Twerefour et al., 2015).

$WTP_i = \boldsymbol{\delta} + X_i'\beta_i + \varepsilon_i$

Where δ is a constant, β_i is a vector estimate parameter, X_i is a vector of commodity and household socioeconomic characteristics, ε_i is the error term which absorbs all the factors that influence consumer willingness to pay which have been omitted from the model and WTP* is the unobserved WTP of the consumer. The stochastic term is assume to follow a normal distribution with a mean of zero and variance of one. If WTP of a consumer's falls within a particular range, a numerical value is assigned to WTP which mirrors the category in which their unobserved (latent) willingness to pay lies. Let $K_1, K_2, \ldots\ldots\ldots\ldots, K_J$, be the j prices which separates the range of WTP into J categories.

$$WTP_i = \begin{cases} 1 \; if \; WTP_i^* \leq K_1 \\ 2 \; if \; K1 < WTP_i^* \leq 2 \\ \vdots \\ \vdots \\ \vdots \\ J \; if \; K_{j-1} < WTP_i^* \end{cases} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

If j = 1, 2, ……, J, where j is the WTP category selected by the respondent, then, willingness to pay is expressed as;

$$\begin{cases} K_{j-1} < WTP \leq K_j \\ \quad or \\ K_{j-1} < \delta + X_i'\beta_i + \varepsilon_i \leq K_j \\ \quad or \\ K_j - \delta < X_i'\beta_i + \varepsilon_i \leq K_j - \delta \\ \quad or \\ K_{j-1} - \delta - X_i'\beta_i < \varepsilon_i \leq K_j - \delta - X_i'\beta_i \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots, 7$$

To ascertain the impacts of the socio-economic variables on households WTP, the values of WTP obtained from the above expression will be used as the dependent variable in the regression equation (ie eqn 4). This is done by using the range of premiums respondents indicated as their maximum WTP for pesticide free products. The probability that consumer *i* choose category j, can be written as;

$$\begin{cases} \Pr(WTP = j) = \Pr\left(K_{j-1} < WTP^* \leq K_j\right) \\ \quad = \Pr(K_j < \delta + X_i'\beta + \varepsilon_i \leq K_j \ ) \\ \quad = \Pr\left(K_{j-1} - \delta < X_i'\beta + \varepsilon_i \leq K_j\right) \\ \quad = \Pr\left(K_{j-1} - \delta - X_i'\beta < \varepsilon_i \leq K_j - \delta - X_i'\beta\right) \\ \quad = \Pr\left(\gamma_{j-1} - X_i'\beta < \varepsilon_i \leq \gamma_j - X_i'\beta\right) \\ \quad = \Phi\left(\gamma_j - X_i'\beta\right) - \Phi(\gamma_{j-1} - X_i'\beta) \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots 8$$

Where; $\gamma_j = K_j - \delta$ and Φ [.] is a cumulative standard normal distribution function. γ_j and β are the threshold parameters and coefficient vector to be estimated respectively. The highest value above which a consumer moves from one category of WTP to the next category of WTP is termed as threshold.

Granted we have J WTP categories and a household chose category j, where j= 1,2, 3, 4 …J. Then the probability that a household chooses category j is written as;

$P_i(1) = Pr(WTPi=1) = Pr(WTP_i^* \leq K_1) = Pr(X_i'\beta + \varepsilon_i \leq \gamma_1) = Pr(\varepsilon_i \leq \gamma_1 - X_i'\beta) = \Phi(\gamma_1 - X_i'\beta)$

$P_i(2) = Pr(WTPi=2) = Pr(WTP_i^* \leq K_2) = Pr(X_i'\beta + \varepsilon_i \leq \gamma_2) = Pr(\varepsilon_i \leq \gamma_2 - X_i'\beta) - Pr(\varepsilon_i \leq \gamma_1 - X_i'\beta)$

$= \Phi(\gamma_2 - X_i'\beta) - \Phi(\gamma_1 - X_i'\beta)$

:

:

$Pi(J-1) = Pr(WTPi = J-1) = Pr(K_{J-1} < WTPi^* \leq K_J) = \Phi(\gamma_j - X_i'\beta) - \Phi(\gamma_{j-1} - X_i'\beta)$

$Pi(J) = Pr(WTPi = J) = Pr(WTPi^* > K_J) = 1 - \Phi(\gamma_J - X_i'\beta)$

To attain the values of the thresholds parameters and the vector coefficients, then the log likelihood function must be maximized.

$lnL = 1[WTP_i = 1] \ln[\Phi(\gamma_1 - X_1'\beta)] + 1[WTP_i = 2] \ln[\Phi(\gamma_2 - X_1'\beta) - \Phi(\gamma_1 - X_1'\beta)] + \ldots\ldots + 1[WTP_i = j-1] \ln[\Phi(\gamma_j - X_1'\beta) - \Phi(\gamma_{j-1} - X_i'\beta)] + \ldots.. + 1[WTP_i = j] \ln[1 - \Phi(\gamma_{j-1} - X_i'\beta)]$ …… 9

Equation 4 can be simplified as;

$$LnL = \Sigma\Sigma WTP_{ij} \ln[\Phi(\gamma_i - X_i'\beta) - \Phi(\gamma_{j-1} - X_i'\beta)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

Interpreting the parameter coefficient estimate using normal regression procedure does not make much sense (Cranfield & Magnusson, 2003). Furthermore, since WTP* is latent (unobserved) using only the responded probabilities to interpret does not also give a good picture (Woodridge, 2002). Estimating the marginal effects to show how a change in any of the explanatory variables affects the probability of each outcome. The marginal effects for each category can be expressed as;

$$\begin{cases} \dfrac{\partial pr(WTPi = 0|X)}{\partial Xi} = -\phi(-X_i'\beta)\beta \\ \dfrac{\partial \Pr(WTP_i = 1)\,|X)}{\partial X_i} = [\phi(-X_i'\beta) - \phi(\gamma_1 - X_i'\beta)]\beta \\ \dfrac{\partial \Pr(WTP_i = 2|X)}{\partial X_i} = [\phi(\gamma_1 - X_1'\beta) - \phi(\gamma_2 - X_i'\beta)]\beta \\ \vdots \\ \vdots \\ \vdots \\ \dfrac{\partial \Pr(WTP_i = J|X)}{\partial X_i}\left[\phi\left(\gamma_{j-1} - X_i'\beta\right)\right]\beta \end{cases}$$

Where; ϕ (.) is the derivative of Φ (.)

The signs of the middle marginal effects are not known in an ordered probit regression and thus cannot be ascertained by the signs of the estimated coefficients in the regression equation. However, the signs of the marginal effects of the upper and lower band of WTP can be identified by having a cursory look at the respective signs of the coefficients.

CHAPTER FIVE

ANALYSIS, PRESENTATION AND DISCUSSION OF EMPIRICAL RESULT

5.0 Introduction

This chapter analyses and discusses the findings from the study. The chapter is in two sections, the first section employs descriptive methods to analyze the data whiles the second section uses econometric estimations techniques to analyze, present and discuss findings.

5.1 Socioeconomic Characteristics of Respondents.

This sections discusses the empirical results obtained from the Contingent Valuation Survey concerning the socioeconomic characteristics of respondents. In total, 500 respondents were interviewed from the three Sub-Metros and different communities within the Sub-Metros. Out of the total sample interviewed, 215 of the respondents were males and 285 females representing 43% and 57% respectively. This implies that, females are more interested and concern about household nutritional needs and environmental consciousness. The result here confirms the findings from Doorn (2010). Figure 5.1 gives a pictorial view of gender representation.

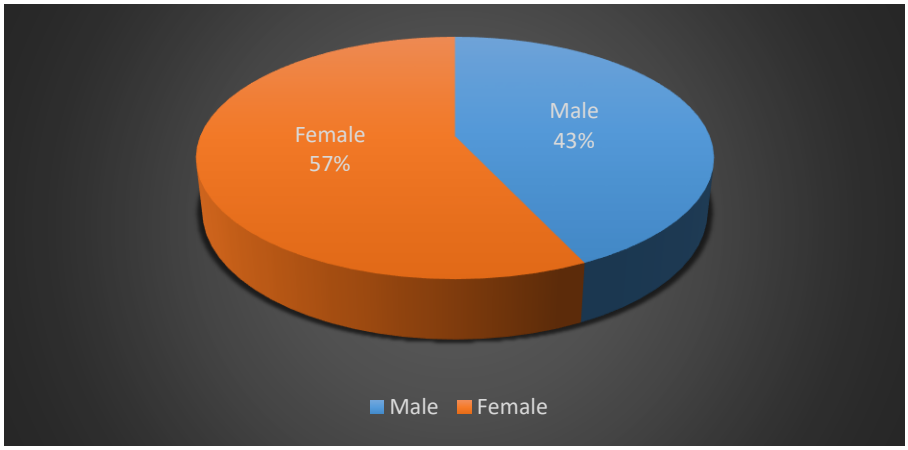


Figure 5.1 Sex distribution of Respondents

Source: Author's Survey, 2017

Average persons per household stood at 4.63 with a minimum of 1 and a maximum 14 persons. The result on average household density is in line with the figures obtained by Ghana Statistical Service (PHC, 2010) for Greater Accra region. The study also sought to know the average number of aged persons in a household. The result revealed that, the average number of persons aged 65 years and above per household was 0.43 with a minimum of 0 persons and a maximum 3 persons per household. This implies that, there exist low dependency ratio in the study area. Another critical demographic variable the study sought from respondents were their ages. The result from the empirical study showed that, majority of the respondents were between the ages 26-35 years (30%). The second majority of the respondents were within 36-45 years, representing 29.4% and the least among them were 56 years and above registering 8.8%. Other age categories of the respondents were 18-25 years and 46-55 years, which has 15.4% and 16.2% respectively. The implication here is that, most of the metropolis population are youthful and within economically active group. Figure 5.2 shows the age distribution of respondents.

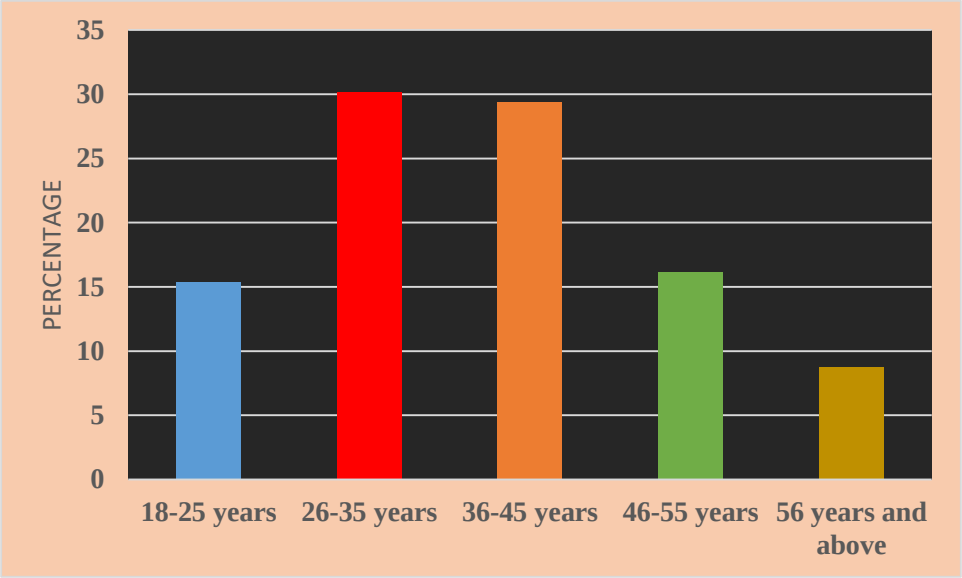


Figure 5.2: Age distribution of the sample

Source: Field Survey, 2017

Furthermore, information on respondents' highest level of education was elicited and the analysis of the data obtained revealed that, majority of the respondents' attained Tertiary education representing 41.8%. Respondents with Senior High School (SHS) qualification formed the second majority representing 30.8% and this is followed by respondents with Junior High School education scoring 15%. The least among the respondents were those with no formal education representing 12.4%. This implies that, most of the respondents in this study stood a better chance of understanding economic, health and environmental consequences of pesticide usage. Furthermore, having 87.6% of the sample being literate goes to suggest that, most of the respondents understood economic implications of the premiums selected. Hence, critical analysis was done taking into account its implication on household's budget.

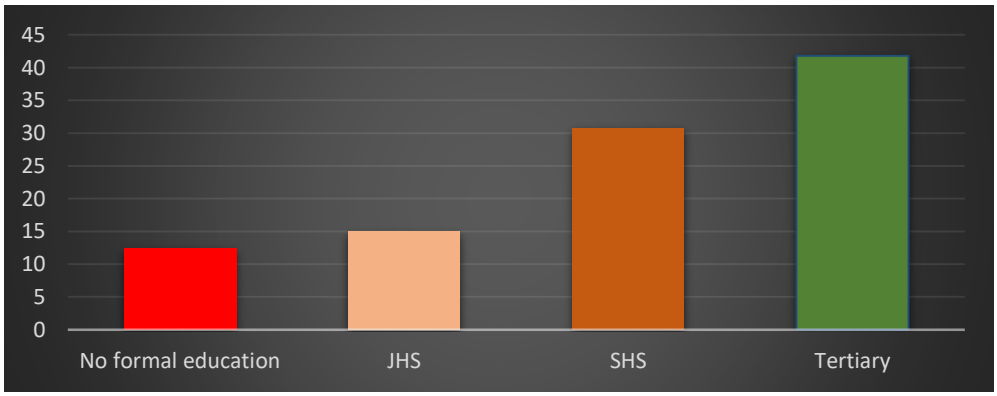


Figure 5.3: Distribution of Respondents highest level of education

Source: Field Survey, 2017

Respondents were further tasked to indicate whether they have prior information on Pesticide Free Products (PFP) or the time of interview was the first time they heard about PFP. Result from the survey showed that, almost 7 persons out of every 10 persons had no prior information on PFP. Majority of the respondents indicated 'no' representing 68.4% whiles 31.6% of the sample interviewed showed a certain level of knowledge on PFP. The study also required respondents to

indicate whether they have ever been sensitized or educated on the side effects of pesticides by Environmental Protection Agency (EPA), Food and Drugs Authority (FDA) and others mandated government institution. The result revealed that, 6 respondents out of every 10 representing 60.8% had never been sensitized on the side effects of pesticides on environment and human health. The remaining 39.2% indicated they had ever received education of a sort but however, not frequent. The result here confirms the argument and findings by Gerken et al, (2001) and Abate (1996), which attributed the high negative impacts of pesticides to lack of rigorous education and sensitization of the citizenry by mandated state institutions.

Furthermore, the study also required respondents to indicate their primary source of information on food safety. The result of the analysis revealed that, majority of the respondents 75.6% obtains most of their information from Radio and Television. This is followed by government programmes on food safety registering 9.6% with the least among all the sources being University academic reports sources recording 1%. Other sources include, newspapers and popular magazines recording 7% of the sample interviewed and information from friends registering 6.8%. This implies that, most of the educational and sensitization programmes by mandated state institutions on food safety and the need for additional premiums (WTP) to obtain PFP should be channeled through radio and television stations where a lot of the citizens gets their information from. Again, the results shows that, respondents have knowledge on food safety and hence its positive impact on WTP for PFP.

Table 5.1 shows respondent's primary source of information on food safety.

Primary Source	Frequency	Percentage
Radio, television	378	75.6
Newspapers, popular magazines	35	7
University academic report	5	1
Government food safety programmes	48	9.6
Friend's word of mouth	34	6.8
Total	**500**	**100**

Table 5.1: Source of Primary Information
Source: Author's Survey, 2017

Another salient socioeconomic variable which has significant impact on an individual's Willingness to Pay (WTP) has to with employment status. The result from the empirical study showed that, a greater proportion of the respondents representing 87.6% of the sample interviewed are employed. The remaining 12.4% of the respondents indicated they are not employed. This implies, most of the households have constant and sustain source of monthly income and hence, stance the chance to offer higher premiums. The study however did not go further to solicit their area or sector of employment and figure 5.4 gives the graphical representation of the responses.

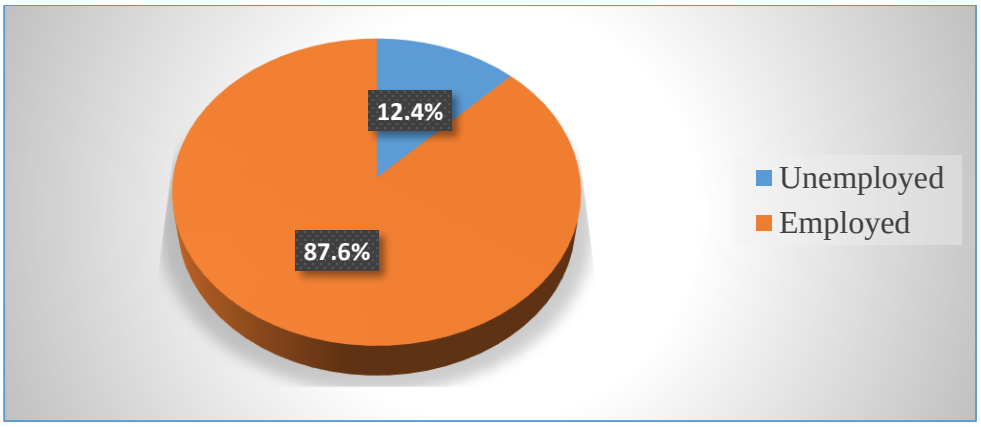


Figure 5.4: Employment status
Source: Field Survey, 2017

Table 5.2: Summary of attitudinal questions responses

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I feel the use of synthetic pesticides in agriculture has a negative effect on the environment	56.6%	41.0%	2.0%	0.0%	0.4%
I am concern about pesticide residues in our food supply	55.0%	35.4%	9.0%	0.6%	0.0%
I feel a lot food-borne illness in recent times emanates from pesticides residues	67.4%	23.6%	9.0%	0.0%	0.0%
The labeling of food ingredients on food packaging is important to me	56.0%	35.2%	8.4%	0.2%	0.2%
I believe farmers should engage in sustainable agricultural production practices. That is, farming which ensures the goal of productive future of agriculture, environment and the economies of rural communities.	56.6%	35.6%	7.6%	0.2%	0.0%

Source: Author's Survey, 2017

The study sought information on the attitudes and perception of respondents concerning the use of pesticides and its effects on the environment and human health. This is modeled with the aim of obtaining an appreciable understanding of respondents' knowledge and concerns towards the use of pesticides using the likert scale. The influence of an individual's attitude towards food safety, clean and sustainable environment on willingness to pay cannot be underestimated. Respondents with great concern about the impact of pesticides on human health, environment and also make food safety a priority have the likelihood of paying higher premiums. Table. 5.2 shows the summary results of responses from the sample interviewed. The findings from the empirical result indicates that, 97.6% of the respondents feel the use of pesticides has negative impact on the environment. In all, 56.6% of them have a strong feeling whiles 41% showed a moderate concern. Those with opposite view or opinion scored 0.4% with remaining 2% being indecisive.

On the issue of pesticide residues in food supply, 90.4% of the respondents registered their concerns. Those who strongly agree that, there exist particles of pesticides in our food supply were 55% whiles respondents with moderate concerns registered 35.4%. On the other hand, respondents who disagree with the opinion recorded 0.6% with the remaining 9% indicating neutrality on the opinion. The contingent valuation survey also required respondents to indicate their opinion on the recent food-borne illness. In total, 91% of the respondent indicated that, the recent food borne-illness emanates from pesticide residues whiles 9% objects the opinion. Among those who ascribe food-borne illness to pesticide residues, 67.4% of them registered strong concerns whiles 23.6% showed moderate concerns.

Furthermore, respondents were asked to indicate their opinion on the importance of labeling food ingredients on packaging materials. Among the sample interviewed, 91.2% of them agreed that labeling food ingredients are important and this include, 56% who strongly agree and 35.2% who agree. Respondents who were indecisive recorded 8.4% leaving 0.2% each to those who moderately and strongly disagree to the opinion. Another significant question in the survey was on sustainable agriculture farming practices. Respondents were tasked to indicate their opinion on farmers adopting sustainable agriculture farming practices. In all, 92.2% agreed that farmers should adopt sustainable agriculture farming techniques, 0.2% objected to the opinion and the remaining 7.6% were neutral or indecisive as at the time of interview.

Households were further asked to indicate their average monthly expenditure on food items. A range of expenditures were listed and what household have to do was just to indicate the range their expenditure fit in. Analysis of the data revealed that, majority of the households representing 29.4% spend between 201-350 Ghana cedis a month on food and this was closely followed by households that spend 351-500 Ghana cedis a month with 28%. The least among the households was those who

spend 20-100 Ghana a month on food. Table 5.3 shows the distribution of the various categories of household's average monthly expenditure on food.

Range of Expenditures	Frequency	Percentage
20-100 cedis	11	2.2
101-200 cedis	96	19.2
201-350 cedis	147	29.4
351-500 cedis	140	28
Above 500 cedis	106	21.2
Total	**500**	**100**

Table 5.3: Average monthly expenditure on food

Source: Author's Survey, 2017

Furthermore, respondents were provided with a range of willingness to pay categories for PFP and tasked to indicate where their maximum willingness to pay falls. The results revealed that, 99.6% of the inhabitants were willing to a pay different categories of premiums to obtain Pesticide Free Products. Majority of the households representing 26.2% were willing to offer a premium of between 1.05 cedis to 1.5 Ghana cedis for PFP. The second majority were those willing to pay 0.55-1 cedis as a premium representing 22.8% of the sample interviewed and the least premium category being 2.05-2.5 Ghana cedis. However, 0.4% of the sample were not willing to offer any premium for pesticide free products. Table 5.4 shows the details distribution of the various willingness to categories.

Table 5.5: Distribution of premium categories

Premium category(GH₵)	Frequency	Percentage
No premium	2	0.4
0.05-0.5	103	20.6
0.55-1.0	114	22.8
1.05-1.5	131	26.2
1.55-2.0	86	17.2
2.05-2.5	64	12.8
Total	**500**	**100**

Source: Authors Survey, 2017

5.2 Ordered Probit Estimation Result

Willingness to pay as mentioned earlier are influenced by socioeconomic factors of the respective respondents. In view of this, an Ordered Probit regression model was used to analyze responses from the survey to ascertain those factors. Prior to the regression analysis, the variables were subjected to a series of test and data cleaning to avoid spurious result which could be misleading.

5.2.1 Multicollinearity Test

The study employed both pair-wise correlation and Variance Inflation Factor (VIF) tests to investigate whether there exist multicollinearity among the explanatory variables in the model. According to Stock and Watson (2011, pp 199), multicollinearity exist when one regressor of the model are highly correlated or linear to other regressors. Multicollinearity is assumed to be an issue in the model when the pair-wise correlation coefficient is higher or equal to 0.8 (Gujarati, 2006 pp.372). In line with this, a correlation matrix was used to verify the multicollinearity problem in the model. The result of the test revealed that, the model is devoid of multicollinearity problem (see: Appendix B). To ensure the robustness of the test, the study conducted Variance Inflation Factor (VIF) to confirm the pair-wise correlation test. The result of VIF test indicates there is no multicollinearity among the variables. According to Michael, Hussaini and Agboola (2015),

multicollinearity is said to exist if the VIF is above 5. The highest VIF factor in the model is 2.21 which is far below the threshold of 5 (See Appendix C).

Table5.6: Result from Ordered Probit Model

Regressand/Dependent Variable=WTP

Explanatory Variables (X)	**Coefficient**	**Std. Error**	**P-Values**
Respondent permanent place of residence(Locality)			
Osu Klottey **(Categorical variable)**	-2.158562***	0.1776000	0.000
Tema West **(Categorical variable)**	-2.110164***	0.1928529	0.000
Environmental Consciousness of respondent **(Categorical)**	0.2558327***	0.0935755	0.006
Sex of respondent **(Male=0, Female=1)**	-0.0839222	0.1031057	0.416
Age of respondent **(Continuous variable)**	0.0060048	0.0454268	0.895
Household income **(Continuous Variable)**	0.1469816**	0.0665087	0.027
Household size **(Continuous variable)**	0.0194534	0.026177	0.457
Number of aged persons in household **(Continuous variable)**	-0.1686542*	0.0876719	0.054
Monthly average expenditure on food items **(Continuous variable)**	-0.1674621**	0.0658407	0.011
Respondent highest level of education (**Categorical variable)**	0.3042352**	0.1295704	0.019
Employment status of respondent **(Employed=1, Unemployed=0)**	-0.5719704**	0.233995	0.015
Frequent shopping place of respondent **(Categorical variable)**	0.0985037	0.1315355	0.454
Respondent belonging to association that educate food safety **(Yes=1, No=0)**	0.1894403*	0.1091375	0.083
Respondent previous knowledge on PFP**(Yes=1, No=0)**	-0.1321502	0.1145368	0.249
Cut1	-4.479206		
Cut2	-2.430342		
Cut3	-1.631946		
Cut4	-0.6500109		
Cut5	0.489790		
Log Likelihood		-643.7558	
LR chi2 (14)		313.93	
Pseudo R2		0.196	
Prob>chi2		0.0000	

*significant at 0.10 level, **significant at 0.05 level, ***significant at 0.01 level

Source: Author's Estimation, 2017

From table 5.6, the null hypothesis that, the variables jointly have no significant impact on willingness to pay is rejected at 1% significance level since prob>Chi2 =0.0000 is less than 0.01 in the model. Thus we conclude that, all explanatory variables jointly are not equal to zero and hence have significant impact on WTP. The value of Pseudo R^2 being equal to 0.196 implies that, the explanatory variables fits the Ordered Probit model by 19.6%. According to Woodridge (2006), less significance is attached to 'goodness of fit' as compared to statistical and economic significance of the explanatory variables. Out of the 14 explanatory variables used, 11 of them had the expected signs but only 9 of them were significant. The variables which were found not to be significant include; sex of respondent, age of respondent, household size, shopping at the mall/super market and previous knowledge on PFP. Thus, these variables do not influence willingness to pay for PFP in this particular study.

Respondent permanent place of residence were statistically significant at 1% level of significance with anticipated negative signs. This is a categorical variable with Ayewaso West Wagon used as a reference variable. The result showed that, living in Osu klotey and Tema West Sub-Metros classified as middle and lower income areas respectively have the likelihood of decreasing willingness to pay of an individual as compare to those in upper income areas (Ayewaso West Wagon). This thus, confirms the findings of Cranfield and Magnusson (2003) that being in upper income band increases willingness to pay.

Environmental consciousness of respondents is also highly significant at 1% significance level with the anticipated positive sign. This implies that, individuals who value and recognizes the significance of a clean and healthy environment to human health and also its contribution to sustainable agricultural practices have the likelihood of paying more for PFP. The result from this studies confirms the findings from Doorn (2010) and Wiser (2003) that environmentally conscious

households have higher probability of WTP for PFP than those who are not environmentally conscious. Furthermore, the result confirms the findings from Botonaki et al. (2006) that households with health consciousness have higher WTP values for PFP than those the opposite side. Thus, respondents who are concerned about the effects of pesticides on their health and the environment and therefore seek information on the products they consume, have a higher probability of offering higher premiums to avoid it.

Furthermore, household income of respondents is significant at 5% significance level with the anticipated positive sign. The positive sign implies that, an increase in household income have the likelihood to increase willingness to pay of an individual or household. Stated otherwise, an increase in household income increases the likelihood of households' offering higher premium for PFP. The result from this study confirms the findings from Mantey, (2013); Anifori, (2009) and Abdullah and Marriel, 2010) that, income status of households is imperative in determining the premium they place on an improved service. Food is a normal good and thus, the result further confirmed economic theory which hypothesizes a positive relationship between income and normal goods.

Number of aged persons in a household is significant at 10% significance level. However, it did not have the expected positive sign indicated in chapter four of this study. The negative sign posit that, households with large number of persons aged 65 years and above are less likely to offer higher premiums for pesticide free products. This result confirms the findings from Anifori (2009) that persons with age above 65 years are less likely to pay higher premium for pesticide free product. This may be attributed to the fact that households with large number of aged persons have budgetary constraints since they may be already spending a lot on their up keep and more especially to household with less employed persons. Another plausible reason for the negative relationship is

that, persons above 65 years of age are not within the economically active group and thus increase the dependency ratio of the household (Napolitano, 2010)

Another important variable in this study is average monthly expenditure on food items. This is statistically significant at 5% significance level with the expected negative sign. The negative sign here implies that, household with already higher expenditure on food items have the likelihood to offer less premiums for pesticide free products. This may be attributed to the fact that, the household is already facing budgetary constraints due to huge expenditures on food products. The result concurs with the findings from Siddiqi (2009) that the current cost of maintaining or consumption influences the WTP of households. Furthermore, the results concurs with the findings from Urutyan (2007) that households with huge financial commitments in other areas of the household's up keep will have less probability of willingness to pay for improved service.

Respondent's highest level of education is statistically significant at 5% significance level with the anticipated positive sign. This implies higher level of education has positive influence on willingness to pay of an individual for PFP. As an individual's level of education increases, he is more inclined and appreciates the impact of pesticides on environment, health and agricultural productivity and thus, more likely to offer higher premium for pesticide free products. The result from this study concurs with findings from Mantey (2013); Twerefour et al. (2015); and Boccaletti & Nardella (2000) that higher level of education influences positively the amount an individual pays for utilities and products.

Employment status of respondent is significant at 5% significance level. However, it did not have the expected positive sign. The negative sign indicates that, persons who are employed and are assured of constant flow of income are more likely to pay lesser premiums for pesticide free products. The result in this study confirms the findings from Eslamian (2016) that employed people

have less (negative) WTP for preservation and reclamation services as compared with those without jobs. This may be attributed to the fact that due to financial constraints and fear of hospital bills, unemployed people prefer prevention rather than cure.

Respondent belonging to an association that educates its members on food safety is also significant at 10% significance level with an expected positive sign. The positive sign implies that, belonging to an association that educates its members on food safety have the likelihood of increasing willingness to pay of an individual. This result concurs with the findings from Elcin (2013) that groups with education for its members increases WTP for improved services. This may be attributed to the fact that, educating individual on the dangers of pesticides residues in food and the need for clean environment makes him/her more inclined and thus increases his willingness to pay for pesticide free product to avoid the potential negative impacts.

Though, interpreting the signs of the variables from an ordered probit model is very vital, however, the coefficients does not indicates the magnitude of impact those variables have on willingness to pay. The reason being that, an ordered probit model is non-linear and thus its estimated coefficients does not reflect the marginal impacts. In view of this, there is the need to estimate marginal effects which gives better interpretation of coefficients from an ordered probit model. The marginal effect attributed to the change in any explanatory variable is the partial derivative of the possibility of each outcome of the regressand with respect to the explanatory variable concerned. Change in probability resulting from a change in any of the explanatory variables is termed as marginal effect. Thus, a change in the probability of household willingness to pay for pesticide free products resulting from any of the explanatory variables is the marginal effect. One vital thing that is worth mentioning is the summation of all the categories of willingness to for a particular variable equals to zero.

Table 5.7 shows the predicted probabilities for all six categories of WTP estimated at the sample means and marginal effects of the explanatory variables on those predicted probabilities. The result of the predicted probabilities indicates clearly that, on average consumers are willing to pay a premium of a sort to obtain pesticide free products. However, taken the predicted probabilities a lone does not give enough information concerning the relationship between the explanatory variables and these predicted probabilities. In view of this, the study estimated marginal effects to show the impact of a unit change in the explanatory variables on each of the predicted probabilities. The result from the predicted probabilities further shows that, an average consumer's willingness to pay increases from zero premium to ₵ 1.28 after which it takes a nose dip.

Another important issue in this study has to do with the interpretation of the marginal effects of binary and continuous variables. The marginal effect of a unit change in a continuous variable on the predicted probability will decrease or increase it equal to the magnitude of the marginal effect. With regards to a binary variable, the marginal effect is the change in the predicted probability grounded on whether a respondent fits into the category or not (Cranfield & Magnusson, 2003; and Whitehead, 2005).

Table 5.7: Estimated marginal effects from Ordered Probit model and Predicted probabilities

	WTP=0	WTP=0.275	WTP=0.78	WTP=1.275	WTP=1.78	WTP=2.27
Predicted Probabilities	**0.0053**	**0.2072**	**0.2186**	**0.2615**	**0.1819**	**0.1255**
Respondent permanent place of residence(Locality)	0.0023943	0.177595	0.117861	-0.044951	-0.152189	-0.1007112
Environmental Consciousness of respondent	-0.001014	-0.075212	-0.0499144	0.0190367	0.0644522	0.0426514
Sex of respondent	0.0003442	0.025842	0.0173923	-0.006311	-0.02231	-0.0149578
Age of respondent	0.0002166	0.016064	0.0106609	-0.004066	-0.013766	-0.0091096
Household income	-0.000687	-0.050924	-0.033796	0.0128893	0.0436391	0.0288783
Household size	0.0000185	-0.001369	-0.0009088	0.0003466	0.0011735	0.0007765
Number of aged persons in household	0.0005288	0.039224	0.026031	-0.009928	-0.033613	-0.0222433
Monthly average expenditure on food items	0.0005162	0.0382863	0.0254087	-0.009691	-0.032809	-0.0217115
Respondent highest level of education	-0.000392	-0.029094	-0.0193083	0.0073639	0.024932	0.0164988
Employment status of respondent	0.0009394	0.0940818	0.084701	0.0004578	-0.094336	-0.0858439
Frequent shopping place of respondent	-0.000582	-0.047675	-0.0349364	0.0089951	0.043091	0.0311081
Respondent belonging to association that educate food safety	-0.000767	-0.060544	-0.043246	0.0122869	0.0539206	0.0383492
Respondent previous knowledge on PFP	0.000393	0.002899	0.0019152	-0.000741	-0.002478	-0.0016345

Source: Author's Estimation, 2017

Analysis of the marginal effects shows that, respondents who live in Osu Klottey and Tema West sub metros are more likely to pay a premium between 0.28 pesewas to 0.78 pesewas for pesticide free products and less likely to pay higher premiums between 1.28 cedis to 2.27 cedis as compared to residents in Ayewaso West Wogan. Stated otherwise, living in Osu klottey and Tema west Sub Metros increases the predicted probabilities of WTP for lower premium values and decrease the probability of WTP higher premium values. For instance, living in Osu Klottey or Tema West Sub

Metros decreases the probability of paying ₵2.27 premium for PFP by 10% and increases the probability of paying 0.78 pesewas premium by 11.8%. This is not surprising because residence in those areas are classified as middle and lower income class respondents as compare to those in Ayewaso West Wagon.

Being environmentally conscious increases the probability or likelihood of willingness to pay for higher premium values. Specifically, being environmentally conscious or friendly increases the probability of willingness to pay (WTP) a premium of ₵2.27 by 4.3% and deceases the willingness to pay a lesser premium of 0.28 pesewas by 7.5%. The marginal effects are stronger for higher premiums than lower premiums. This confirms the findings from Doorn (2010) that environmentally conscious households have higher premiums than those who are not. This is attributed to the fact that, respondents who value a clean environment will be more than prepared to pay any amount to maintain it. As the scale of being environmentally conscious increases, the probability of willingness to pay lesser premiums decreases.

Marginal effects for household income also showed positive values for higher incomes and negative for lower values. This implies that, households with higher income increase the predicted probability for willingness to pay higher premiums and decreases the likelihood of willingness to pay lesser premiums. The result from the estimated marginal effects showed that, a 1% increase in household income increases the probability of willingness to pay a premium of ₵2.25 by 2.9% and decrease the predicted probability of willingness to pay a premium of 0.28 pesewas by 5.1%. Holding all other variables constant, higher household income increases the likelihood of willingness to pay higher premiums and decreases the probability of willingness to pay lesser premium for pesticide free products. This result concurs with the findings from Gaetano (2002) that, higher income increases the likelihood of WTP for PFP.

Marginal effects for number of aged persons in household depicted positive values for lesser premiums and negative values for higher premiums. This implies that, all other things being equal, for households with large number of aged persons, the likelihood of willingness to pay higher premiums for pesticides free products decreases but increases with lesser premiums. The result revealed that, having a larger number of aged persons in a household increases the probability of willingness to pay 0.78 pesewas by 2.6% and decreases by 2.2% for a premium of ₵2.27 holding all other things constant. This may be attributed to the fact that, households with larger number of aged persons may be facing budget constraints due to other commitment to their health but pesticide free improves health inclusively.

Furthermore, the marginal effects for household monthly expenditure on food items showed positive for lesser premiums and negative for higher premiums. All things being equal, the likelihood of willingness to pay ₵2.27 premium decreases by 2.17% but increases by 2.5% for a premium of 0.78 pesewas. The reason could be that, households are already incurring huge expenditures on food items and are less likely to pay higher premiums for pesticides free food products. This result, is not surprising as it was expected. The results further confirms the findings from Siddiqi (2009).

Marginal effects for educational variable recorded negative values for lesser premiums and positive for higher premiums. This implies that, holding all other things constant, highly educated respondents have the likelihood of paying higher premiums for pesticide free food products than respondents with no formal education. The likelihood of willingness to pay ₵2.27 as a premium increases by 1.6% for respondents with higher education but decreases the likelihood of willingness to 0.78 pesewas by 1.9%. This result concurs with the findings from Lea (2005) that education increases the probability of willingness to pay. The result is expected because, educated persons are

better placed to know the consequences of pesticide residues on their health and thus, will be ready to pay any amount to avoid its impact.

Marginal effects for respondents who belongs to an association that sensitizes its members on food safety showed positive values for higher premiums and negative values for lower premiums. This implies that, the probability or likelihood of unwillingness to pay higher premiums decrease for persons who are sensitized and increases for those who not sensitized. Analysis of the data further revealed that, being sensitized increases the predicted probability of willingness to pay ₵2.27 as premium by 3.8% and decreases the probability of willingness to pay for 0.28 pesewas as premium by 6%. This is in line with the anticipated signs and impacts and therefore, not surprising.

5.4 Estimation of Total Willingness-To-Pay and Total Revenue

This section of the study make use of extrapolations based on the data collected through contingent valuation survey on willingness to pay for pesticide free yam, cabbage, tomatoes, plantain and lettuce. The prevailing average price on a tuber of yam, a tin of tomatoes, a unit of cabbage, three sizable fingers of plantain and bunch of carrot produced using the conventional method was GH₵ 5.00 as at the time of the study. Respondents were then presented with a range of premiums and tasked to indicate their WTP category using the GH₵ 5.00 as a baseline.

Table 5.8: Maximum WTP Premium descriptive statistics

Maximum WTP	Minimum WTP	Mean WTP Premium	Std. Deviation
2.27	0.00	1.28	0.6698

Source: Author's computation

Table 5.8 shows the descriptive statistics for the indicated WTP premiums. Analysis of the data revealed that, mean (average), minimum and maximum willingness to pay premium for the selected PFP products are GH₵0.00 and GH₵2.27 respectively. This therefore implies that, on average

households within Accra-Tema Metropolis are prepared to pay GH₵1.28 as a premium per unit of the selected pesticide free products (yam, cabbage, tomatoes, plantain and lettuce). The mean WTP premium by households represents 17.5% increase on the original price of GH₵ 5.00. The total amount of households' willingness to pay to avoid the negative consequences associated with pesticide residues crops is the cost of consuming those products. Therefore, economic cost of consuming pesticide residue products is equal to the total amount households within the Accra-Tema Metropolis are prepared to pay for the non-pesticides residue products. In statistical analysis, a well-represented sample mean is used to extrapolate for the population. In line with this, the study employed mean WTP to extrapolate for Accra-Tema Metropolis population. However, the calculation in this study will be in two categories. First part will calculate the accrued revenue from the indicated additional WTP premiums whiles the second part calculates total TWP. The reason being that, total revenue from the indicated additional premiums serve as a good indicator for PFP market potential.

The estimated number of households in the District Analytical report for Accra-Tema Metropolis by Ghana Statistical Service, using 2010 population and housing census data stood at 599,552 (GSS,2015). Analysis of the data collected through the contingent valuation survey revealed that, average household monthly expenditure on food items is ₵336.353. To arrive at the quantity of the products consumed by a single households in the Accra-Tema Metropolis, average monthly cost is divided by cost per unit (₵5) as mentioned earlier. Thus, 336.353/5 = 67.27 units per household. The quantity here could be a single or mixture of those products selected. The result from the survey showed that, 0.4% of the household are unwilling to pay any premium. By extrapolation, the remaining households that are willing to pay a premium is 597,154.79 (ie.599,553 - 0.4%

*599,553). The total number of units consumed by all the remaining 597,154.79 households is calculated below.

= 597,154.79*67.27

= 40,170,602.72 units

5.4.1 Total Economic Cost of Consuming Pesticide Residue Products.

Economic theory of valuation posit that, total willingness to pay for an improved service or product signify economic cost of consuming the status quo. Thus, total willingness to for pesticide free products represents economic cost consuming products containing pesticide residue.

Using the mean WTP premium from the sample survey to signify the population mean WTP, then total willingness to pay premium could be extrapolated as;

TWTP*= mWTP1 X N …….. (5.4)

Where;

TWTP* is Total willingness to pay premium revenue, mWTP* is population mean willingness to pay premium for pesticide free product and N is total quantity of the selected products consume by households in Accra-Tema metropolis. By substitution, equation 5.1 yields

TWTP*= 40, 170,602.72 X 1.28

= GH₵51,016,665.45 per month

= GH₵612,199,985.45 per annum

This results implies that, residents in Accra-Tema Metropolis are willing to pay additional monthly premium of ₵51,016,665.45 or ₵612,199,985.45 annually as premium to avoid pesticide residue

products. This demonstrate the extent to which Ghanaians have recognize the negative impacts of pesticides on the environment and human health and their readiness to avoid that canker. Moreover, total revenue from premiums also indicates the market potential for pesticide free products within the metropolis.

5.4.2 Total Revenue from Willingness to pay

The study in this section, computes total revenue that accumulates to each category of the willingness to pay premiums. Furthermore, this section also make extensive use of extrapolations. Mean WTP from the sample survey is used to proxy population mean for Accra-Tema metropolis. This is different from mean WTP premium (see table 5.8)

Table 5.9: Computation of total WTP and Revenue at Different Premium Categories

WTP Category	No. of HHs	% of sample	Share of households	Cmmulative number of household	Total units of products consumed monthly	Monthly Total Revenue per WTP Categories
A	**B**	**C**	**D=C*597,154.79**	**E**	**F=E*67.27**	**G=F*A**
0.00	2	0.4	2,397.21	**2,397.21**	**161,260.32**	**0.00**
5.28	64	12.8	76,742.78	79,139.99	5,323,747.13	28,109,384.85
5.78	86	17.2	103,123.12	182,263.11	12,260,839.41	70,867,651.79
6.28	131	26.2	157,082.89	339,346	22,827,805.42	143,358,618.04
6.78	114	22.8	136,698.08	476,044.08	32,023,485.26	217,119,230.06
7.27	103	20.6	123,507.92	599,552	40,331,863.04	293,212,644.30
Total	**500**	**100**	**599,552**			

Source: Author's Computation

Table 5.9 shows total revenue for each category of WTP in Accra-Tema Metropolis. The is estimated to serve as a blue print for investors who are determine to endeavor into producing

pesticide free products and the revenue that will accrue to the company at the different prices per unit. The result revealed that, the least willingness to pay category (₵5.28) gives a revenue of GH₵ 28,109,384.85 whiles the highest willingness to pay category (7.27) produces an amount of GH₵ 293,212,644.30 as revenue. However, it is important to note that, the indicative revenues figures are based on the PFP hypothetical scenario on the selected products described in the Contingent valuation survey of this study. It is also important to mention that, this study is not the first of its kind to have employed this methodology to come out with indicative revenue for an improved hypothetical product or service. Similar studies by Whitehead (2005) for improved water and electricity, Mantey (2013) for an improved electricity and Mensah (2011) also employed the same techniques.

5.6 Chapter conclusion

The chapter analyzed and discussed the result from the contingent valuation survey for pesticide free products in Accra-Tema Metropolis. The study found that, 99.6% of the respondents in the sample surveyed are willing to pay different categories of premiums to obtain pesticide free products. The minimum and maximum WTP categories indicated by respondent are ₵5.27 and 7.27 respectively. The study also found that, economic cost of consuming pesticide residues products by households in the Metropolis is about ₵51,016,665.45 monthly or ₵612,199,985.45 a annually.

Furthermore, ordered probit regression result showed a positive relationship between WTP and household income, environmental consciousness, education and association membership with food safety education programmes. This implies that, these socioeconomic variables of households increases the probability of willingness to pay for PFP.

The ordered probit regression result also showed a negative relationship between WTP and household monthly expenditure on food items, employment status and number of aged persons in a household. The implication here is that, these variables decreases the probability of WTP for PFP.

CHAPTER SIX

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

This chapter presents summary of the whole study and draws conclusion. The chapter also looks at policy recommendations from the findings.

6.1 Summary of the study

The contribution of safe and healthy food to human resource development cannot be underestimated. The popular saying that, a healthier nation is a worthy nation attest to the crucial importance of safe and healthy food in economic development of every country. In view of this, there had been renewed interest by individuals, households, civil society groups, consumers associations and governments concerning pesticide residues in vegetables and tubers. The economic cost associated with the consumption of pesticide residues products are enormous. Firstly, the number of labour hours lost due to ill health impacts negatively on productivity and hence gross domestic product. The study by Pesticide Action Network (2012) found that, cotton and cowpea farmers in Ghana whose health are affected by pesticides loses on average 15-21 days off work in a year, translating into $17-35 in monetary equivalence. Notwithstanding this, the amount of money the Government of Ghana commits into taking care of people with pesticides illness post a huge cost to the nation. These monies could have been channeled into any productive sector of the economy.

Furthermore, one cannot speak about the impacts of pesticides without touching on its negative consequences on the environment. Sustainable development cannot be guarantee in areas where sustainable agricultural practices are ignored. The impacts of pesticides on the soil and other ecosystems leaves much to be desired. This raised a lot of concerns by all well-meaning Ghanaians on the upsurge of pesticide usage and the economic cost associated with its application. It is in line

with this that, this study investigated the economic cost of consuming products containing pesticide residues in the Accra-Tema Metropolis and how much they are willing to pay for pesticide free products. The study also sought to know the factors that influence households' willingness to pay for pesticide free products.

A review of existing empirical literature revealed that, factors such as age, sex, income, environmental consciousness, educational level of respondents, geographical location and among others variables influence willingness to pay for PFP by households. Especially, individuals who are environmentally conscious recognizes the impact of pesticides on the environment and the economic cost associated with its application. With regards to the methodology for the topic under study, Contingent Valuation Method prove to be the best among other available elicitation techniques. In view of this, Contingent Valuation Methods was employed to unearth the willingness to pay by households for pesticide free products. Again, a review of similar studies on WTP for pesticide free product from all parts of the world showed that, consumers are willing to pay a considerable amount of premium to avoid the impact of products with pesticide residue.

Furthermore, the study also presented an overview of pesticide management in Ghana. The overview showed that, Ghana is committed to regulating pesticide imports and usage according to internationally accepted standards. This was made evident through the enactment of several laws including the constitution of Ghana on pesticides application, imports and distribution are supposed to be carried out. The review also showed that, there exist enough rigorous legal framework for pesticide import, export, distribution and application management but the problem has to do with enforcement of the laws by constitutionally mandated institution. The low enforcement rate has been attributed to inadequate logistics and human resources. Added to the above was inadequate education and sensitization of citizens on the negative impacts of pesticides and the best application

practices. Farmers are not educated enough on best pesticide application and disposal techniques which post a great danger to the farmers. The study also discovered through the review that, most of the band pesticides are still in massive use and thus, post a potential threat to food safety in the country.

The study employed a contingent valuation technique to elicit information from respondents concerning pesticide free products. A hypothetical scenario on pesticide free product and its benefits was described to respondents and thereafter, were tasked to indicate the premiums they were willing to offer to avoid pesticide residue products. The estimated average premium to using willingness to pay data from survey and also extrapolated to revenue that will accrue from PFP production as well as economic cost of consuming products with pesticide residues. However, the premium mentioned above might not be guarantee if the characteristics of any pesticide free deviates from the one prescribe in the hypothetical scenario.

6.2 Conclusion

The study found that, majority (97.6%) of the inhabitants in the Accra-Tema metropolitan areas had knowledge on the negative impacts of pesticides use in food production.

Findings from the study showed that, consumers are really feeling the impacts of pesticides residue products and are ready to pay significant premiums PFP products which are devoid of pesticides residues. Specifically, an average premium of GH₵ 1.28 for PFP. Extrapolating using information from the survey indicates that, the economic cost of consuming products with pesticide residues by inhabitants in the Accra-Tema metropolitan areas is GH₵612,199,985.45 per annum.

Analysis of the determinants of willingness to pay for PFP using an ordered probit model revealed that, income of household, education, environmental consciousness and being a member of

association increases the likelihood of paying higher premiums whiles current monthly average expenditure on food, employment status, residing in low income areas and number of aged persons per household decreases the likelihood of paying.

6.3 Policy Recommendations

Based on the findings of this study, the following policy recommendations are therefore suggested.

1. Government of Ghana through ministry of Food and Agriculture should advocate for the adoption of pesticide free production techniques since households within Accra-Tema Metropolis demonstrated their willingness to pay for the products. In view of the varied agronomic practices that are required in pesticide free technology, government of Ghana should train enough agricultural extension officers to assist existing and new farmers willing to in the production of PFP.
2. The result of the study revealed that, people in upper income class have higher premiums as compared to those in middle and lower income class. The study thus, recommends that, there should be general increase in income and producers should also develop a market niche to target upper income class consumers in order to increase revenue from PFP products.
3. Findings of the study showed higher likelihood of willingness to pay for PFP and environmental consciousness. The study thus, recommends that intensive educational and sensitization programmes on importance of maintaining a clean and healthy environment should be carried out by Environmental Protection Agency (EPA) and all constitutionally mandated bodies. Again farmers should also be educated on the importance of using sustainable agricultural farming techniques.

4. Higher average monthly expenditure on food by households decreases the likelihood of willingness to pay for pesticide free product. The study recommends that, food inflation in the economy should be tackled with all the urgency it deserves.
5. The study also revealed that, higher household income increases the likelihood or probability of WTP for PFP. Considering the fact that most of Ghanaians are in the informal sector, government should embark on measures that will provide enabling environment for small and medium scale enterprises to thrive. In this regard, jobs opportunities will be created for the unemployed which will increase household incomes. With regards to those in the formal sector, the study recommends an increase in minimum wage and salaries of public sector workers.
6. Educational variable showed that, people with higher level of education increases the likelihood of WTP for pesticide free product. It is thus, recommended that actors in educational sector should design a new policy that permits higher learning. More scholarships should be offered to encourage higher learning alongside making Senior High Secondary and Junior High Schools compulsory for every Ghanaian child. Again, non-formal education in the country should be promoted with component on environmental cleanness.
7. The study also revealed that, associations with food safety education for its members increases the likelihood of WTP for PFP. It is recommended that, most associations should embark on food safety programmes that will increase members' awareness on the negative impacts of consuming products with pesticide residues.

6.4 Limitations of the study

The major limitation of the study has to do with the cost of producing pesticide free products. The study did not investigate how much it will cost producers to bring pesticide free products onto the market. Though the study recommended the use of price description and market niche for upper income class households but research on how to adopt the price description has not been done. Another significant limitation of the study is that, the data used covers only 500 households with Accra-Tema Metropolis. However, revenue from pesticide free products was calculated for all the households in the metropolis. The limitation in this regard has to do with financial and time constraints.

6.5 Recommendations for future studies.

This study established that, households are willing to pay for pesticide free products, it is therefore recommended that future studies be conducted into farmers' willingness to adopt the new proposed technology which involved a lot of agronomic practices. Furthermore, a research should also be conducted into the total cost of producing pesticides free products. Even though that will not reflect the true cost but will serve as a good indicative figures for planning.

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Appendix A: Contingent valuation survey questionnaire

CONTIGENT VALUATION SURVEY

GEOGRAPHICAL INFORMATION

Enumeration Area/ Community…….

House Number ……..

Date of Interview ……..

Enumerators Code ……..

INTRODUCTION

Please, my name is ……., an enumerator from the University of Ghana assisting in data collection for an ongoing research by Mr Konde Jein Joshua as part of the requirement for the award of MPhil Economics Degree. We are interviewing a sample households in the Accra-Tema Metropolis with the prime objective of estimating the WTP for Pesticide Free Food Products in the metropolis. I would be very grateful if you could support this research by completing this questionnaire and your candid response will be very much appreciated. You are assured of anonymity of your identity and confidentiality of your response.

SECTION ONE: WILLINESS TO PAY

HYPOTHETICAL SCENARIO

In this section, I would like to know how much you value in monetary terms, the consumption of food product which is devoid of pesticides residues. Pesticide Free Products (PFP) are grown using pure agronomic techniques and are not treated with pesticides during the growing season and whiles in storage. Other pest control methods are used such as competitive crop varieties, natural pest enemies, and crop rotation. No pesticides are applied from the time the crop is planted through to harvest, storage and sale of the crop. In addition, such crops cannot be grown where previous pesticides application are considered to still be active. Unlike food from the conventional production methods, PFP has the potential to alleviate the problems of pesticide residues in food, environment and danger they post to human health.

NOW TAKE TIME AND ASK THE WTP QUESTIONS

C1. Do you always make food safety a priority when shopping?

Yes ( ) No ( )

C2. Have you previously heard of or read any news report about PFP?

a) Yes ( ) b) No ( )

C3. Will you prefer to buy a PFP food product over conventionally produced food products if they were of the same taste, price and nutritional content?

a) Yes, I would buy a PFP food product
b) No, I would not buy a PFP food product
c) I do not know/ not sure
d) I would need more information/ experience with the PFP food product

C4. Suppose your favorite food product regularly costs GhȻ 5 for each unit you purchase. Let us assume there is no difference in taste and nutritional content, would you pay slightly more for a PFP version of the same food product?

a) No ***(If no, then skip to section two)***
b) Yes, I would pay between 0.05-0.5 pesewas **(ie.1% to 10%)** more for the PFP version
c) Yes, I would pay between 0.55-1.0 cedis **(ie. 11% to 20%)** more for the PFP version
d) Yes, I would pay between 1.05-1.5 cedis **(ie. 21% to 30%)** more for the PFP version
e) Yes, I would pay between 1.55-2.0 cedis **(ie. 31% to 40%)** more for the PFP version
f) Yes, I would pay between 2.05-2.5 cedis **(ie. 41% to 50%)** more for the PFP version

SECTION TWO: ATTITUDINAL QUESTIONS ON THE USE OF PESTICIDES

***Please indicate how you feel about the following statements*.**

	Select one response per statement				
Q1.I feel the use of synthetic chemicals/pesticides in agriculture has a negative effect on the environment	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree
Q2. I am concerned about pesticide residues in our food supply	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree
Q3. I feel a lot of food-borne illness in recent times emanates from pesticides residues.	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree
Q4. The labeling of food ingredients on food packaging is important to me.	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree
Q5. I believe farmers should engage in sustainable agricultural production practices. That is, practices which adopt the goal of ensuring the productive future of agriculture, the	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree

environment and the economy of rural communities.					

Q6. If PFP food product were available at the same price and with no difference in taste would your consumption of the conventionally produced food product be reduced?

Yes ( )

No ( )

SECTION THREE: INSTITUTIONAL CAPABILITY QUESTIONS

Q1. Please indicate your primary source of information regarding food safety

a) Radio, television ( )
b) Newspapers, popular magazines ( )
c) University academic report ( )
d) Government food safety programmes (eg Food & drugs authority) ( )
e) Friend's word of mouth ( )
f) Other ……..

Q2. Do you belong to any association?

a) Yes ( ) b) No ( )

Q3. Does the association educate its members on food safety?

a) Yes ( ) b) No ( )

Q4. Have you ever received education or sensitization on the effects of pesticides on the environment and human health from any the following government institutions? FDA, EPA, MOE, MOFA, NCCE, MOH etc.

a) Yes No ( )

Q5. Do you think Ghanaian institutions mandated to control and manage the import, licensing and sale of pesticides in Ghana are executing their job well?

a) Yes ( ) No ( )

SECTION FOUR: SOCIO-ECONOMIC INFORMATION OF RESPONDENT

Q1.Sex of respondent. Male ( ) Female ( )

Q2. Age of respondent in completed years. Less than 18 ( ) 18-25 ( ) 26-35 ( ) 36-45 ( ) 46-55 ( ) 56 and above ( )

Q3. In what range does your **household** monthly income fall?

a) Less than 300 Ghana cedis ( )
b) 300-400 Ghana cedis ( )
c) 450-550 Ghana cedis ( )
d) 600-700 Ghana cedis ( )
e) 750-850 Ghana cedis ( )
f) 900-1000 Ghana cedis ( )
g) 1050-2000 Ghana cedis ( )
h) Above 2000 Ghana cedis ( )

Q4. Please indicate your marital status

a) Married ( )
b) Divorce ( )
c) Never Married/single ( )
d) Separated ( )
e) Consensual Union ( )
f) Widow/Widower ( )

Q5. What is your religion?

a) Christianity () d) Spiritualist ( )
b) Islam () e) No religion ( )
c) Traditional () f) Other, ( ) Specify, ……

Q6. Are you employed?

a) Yes ( ) b) No ( )

Q7. Household size ……

Q8. Number of aged (66 years and above) in the household ……

Q9. Please indicate the ethnic group you belong

a) Akan ( ) f) Mole Dabgani ( )
b) Guan ( ) g) Grusi ( )
c) Mande ( ) h) Ewe ( )
d) Ga/Dangme ( ) i) Other ( )
e) Gruma ( )

Q10**.** Highest Level of Education:

a). Tertiary ( )
b). SSCE/WASSCE ( )

c). JSS/JHS ( )
d). No formal education ( )

Q11. Where do you normally shop?

a) Traditional Market ( )
b) Super Market ( )
c) Mall ( )

Q12. What is your average monthly expenditure on food products?

i) 20-50 Ghana cedis ( )
j) 100-200 Ghana cedis ( )
k) 250-350 Ghana cedis ( )
l) 400-500 Ghana cedis ( )
m) Above 500 Ghana cedis ( )

THANKS VERY MUCH FOR YOUR KIND CORPORATION

Appendix B: Pair-wise correlation results

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. corr LOCALITY ENVCONCIOUSNESS SEX AGE HHSINCOME HHSSIZE NUMAGED MEXP EDUCATION EMPLSTATU
> S SHOPPING1 ASSEDU3 PREVIOUSINFOR
(obs=500)
```

	LOCALITY	ENVCON~S	SEX	AGE	HHSINC~E	HHSSIZE	NUMAGED	MEXP
LOCALITY	1.0000							
ENVCONCIOU~S	-0.0454	1.0000						
SEX	0.2188	-0.0544	1.0000					
AGE	-0.0256	-0.0551	-0.1369	1.0000				
HHSINCOME	-0.3545	-0.0915	-0.1949	0.2091	1.0000			
HHSSIZE	-0.0050	-0.0480	0.0176	0.2151	0.1748	1.0000		
NUMAGED	-0.0606	-0.1111	-0.0095	-0.0031	0.0284	0.3125	1.0000	
MEXP	-0.0773	-0.3162	-0.0755	0.2953	0.6118	0.3472	0.0655	1.0000
EDUCATION	-0.4829	0.0383	-0.2142	0.0406	0.3534	-0.0364	-0.0279	0.1962
EMPLSTATUS	-0.2781	0.0825	-0.0694	0.0215	-0.0045	-0.0902	-0.0568	-0.0277
SHOPPING1	-0.3621	0.0815	-0.0718	-0.0210	0.3130	0.0226	0.0091	0.1400
ASSEDU3	0.0217	0.2310	-0.0259	-0.0080	0.0287	-0.0455	0.0263	-0.0907
PREVIOUSIN~R	0.1953	-0.1974	-0.0179	-0.0075	0.0491	0.0824	0.0842	0.1856

	EDUCAT~N	EMPLST~S	SHOPPI~1	ASSEDU3	PREVIO~R
EDUCATION	1.0000				
EMPLSTATUS	0.7213	1.0000			
SHOPPING1	0.2851	0.0755	1.0000		
ASSEDU3	-0.0722	-0.0852	0.1691	1.0000	
PREVIOUSIN~R	-0.1558	-0.2142	0.0679	0.0421	1.0000

Appendix C: Variance Inflation Factor Test Result

vif

Variable	VIF	1/VIF
MEXP	2.21	0.453235
HHSINCOME	2.14	0.467341
LOCALITY	1.87	0.534349
EDUCATION	1.54	0.647705
SEX	1.54	0.649704
HHSSIZE	1.34	0.748769
ENVCONSCIOUS	1.30	0.770255
SHOPPING1	1.27	0.788313
NUMAGED	1.20	0.834842
AGE	1.20	0.835713
PREVIOUSINFO	1.18	0.850053
ASSEDU3	1.12	0.889365
EMPLSTATUS	1.11	0.899213
Mean VIF	1.46	