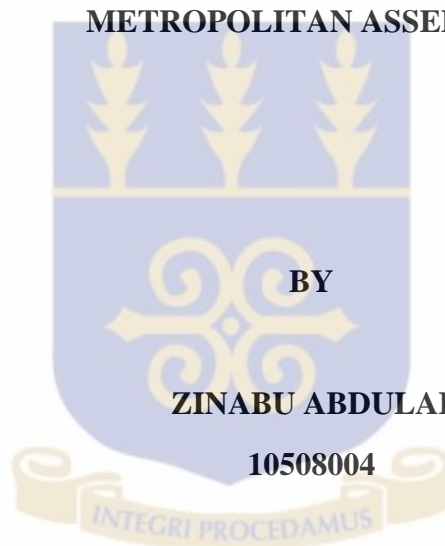


**UNIVERSITY OF GHANA**

**COLLEGE OF BASIC AND APPLIED SCIENCES**

**DEPARTMENT OF AGRICULTURAL EXTENSION**

**THE CONTRIBUTION OF SOCIO-ECONOMIC FACTORS TO  
KNOWLEDGE, ATTITUDE AND SKILLS ACQUIRED THROUGH  
TRAINING IN PESTICIDE UTILIZATION IN THE ACCRA  
METROPOLITAN ASSEMBLY**



**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF  
GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE AWARD OF M. A. AGRICULTURAL EXTENSION DEGREE**

**OCTOBER, 2015**

## DECLARATION

I, ZINABU ABDULAI, hereby declare that this research work submitted by me is based on actual and original work carried out by me. Any reference to work done by any other person or institution or any material obtained from other sources have been duly cited and referenced. I further certify that the research paper has not been published or submitted for publication anywhere else.

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## ABSTRACT

The use of recommended agricultural practices such as the safe adoption of pesticides is influenced by several factors as identified in the evaluative frame of reference. These factors have often led to the existing gap between farmers' knowledge and pesticide use. The purpose of the study was to examine the contribution of socio-economic factors to the application of skills acquired through training on the safe use of pesticides in vegetable production in the Accra Metropolitan Assembly. The study adopted a descriptive research design. Simple random sampling technique was used to sample 100 MoFA training beneficiary farmers from a population of 135. The study used interview schedule as instrument to gather data from the respondents. SPSS and descriptive statistics such as means, frequencies, and percentages were used to analyse the quantitative data, while content analysis was used to analyse the qualitative data. The study found that the even though the farmers acquired good knowledge in pesticide use, they are using a number of practices that are injurious to themselves, consumers and the environment after benefiting from a training programme from MoFA. Thus, few farmers were using protective gears and most farmers perceived applying more pesticides guarantees higher farm yields. Nevertheless, the training programme contributed to change some of the poor attitudes and practices associated with the use of pesticides. Educational level of farmers was the main socio-economic variable that explained differences in the attitudes of farmers. The study recommends that MoFA should organise more training programmes for the farmers to help continue change some of the negative attitudes towards the use of pesticides, and MoFA should provide extension services to the farmers to monitor their rate of adoption of the improved practices in the use of pesticides.

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It is my genuine gratefulness and warmest regard that I dedicate this work to my beloved husband Hakeem Duweijua and wonderful sons Ridwan Hakeem Duwiejua and Masud Hakeem Duwiejua for their patience, love and all the suffering they endured throughout the course period.



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## ACRONYMS

CODAPEC	-	National Cocoa Disease and Pest Control
EPA	-	Environmental Protection Agency
FAO	-	Food and Agricultural Organization
ILO	-	International Labour Organization
IPM	-	Integrated Pest Management
KAP	-	Knowledge Attitude and Practices
MSDS	-	Material Safety Data Sheets
MoFA	-	Ministry of Food and Agriculture
NASS	-	National Agricultural Statistics Service
PPEs	-	Personal Protective Equipment
PMP	-	Pest Management Plan
UNEP	-	United Nations Environmental Programme
USGS	-	U.S. Geological Survey
WHO	-	World Health Organization
WAAPP	-	West Africa Agricultural Productivity Programme
TPB	-	Theory Of Planned Behaviour
ICPM	-	Cocoa Integrated Crop and Pest Management

## **CHAPTER ONE**

### **Background to the study**

#### **1.0 Introduction**

This chapter presents information on the background of the study, discusses the use of pesticides in farming, examines the problem of the study and brings out the objectives of the study. The justification and structure of the dissertation are also looked at in this chapter.

#### **1.1 The use of pesticides**

Many people are of the view that the use of pesticides is currently the main pest management strategy to guarantee the world's food supply (Karlsson, 2004). Most pesticides, however, are toxic to non-target species, including humans, aquatic lives, and the environment, while the extensive use of these products in the field can lead to occupational diseases and poisonings (Faria, Rosa & Facchini, 2009). There is, therefore, a scientific consensus that the effects of an inappropriate use of pesticides can seriously affect human health and the environment (Ospina, Manrique-Abril & Ariza, 2009). As estimated by the World Health Organization (WHO) and United Nations Environment Programme (UNEP), pesticide poisoning injures 1.5 million agricultural workers a year. At least 20,000 workers die from exposure to pesticides every year, most of them in developing countries (Karunamoorthi, Mohammed & Jemal, 2011). According to the WHO (2004), chemically polluted run-off from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems, and created growing "dead zones" in the ocean.

The US National Library of Medicine (2007) expressed that a wide range of pesticides is used for pest management and vector control in agriculture but many farming communities are not adequately informed about the hazards associated with the chemicals. As a result, farmers use pesticides without full understanding of their impact on human health and the environment. Human contacts with pesticides, whether in the field, during pesticide application, weeding, planting, pruning, harvesting, and storage may lead into acute and/or chronic exposures, with adverse health consequences (Recena & Caldas, 2008). Although the inhalation, dermal and oral routes of exposure are the most common, Faria et al., (2009) posited that pesticide residues in food and water may add to indirect exposures common in the general population. Karunamoorthi et al., (2011) suggested that the use of personal protective devices (PPDs) can help reduce exposure levels or identify early effects before irreparable disease develops.

In a report by the WHO, 20% of pesticide use in the world is focused in developing countries, and this is increasing (Ngowi, Maeda & Partanen, 2002). Studies regarding pesticides are, therefore, considered important in order to decrease pesticide risk and help to improve public health policies. In other words, farmers' knowledge over the use and application of pesticides are critical for ensuring the wholesome consumption of food. Karlsson (2004) indicated that the unsafe use of pesticides is common in developing countries.

In terms of dispensing modern and improved methods in the application of pesticides to farmers, Waichman et al., (2007) expressed that the socio-economic characteristics of farmers play critical role in ensuring their effective adoption of the

strategies. This suggests that the introduction of good agricultural practices to farmers must be done alongside with careful examination of the demographic and economic characteristics of the farmer. Educational qualification, gender, income levels and age are the most examined factors in the use recommended practices. Recena and Caldas (2008) indicated that farmers with different levels of education have different levels of understanding and attitude towards the application of pesticides. Akudugu, Guo & Dadzie (2012) found that differences in gender, farm acreage, types of crops cultivated and level of income from farming influenced farmers' attitudes and level of application of pesticides. As a result, Akudugu et al., (2012) recommended that efforts to assess knowledge, attitudes and application on the use of pesticides should factor into the process the socio-economic characteristics of the farmers.

As part of the effort to educate farmers on the use and application of pesticides, Ghana integrated agricultural extension services` into the agricultural process. The aim was to create a link between technology or improved agricultural methods and agricultural production. As part of the extension services to farmers, the government introduced a programme to train vegetable farmers on the use and application of pesticides in 2014. The aim was to improve their knowledge, attitudes and practices on the use of pesticides to help guarantee the wholesomeness of vegetables, reduce hazard exposure through the use of pesticides as well as protect the environment. This was critical because consumers do not pay much attention to the thorough cleaning of vegetable before consumption, whereas some are eating fresh without cooking.

Urban agriculture is crucial to the supply of fresh vegetable in the Accra Metropolitan Assembly. Farmers in the metropolis also benefited from the training programme on the safe use of pesticides.

## **1.2 Statement of the problem**

All over the world, the use of pesticides is considered the most attractive method of controlling pests which involves less labour and characterizes higher output per hectare of land (Recena & Caldas, 2008). However, EPA (2007) indicates that the extensive use of such pesticides results in substantial health and environmental threats. The threat posed by the use of these pesticides affects both human and other organisms. Agricultural workers are at the top of this risk followed by consumers, and aquatic organisms. According to Akudugu et al., (2012), agricultural workers engaged in the use of pesticides run at least twice the risk of dying on the job than workers in other sectors.

Ngowi et al., (2002) identified that farm workers in developing countries will continue to use pesticides in increasing quantities because of the lack of alternatives to pesticides control, ignorance of the sustainability of pesticide use, and the weak enforcement of regulations and laws on pesticide use. Although the use of pesticides is increasing in developing countries, farm workers' knowledge on hazards and the prevention of acute and chronic poisoning is limited (Ospina et al., 2009). They also pointed out that erroneous beliefs can seriously impair workers' capacity to protect themselves against the risks of pesticides.

Due to these and many factors various programmes have been designed by government agencies and Non-governmental Organizations (NGOs) to protect farm workers and minimise exposure to pesticide residues. For instance the Pest Management Plan (PMP) programme, the Integrated Pest Management (IPM) programme, the Input Dealers Training under WAAPP2, the National Cocoa Disease and Pest Control (CODAPEC) programme, among others.

These programmes are mostly in the form of training farmers in the area of re-entry period of farms after application of certain chemicals, wearing protective clothing to minimize risk of exposure, pesticide label identification and disposal of chemical containers after use (Recena & Caldas, 2008).

In line with this, the Metropolitan Agricultural Development Unit introduced a training programme on safe and responsible use of pesticides and fertilizer products for vegetable farmers in the Metropolis. 135 farmers were trained in the Metropolis. It is expected that this training programme will help improve farmers' skills in the application of pesticides. Farmers' skills include their Knowledge, Attitude and Practices acquired in the application and use of pesticides. However, observation from the field shows that although the vegetable farmers acquired the right knowledge there is the possibility that they do not exhibit the correct attitudes on their farms hence not being better off than those who did not participate in the training programme. Thus these farmers are practicing only half of the safety measures known to them.

Similarly, a reconnaissance survey in the area shows that not all the beneficiary farmers practiced safe application of pesticides. While some of the beneficiary farmers possessed modern and improved knowledge on the use of pesticides, others still uphold the old and less safe practices in the use of pesticides.

Armah (2011) identified that most research results on farmers' knowledge on pesticides shows that about 48% of farm workers have reasonable good knowledge on pesticides. But the extent to which the knowledge is being practiced has been given little attention by researchers. This implies that there is a gap between farmers' knowledge and pesticide use.

The gap that exists between farmers' knowledge and pesticide use is affected by various factors (Frag, Abdel, El-Gawad & Dogheim, 2011, Kumari & Reddy, 2013). Factors such as environmental, cultural, poverty, access to extension services, socio-economic among others affect the knowledge, attitude and practice of farmers in the application of recommended technologies. Leeuwis & Ban (2004) in the evaluative frame of reference explained that what farmers do or do not do depends partly on their perceptions of the manifold consequences of certain practices thus farmers do not only consider possible technical consequences but also socio-economic and other effects in the application of recommended technologies.

Frag et al., (2011) reported that socio-economic factors such as age, level of education, farm size, gross annual income, household size and off-farm income influence the adoption of lessons learnt from extension training programmes.

Kumari and Reddy (2013) indicated that certain level of education and experience has contributed significantly to farmers' knowledge on safe use of pesticides. Also differences in the knowledge, attitudes and practices of farmers could be traced from the differences in their socio-economic characteristics (Parker, Osei, Armah and Yawson, 2010; Amoako 2010).

It can be observed from literature that knowledge, attitudes and practices of farmers are influenced by numerous factors. These factors such as socio-economic have contributed to gap creation between farmers' knowledge and the use of pesticides. It is therefore important to investigate into how the socio-economic characteristics of beneficiary farmers of the training programme organised by Metropolitan Agricultural Development unit has contributed to the application of knowledge, attitudes and practices they acquired through the training on the responsible use of pesticides and fertilizer product.

### **1.3 Research Question**

How do socio economic factors contribute to the application of knowledge, attitude and practices acquired through training by vegetable farmers in the Accra Metropolis in the use of pesticides?

### **1.4 Main Objective**

The general objective of the study is to assess the contribution of socio economic factors to the application of knowledge, attitude and practices with the use of pesticides in vegetable production in the Accra Metropolitan Area.

### **1.5 Specific Objectives**

- i. To determine the contribution of socio-economic factors to the application of knowledge acquired through training.
- ii. To investigate the impact of socio-economic factors to farmers attitudes towards pesticide use.
- iii. To assess the contribution of socio-economic factors on the application of skills acquired through training in the use of pesticides.

### **1.6 Justification of the study**

The study highlights the considerable effects of the use of pesticides on both farmers and consumers of fresh vegetables. It explores the applicative knowledge of farmers using these pesticides and its considerable effects on mankind. The study results shall be significant to all the stakeholders of agriculture in Ghana, more specifically, the immediate farmers who use pesticides on their farms and the households who directly purchase from these farmers. As it shall expose to them the dangers in the applications of pesticides on food crops when proper regulatory measures are ignored, the indiscriminate handling of pesticides containers and their relevant side effects on the consumptions of crops which have seen immediate administration of pesticides.

To policy makers, the results of the study shall be a guide in the enacting of policies to check farmers in the administrations of pesticides and sensitise the general public on the health related hazards in the consumption of food crops which have had pesticides or chemical administrations.

To academic, the study results shall enhance the store of knowledge on the contribution of socio economic factors to the application of knowledge, attitude and practices with the use of pesticides in vegetable production. It shall serve as a reference for any further work in this field either by supporting the findings of the study or providing otherwise using the same methodology adopted or another alternative method.

### **1.7 Structure of the study**

Chapter one looked at the background of the study, the use of pesticides and the problem statement. It also stated the research question, the objectives and the justification of the study. Literatures underpinning the study are reviewed in the Chapter Two. The conceptual framework of the study, knowledge acquisition, and attitude development and farmers practices in line with socio economic factors were also discussed in Chapter Two. This is followed by Chapter Three which describes the methodology, the type of method employed and how the data was collected and analysed. Chapter Four presents the findings and discussion of results. Chapter five as well present a summary of the results, conclusion and recommendations for further research and policy makers.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter reviews literature related to knowledge, attitude and practices with the use of pesticides in line with socio-economic factors. The chapter looked at the overview and application of pesticides in agricultural production. The impact of training on knowledge, attitude developments, and practices in the use of pesticides, socio-economic factors and knowledge, attitude and practice of safety mechanisms in pesticide utilization were also reviewed; socio-economic challenges and benefits associated with the use of pesticides use were also discussed. Another issue discussed under this chapter was agriculture and pesticide use in Ghana.

#### **2.1 Overview and application of pesticides in agricultural production**

Pesticide has been defined as any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies FAO (2002). The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also, pesticides are used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport (Amoah, Drechsel, Abaidoo & Ntow, 2006). From the above definition, a pesticide can be described as a natural or

man-made preparation used to kill or control an insect population, control weeds or diseases in plants and animals including humans. According to Bempah and Donkor (2010), pesticides are classified based on the following:

- i. the target pest
- ii. their mode of action and
- iii. the major compound making up the chemical.

Different types of pesticides are used for controlling various pests. For example, insecticides are applied against insect pests, fungicides against crop diseases, herbicides against weeds etc. in order to protect crop losses. Pesticides as an agricultural input are composed of active ingredients and inert materials, which are used in their formulation to control pests and diseases (Bhanti & Taneja, 2005). Horna, Timpo and Alhassan (2007) recommended some precautionary measures in the application of the chemicals either as sprays or dust, viz: wearing of nose shield to avoid inhalation; putting on protective clothing; rubber gloves and boots; refraining from smoking, eating and drinking; covering food and water to avoid contamination. Also during application, chemicals must not be spilled or sprayed on skin. This has been confirmed by Chowdhury, Razzaquema and Khanmsi (2011) that most of the pesticides are dangerous, toxic and can cause serious health hazards to human beings.

Pesticides are widely used throughout the world in agricultural production to protect crops and increase production. According to Gyau and Spiller (2007), proper technique of applying pesticides and the equipment used for applying pesticides are vital to the success of pest control operations. In other words, the application of

pesticide is not merely the operation of sprayer or duster, rather it has to be coupled with a thorough knowledge of the pest problem (Bempah & Donkor, 2010). Chowdhury et al., (2011) emphasised that the use of pesticides involves knowledge not only of application equipment, but of pest management as well. The main purpose of pesticide application technique is to cover the target with maximum efficiency and minimum efforts to keep the pest under control as well as minimum contamination of non-targets. All pesticides are poisonous substances and they can cause harm to all living things. Therefore their use must be very judicious.

Bhanti and Taneja (2005), have suggested that, pesticides application techniques should be target-oriented so that safety to the non-targets and the environment is ensured. Therefore, proper selection of application equipment, knowledge of pest behaviour and skilful dispersal methods are vital. Jurewicz and Hanke (2008a) indicated that the complete knowledge of pest problem is important to define the target i.e., location of the pest (on foliage, under the leaves, at root zone etc). The most susceptible stage of the pest for control measures will help to decide the time of application. The requirement of coverage and spray droplet size depends upon the mobility and size of the pest (FAO, 2007).

The mode of action of pesticide, its relative toxicity and other physicochemical properties, help to decide the handling precautions, agitation requirement etc. Further the complete knowledge of the equipment is necessary to develop desired skill of operation, to select and to estimate the number and type of equipment needed to treat the crop in minimum time and to optimize use of the equipment (Sadlo, Szpyrka, Jazwa & Zawislak, 2007).

The success of pest control operations by pesticide application greatly depends on the quality of pesticide, timing of application, quality of application and coverage (Amoah et al., 2006). EPA (2007) report indicated that besides choosing an appropriate pesticide for application it has to be a quality product i.e., proper quantity of pesticide active ingredient must be ensured that the quantity is maintained in production and marketing of pesticide formulations. According to Ntow, Gijzen, Kalderman and Drechesel (2006), the application of pesticide is very successful when applied at the most susceptible stage of the pest. Thus, if the timing of pesticide application is carefully considered and followed, the results will be good pest control and economy. Therefore for large area treatment careful selection of equipment becomes necessary so that within the available 'Time' the area could be treated.

Even though good quality pesticide is used and optimum timing for the application of pesticide is also adopted; unless the pesticide is applied properly it will not yield good results. Accordingly, the quality of application of pesticides is very important in pest control operations. The FAO (2002) recommended the adherence to the following issues to guarantee optimum effectiveness in the application of pesticides:

- i. Proper dosage should be applied evenly
- ii. The toxicant should reach the target
- iii. Proper droplet size
- iv. Proper density of droplet on the target.

For spraying against flying insects, Bhanti and Taneja (2005) reported that the hydraulic nozzles are not effective. They, however, require fine size spray particles

to remain airborne for longer time. For weed control operation, usually the requirement is drift free application or coarse spray droplets. Jurewicz and Hanke (2008b) recommended that adequate number of spray droplets should be deposited necessarily. For fungicide application, the number of droplets deposited per unit area should be more and may be for herbicide application it can be less in number (Bempah & Donkor, 2010). It may need fewer numbers of droplets to be deposited in case of highly mobile (crawling) insect pest.

From the preceding discussion it is clear that pesticides are poisonous substances and their uses require a complete and adequate knowledge and skills of needed equipment and handling precautions. The next section therefore reviewed literature on knowledge and skills acquisition, with attitude development through training in pesticide utilization.

## **2.2 Impact of training on Knowledge, attitude, and practice in the use of pesticides**

There is a great concern that farm workers should be aware of the adverse effects of pesticide use if not handled properly. As such improving farm workers confidence in pesticide use will depend partly on the availability of relevant information which is crucial in enhancing their knowledge in the use of pesticides. Recena and Caldas (2008) suggested that extensive training programmes are required to influence farmers' knowledge, attitudes and practices with the use of pesticides.

Training presents a prime opportunity to expand the knowledge base of farmers. It is as well a comprehensive term referring to those aspects of the educational process

involving, the study of technologies, the acquisition of practical skills, attitudes, and knowledge relating to occupations in various sectors of economic and social life (UNESCO, 2004).

Training programmes for farmers, therefore, play an intermediary role between primitive methods and approaches, and modern and improved methods with the use of pesticides. As a result, it is expected that, with improved knowledge through training programmes, farmers should be able to adopt safe and improved methods in the application of pesticides to increase production and improve food safety.

It has however been suggested that farmers' knowledge on improved agricultural practices enhance their attitudes towards such practices and this has been reported by (Sadati, Shaabanali, Fami & Asadi, 2010) that, attitudes of farmers towards sustainable agriculture are influenced by the farmers' knowledge. This means that to transfer knowledge and skills to farmers, it is necessary to generate desirable changes in the attitudes of farmers as a first step.

### **2.2.1 Acquisition of knowledge by farmers in the use of pesticides**

By general conception farm workers use several possible means to search for information about new technologies. As stated by Rogers (2010) farmers seek information on chemical use from agro input dealers, extension officers, neighbours, the media among others. The information provided by extension officers are usually organized in the form of demonstration, trainings and education.

Bandara, Abeynayake & Anjalee (2013) observed that most farmers do not use any medium to gather information on pesticides and other issues related to agriculture.

They rather acquire information from neighbours, sellers, and from farmer societies. In addition they gather information from television, radio and newspapers and also from company activities such as company promotions. Farm workers may also acquire knowledge on pesticide use through other means such as farmer field schools, Farmer-to-Farmer Extension Approach and also through agricultural extension services.

### ***Farmer Field Schools***

Farmers are able to acquire knowledge through the Farmer Field Schools (FFS) exercise. A report by FAO (2010) indicate that, FFS consist of groups of farmers who get together to study a particular topic. The topics covered vary from conservation agriculture, organic agriculture, animal husbandry, soil husbandry, income generating activities and pesticides usage on the farm land. This approach provides opportunities for learning by doing and teaches basic agricultural and management skills which enhance farmers' expertise. The report further reveal that, FFS sensitizes farmers is improved means of thinking and problem solving and also helps farmers learn how to organize themselves. For instance, in a research finding on FFS by David (2007) indicated that, FFS provided farmers with improved skills and knowledge on Cocoa Integrated Crop and Pest Management (ICPM) and as such FFS graduates demonstrated superior knowledge on cocoa ICPM than non FFS farmers.

### ***The Farmer-to-Farmer Extension Approach***

Traditional view of extension is very much focused on increasing production, improving yields, training farmers and transferring technology (Davis, 2008). In

improving smallholder farmers' access to information, many extension services use farmers to help disseminate information to their fellow farmers which can be used to improve agricultural productivity. This extension approach is known as "farmer-to-farmer," and the farmer extension agents are usually referred to as lead farmers, model farmers or extension multipliers as stated by Khaila et al., (2015). They further mentioned that, to ensure the best use of the farmer-to farmer approach to agricultural extension there is the need to reaffirm the role of groups and communities in selecting and monitoring of the lead farmers.

### *Agricultural extension services*

Extension has been described as involving the conscious use of communication of information to help people form sound opinions and make good decisions (Anaeto, 2012). It is also seen process in helping farmers to acquire specific knowledge related to certain problems, solutions and their consequences so that they can act on possible alternatives, helps farmers to evaluate and improve their own opinion-forming and decision-making skills MoFA (2011). The extension services are usually organized in the form of trainings, demonstrations. This has been recommended by Ntow et al., (2008), that training programmes when organised for farmers will improve their knowledge, attitudes and practices with the application of pesticides in agricultural production. Such programmes help to guarantee the safety of foods produced for the public. Thus, training programmes on the application of pesticides enable farmers to know and understand the quantity, timing and mechanisms to apply pesticides for different crops and pests within different geographical areas and topographical landscapes (Bempah & Donkor, 2010).

Programmes to promote the safe use of pesticide have been tried in many settings to encourage self-protection and pesticide residue-free cultivation. In U.S.A., health knowledge and trainings under Worker Protection Standard were provided to farmers.

Gyau and Spiller (2007), in a study on the assessment of the adoption of seed and fertilizer packages and the role of credit among small holder maize production in Ethiopia, used a Tobit analysis to model the farmers' adoption behaviour concerning the allocation of land to improved maize varieties. It was found that extension services have significant influence on the probability of adopting safe and improved methods of applying pesticides on farms

### **2.2.2 Attitude development and practice in the use of pesticides**

It has been indicated that agricultural knowledge is a significant antecedent determinant of the attitudes and practices of participants in most agricultural programmes and as such both the agricultural knowledge and attitudes of the participants had positive effects on their behaviour in practice. In addition, Bempah and Donkor (2010) postulated that farmers' risk perception about the use of pesticides influences their attitudes and practices in the application of pesticides in agricultural production.

In explaining the attitudes and practices of farmers using the theory of planned behaviour (TPB) Veisi (2012) reported that TPB assumes individuals do not have full volitional control over their behavioural actions, but rather the perceived behavioural control component can be used as a substitute for a measure of actual

control. Therefore TPB suggests that the more positive the attitude, subjective norm and perceived behavioural control is, the greater the likelihood an individual has of intending to carry out the behaviour when the opportunity arises. More so, Karami, & Mansoorabadi (2008) identified that behaviours are not within a farmer's control. They further explained that; access to relevant information; the personal characteristics and attitudes of the reference group; farmer's attitudes; economic factors; access to resources; and the feasibility of sustainable agriculture are control factors that give rise to perceived ease or difficulty of performing the behaviour. In addition, Vaughan & Hogg (2005) identified three important links between attitudes and action in the context of environmental management such as pesticide utilization. First attitudes do not just appear *sui generis* but are constructed. Secondly the adoption of attitude is a process and finally attitudes do not necessarily translate into action. This explains why Barr (2007) mentioned that there is 'Attitude-behaviour inconsistency'.

This is an indication of the fact that farmers attitude are more likely to correspond with their behaviour if they have experimented with an innovation themselves or have information from reliable sources. Thus, farmers' behaviours are influenced not only by their private opinions but also the expectations they perceive of their social environment has of their behaviour. Further it is understood that farmers are not able to fulfil their intentions. The farmer may want to act in a certain way but feels constrained to do so. The actual situation of the farmer is important if one would want to predict his/her behaviour. Thus, perceived behavioural controls/self-efficacy independently influences intentions but also has a direct influence on behaviour. This could explain why Baker, Al-Gahtani, & Hubona, (2007) reported

that demographic characteristics such as age and gender are among the most significant factors that influences a person's attitude. They argue that a focus on attitudinal factors alone is insufficient given the significance of these wider drivers in constraining or enabling farmers' actions.

According to the final report on 'Farmer attitudes and evaluation of outcomes to on-farm environmental management' by Exeter University 2013 an in-depth, face-to-face, qualitative interviews were used to understand farmers' behaviour in order to identify the psychological and physical motivations or barriers to environmental management activities in terms of farmers' situations and needs, opportunities and constraints; behaviours, and how these may have changed over time and how attitudes have influenced decisions. Yeboah (2013) also used in-depth interview and semi-structured interview guide to gather data on the attitudes of urban farmers towards the use or non-use of pesticides.

It is evident that training programmes when organised for farmers will improve their knowledge, attitude and practices in the use of recommended agricultural practices, however, in the process of accessing and adopting relevant information the demographic characteristics and economic factors of a person should be taking into consideration since they are the control factors in performing a particular behaviour. The next section discusses the socio-economic factors supporting the study.

### **2.3 Contribution of socio-economic factors to Knowledge, attitude and practice in the safe use of pesticides**

The adoption of safe and good practices such as reading and following label instructions, proper disposal of used pesticide containers, washing of hands among others have been highly recommended. However, factors such as education, gender, age etc. have been identified to reduce the rate of using these practices, Kumari & Reddy (2013).

As reported by Ntow et al., (2008), there is a growing consensus among research findings, concerning the importance of socio-economic and demographic characteristics of farmers and the adoption of recommended agricultural practices. Among others, they are farmers' age, educational level, gender, farm size, access to information, income levels and experience.

#### **2.3.1 Gender and pesticide use**

With respect to gender, men and women are involved in different ways in agricultural activities beyond production, such as processing and marketing. Men and women may be affected by pesticides in different ways. Men are more likely to attend trainings, participants in group discussions and, usually the household visit respondents. As such men are more likely to acquire enough information about pest management than women. Knowledge and perceptions of the risks of pesticides is likely linked to access to education and information. Studies also show that knowledge, perceptions, and practices of pesticide use differ by gender; in some cases, women are less likely than men to be able to read warning labels, to have knowledge of the risks of pesticides, and to use protective clothing (Atreya, 2007; Garcia, 2003).

In other circumstances, women's concern for the health of family members may actually increase their awareness of the risks of pesticides (Kromann, Pradel, Cole, Taipe & Forbes 2011). Attitudes of farmers have also been linked to the fact that men and women are exposed to pesticides in different ways because of their different roles in crop production. While men are more likely than women to be exposed to pesticides during the mixing and application processes, women are at risk of exposure to the chemicals when they wash the clothes worn to spray pesticides. Findings also revealed that gender differences in access to, knowledge, perceptions, and practices of pesticides and pest management are related to gendered activities in productive and reproductive spheres in some cases but may be more closely linked to gendered access to resources. For example, women are not necessarily more likely than men to perceive the risks of pesticides because of their roles in food preparation, washing clothes, and caring for the sick. In contrast, men are more likely than women to report having experienced, or knowing someone who has experienced negative health effects due to pesticides.

Furthermore, Asfaw and Admassie, (2004) reported that male-headed households are more likely to get information about new technologies and undertake risky businesses than female-headed households. In the same way, Tenge, De Graaff and Hella (2004) stated that having a female head of household may have negative effects on the adoption of new technology, because women may have limited access to information, land, and other resources due to traditional and social barriers.

Apart from the educational status of farmers, Horna (2008) suggested that gender is also an important factor to be taken into consideration when campaigning for the use of safe practices in pesticide utilization. He identified that most male farmers being the head of households control the resources of the house there by making them financially sound. This intends he said increases their decision making powers and as such will determine which of the safe practices to adopt.

On a contrary view in a study Nhemachena and Hassan (2007) argued that female-headed households are more likely to adopt improved agricultural practices. It can be confirmed that women are more likely to adapt because they are responsible for much of the agricultural work and therefore have greater experience and access to information on various management and farming practices.

Other studies have also shown that more female farmers are of poor educational background and this could affect their understanding on recommended practices. This explains why a study by Atreya (2007) reported that women farmers are less likely than men to adopt safety in the use of pesticides partly because he found that more than 50% females had never been to school and identified gender differences on household decision, reading and understanding of pesticide labels.

### **2.3.2 Educational status and pesticide use**

On the issue of education, the educational statuses of farmers have been found to have a positive influence on the adoption of improved agricultural practices. As said by Sa'ed, Sawalha, Sweileh, Awang, Al-Khali, Al-Jabi, and Bsharat (2010) farm

workers with little formal education might be at higher risk when using pesticides, possibly due to difficulties in understanding the use, instructions and safety procedures included on the product labels. They further mentioned that, a high level of knowledge was recorded among the participants who had a higher education level and their knowledge on the effects of pesticides on human health was relatively accurate. It can therefore be concluded that, farm workers with good pesticide knowledge are more inclined to use pesticides according to the recommended guidelines for protective measures.

To Hammond (2006) higher level of education is believed to be associated with access to information on improved technologies and higher productivity. Shankar and Thirtle (2005) also found a positive relationship between educational levels of farmers and the probability of adoption of improved agricultural technologies in northern Tanzania. Essumang et al., (2008) also found that farmers' level of education influence the adoption of technologies positively. Similarly, an empirical evidence according to Fu and Song (2010) revealed that farmers with higher status in education better understood the rapid and effective insecticidal effect of chemical pesticides. However, Horna et al., (2007) found out that farm size, farmers' experience and farmers' educational level and age have insignificant effects on the likelihood of adoption of certified organic production.

### **2.3.3 Age and pesticide use**

In relation to age, research findings have predicted that age of the farmer and the number of extension visits farmers receive have significant and positive influence on

the knowledge, attitude and practices in the use of pesticides (Chowdhury et al., 2011).

In the process of acquiring knowledge in farming, young farmers are usually introduced into farming and trained by older farmers with several years of working experience. This according to Yeboah (2013), young and new farmers tend to draw on the experiences of the older ones in the use of pesticides. He further said their attitudes and practices towards the use of pesticides are highly influenced by the elderly ones. This suggests that in the use of pesticides old and young farmers are likely to adopt the same practices.

Also age and experience in farming have shown a significant influence on knowledge as well as on practice. Farmworkers knowledge is positively associated with their experience, but experience could not influence their practices much (Kumari and Reddy, 2013). However they identified that farm workers with high working experience are likely to have carelessness in practicing good measures while using pesticides despite their good knowledge.

On the other side, a study by Ntow et al., (2006) revealed that age has no influence on having knowledge and the practice of safety in the use of pesticides. They further found that farm workers in all age groups have nearly 80% of the knowledge on pesticides but they are practicing only 50% of the safety measure while using pesticides.

#### **2.3.4 Income levels and pesticide use**

With regards to income, an individual's observed behaviour in response to a health risk generally cannot be such that utility is held constant. To (Knowler and Bradshaw, 2007) when an increase in exposure creates a need for the purchase of protective gear, for instance, the farmer's real income declines by that amount. Hence, to obtain an estimate of willingness to pay to avoid a health risk, an income effect associated with a change in exposure has been estimated. When the amount of money spent on PPE to substitute for other items is a small part of income, this effect is negligible and can be disregarded. As such the income effect may be very important for individuals with low incomes. When one observes poor farm workers who take few precautions to avoid health risk from pesticide exposure, it may be incorrect to infer that they are unaware of the health risks or that they attach a low value to the health risks. An alternative explanation is that they are aware of the health risks and attach a significant value to them, but that value is less than the income that would be foregone from buying the protective gear and the disutility associated with wearing it. This might explain why poor farmers rarely use protective gears. Also, Farag (2011) observed that farm income, and family sizes have significant effects on adoption of fertilizer and pesticide technologies in Ethiopian crop production systems.

#### **2.3.5 Size of farm and pesticide use**

Despite the fact that improving the knowledge of farmers could enhance their practices, it is often difficult to get farmers, particularly poor smallholder farmers, to alter behaviour by applying risk-reducing practices. (Toze, 2006). Therefore,

effective risk reduction strategies must account for farmers' practices and attitudes towards the adoption of intervention to mitigating these risks. Higher income farmers on the other hand may be less risk averse and have more access to information and use pesticides appropriately. Ribhoi (2013) identified that, income is one of the factors influencing the increase of knowledge level of farmers towards the use of recommended practices. Bhanti and Taneja (2005) reported that attendance of agricultural training courses, farm size, and access to farm credit exert high influences on the farmers' knowledge, attitudes and practices with the use of pesticides. In another study, Randall (2013) also found that farm size and, contacts with extension agents, farmers' have significant influences on the conditions surrounding the use of pesticides. However, Qaim and Matuschke (2005) found insignificant the influences of farm size on the application of pesticides among maize farmers in Kenya.

From the afore mentioned discussions it is clear that socio-economic and demographic characteristics of farmers play crucial roles in the adoption of recommended agricultural practices. The study therefore focused on respondents characteristics such as gender, educational status, income age and experience in farming.

#### **2.4 Socio-economic factors and challenges for implementing safe practices in pesticide use**

Many farm workers are unaware of some of the properties of pesticides, in what conditions they present danger and how to protect oneself from poisoning. The general belief seems to be that if one does not die immediately then pesticides present no harm. There is widespread ignorance of the existence of chronic pesticide

poisoning. The Concept of pesticide resistance and resurgence are not understood by farmers. Importers, Resellers and Farmers refer to pesticides as medicines rather than poisons. It is these among other reasons why Tadesse, (2008) reported that farmers need to know what information is printed on a pesticide label. Instructions written on the label or an accompanying leaflet need to be followed to obtain the recommended dosage. Farmers need to be reminded that pesticides are not the only control measures for pest problems. Past research has indicated that aspects of farm structure such as farm size, farm type, tenure, dependency on farm income and farm household characteristics can have a significant effect upon participation and use of recommended practices.

The role of the farm household (rather than just the farmer) has been shown to be important (Dwyer & Turner, 2007) in the use of recommended practices. Many of these factors such as age succession and education cannot be viewed in isolation. Psychological factors have been included among these socio-economic factors with attitudinal factors and perception playing a key role (Kabii and Horwitz, 2006).

***Social factors:***

Gender related issues have been demonstrated in numerous research findings as one of the key factors to ensuring agricultural growth and sustainability. Therefore there is the need to address the differences between male and female farmers, as reported by NASS (2007) women now account for 14% of principal farm operations. Surveys of the wider female farm population have found women emphasize not only the environmental and economic benefits of sustainable agriculture, but are also more

likely to emphasize the link between community sustainability and well-being (Trauger et al., 2008).

Women now play a significant role in the agricultural labour force worldwide. The United Nations reports that nearly 80% of economically active women in sub-Saharan African and at least half in Asia, other than western Asia, are now working in agriculture. In Latin America and the Caribbean and in developed countries women farmers and workers are frequently exposed to dangerous pesticides directly when working as pesticide applicators, or indirectly during harvesting, planting and soil preparation. The ILO has shown that agricultural workers run at least twice the risk of dying on the job as workers in other sectors reporting that tens of thousands of agricultural workers die each year, and millions suffer injuries, or are poisoned by chemicals.

Badrie, (2006) reported that when women are exposed, so too are children through women's breast milk contamination and because women play an important role in educating children, and also through teratogenic or embryo-toxic effects. Women are as well exposed to pesticides when they come into contact with pesticides through washing pesticide-soaked clothes and disposing of empty containers from family members. Women farmers working as partners in farming operations are often undercounted because usually the husband is considered the main operator and usually receive little or no information on pest control technologies.

In Africa there are reports that rural women often reuse pesticide containers for storing or transporting their crops. This in effect therefore calls for increased public awareness of sustainable agriculture in women's groups, that governments should

disseminate to farming households more information involving reduced use of agricultural chemicals and train women's groups, farmers and extension agents in alternative non chemical ways of controlling pests (Ramsom, 2002).

Generally, education is thought to create a favorable mental attitude for the acceptance of new practices, especially of information-intensive and management-intensive practices. According to Bhavani and Thirtle (2005), farmers in the field are often unaware that pesticides should be used in a specific dosage in order to be as cost-effective as possible. Adding to this problem is the unavailability of measuring instruments, illiteracy of farmers and non-calibrated equipment. Inadequate awareness creation and promotion of farmer education in proper pesticide use is another challenge posing a threat to the health of farm worker, consumers and the environment. This refers to what formerly has been called "safe use training". The term has been discontinued in the revised Code of Conduct because it incorrectly led to the perception that training would make the use of highly hazardous products safe. Further research findings have raised questions about the long-term impact of such training and reported that removal of highly hazardous products from the market in many cases is the only effective mechanism for risk reduction. It was found that knowing the risks does not necessarily lead to a change in practice Atkin & Leisinger (2000).

Other findings on safe and effective use of crop protection products in developing countries indicated that if the use of protective gear is expensive or uncomfortable for instance in hot and humid climates, farmers will be inclined not to use it despite knowledge about the risks. To address risks associated with the use of highly

hazardous pesticides, and the more problematic moderately hazardous products, it therefore appears more effective to show farmers alternatives for use of these products than to demonstrate the use of protective gear. Furthermore, it is often impossible to train all users of the product concerned. U.N (2005) Nevertheless, it remains important to train farmers in the proper use of pesticides, including: reading, understanding and following label instructions, the use of protective gear, selection, calibration and maintenance of application equipment to prevent operator exposure and overuse due to inefficient application techniques, respecting pre-harvest intervals or re-entry intervals, pesticide storage and disposal of empty containers and leftover product, pesticide resistance management.

***Economic factors:***

Economists assume that farmers make choices so as to improve their utility, or well-being. In particular, farmers tend to pursue activities that increase their income, reduce their financial and physical risk, reduce labor requirements, and are convenient or enjoyable. A variety of constraints play into farmers' decisions, including constraints with respect to available production technologies, biophysical or geophysical constraints, labor and input market constraints, financial and credit constraints, constraints to knowledge or skills (Stoorvogel et al. 2004). In a research finding by Karunamoorthi et al., (2011) on Peasant association member's knowledge, attitudes, and practices towards safe use of pesticide management, sampled farmers explained that, the constraints for implementing improved and recommended practices were finance (60 percent), Know-how (20 percent), technical (13 percent), and labour (7 percent), respectively.

Literature on technology adoption at the farm level informs us that many factors in particular, variables that vary across farms and are sources of heterogeneity influence farmers' choices about what crops to grow, whether to use a new technology, and how to manage their land. Just as individual consumers have different preferences about products they consume, farmer characteristics, asset endowments, risk preferences, and intertemporal considerations affect their choices. Farmer attitudes, resource availability, and education and knowledge are especially important; farmers may be risk-averse toward making changes in cropping decisions or adopting new agricultural practices, or might have very conservative attitudes toward technology or lower or higher levels of concern for the natural environment (Bowman & Zilberman, 2013). A farmer's income or resource base and ability to obtain credit will also influence his/her choice of crops, farming systems, and willingness to invest in new crops, systems, or technologies (Knowler & Bradshaw 2007). A risk-averse farmer or one who is credit or income-constrained may be less likely to adopt new technologies, even if they are likely to reduce his susceptibility to risk or increase productivity or income over the long-run (Liu & Huang, 2013). As stated by Abdulai & Huffman (2014), lack of knowledge and information about the costs and benefits of adopting new technologies or conservation practices or lack of knowledge about how to implement such technologies or practices will also affect a farmer's propensity to adopt them. Even if farmers have full information and can implement new technologies efficiently and at low cost, differences in intertemporal preferences or credit constraints may mean that farmers are unwilling to sacrifice current profits or income for long-term improvements in soil fertility, risk-reductions, or improved yields (Helmerts, 2012).

***Knowledge and change in behavior in pesticide utilization***

With reference to a study finding, Zhang & Lu (2007) concluded that there was an evident increase in knowledge about safe use of pesticides was obtained” and that "a significant change of attitude among trained target groups is palpable. Unfortunately, these findings of increased knowledge and changed attitude may not necessarily indicate changes in behavior, for at least three reasons. First, recipients of training often temporarily exhibit desired changes in attitude and even behavior because of “Hawthorne effects”. Project participants’ knowledge of and enthusiasm for Safe use may be temporary, and may decline as the training experience recedes in time. Second, project participants may not be representative of the target population as a whole but instead may be self-selected out of a group interested in receiving training in general or in pesticide issues in particular. Third, the possession of accurate knowledge about pesticides and their safe use may not lead to actual safe practice. Indeed, if we understand common logic action as that which responds appropriately to a given situation, common sense may actually lead users to engage in practices which are unhealthy for themselves and for the environment.

In a case of mass worker poisoning in Honduras, for example, a group of 15 young workers were poisoned after applying carbofuran with their bare hands, then eating lunch without washing, resulting in pesticide exposure through a combination of dermal absorption and oral ingestion (Cantor & Young-Holt, 2002)). These melon workers were not provided with gloves or other safety equipment, nor was adequate water made available for washing. The simple protective measure of washing hands, therefore, would have required leaving the field, losing the brief rest period provided for lunch reportedly only 20 minutes taking such measures may have jeopardized

their employment. 15 Pesticide practices are shaped by larger structural influences above and beyond the presence or absence of accurate knowledge of the product. The inappropriate use of pesticides is driven by many complex factors, including credit systems and government policies which promote chemical intensive farming, aggressive marketing by distributors, lack of information on alternative pest control measures, farmers' lack of education adequate to understand the health and environmental effect of pesticides or, in the presence of such information, risk aversion which actually precludes easy adoption of new pesticide practices (Garcia, 2003). In other words, Safe Use campaigns which focus on delivering a clear message with information on pesticide dangers and appropriate use will not necessarily produce changes in actual behavior.

Actual changes in pesticide practice will follow the transfer of information only when users experience safe use as possible within a given organizational context. This implies that, among other measures, the Safe Use curriculum might better take into account the broader context of pesticide use. Rather than bringing farmers and other interested parties together to receive generic and centrally vouchsafed and homogenized information about pesticides, training might more fruitfully incorporate greater user participation in identifying what current practices are and why they exist, and what organizational changes could be made to help make Safe Use more practical and accessible.

In addressing challenges in the use of pesticides, the preceding discussion emphasized on inadequate awareness creation on the harmful effect of pesticides

focusing on social and economic factors as well as effect of knowledge and change in behavior in pesticide utilization.

## **2.5 Socio-economic benefits associated with the use of pesticides**

Pesticides are an important part of significantly increasing food production. The ability to improve farm yields means farmers can produce more food to meet the current needs without expanding their land base.

When women attended FFS to learn about IPM, they reported that the school helped them gain recognition of their personal skills and abilities. Van den Berg & Jiggins (2007) showed that the personal growth stimulated by participation in FFS was particularly relevant to women and confirmed the importance of increasing access to these educational programmes.

Cultural taboos on women's dress were identified as having an important impact on women's health by the Safe Use Project (SUP). The issue was addressed by competition contest for women farmers to design and produce their own protective clothing. Individual women and women's farmer groups were offered the opportunity to learn, design and sew their own protective clothing. The best designs were judged by a panel of female agricultural extension officers. Regional winners came up with designs that were acceptable to their local communities and were able to use the sewing machines given them to produce and sell to other women the protective clothing that they had designed. Muchoki (2015).

Chemical crop protection products, also known as pesticides, help farmers control insects, weeds, fungi and other potentially harmful pests. The term pesticide encompasses a whole range of products including insecticides, fungicides, herbicides and rodenticides. One of the biggest benefits of these products is that they are designed to control pests that threaten agricultural production, which in turn impact on food security (Essumang, Dodoo, Adokoh & Fumador, 2008). Farmers use pesticides to control weeds, diseases and insects that threaten to dramatically decrease their harvest. Global production of major crops has increased significantly, due in large part to plant science innovations like pest control products, but with the world population rapidly increasing, and the amount of land available for agricultural production decreasing, it's becoming increasingly important for farmers to be able to sustainably maximize the amount of food they are able to grow on the land that is currently being used for agriculture (Bhavani & Thirtle, 2005).

A research finding by Edmeades and Smale (2006), indicated that, up to 40% of the world's potential crop production is already lost annually because of the effects of weeds, pests and diseases. These crop losses would be doubled if existing pesticide uses were abandoned. Increased production also means consumers save money on food and agricultural products. Modern tools like pesticides help prevent yield losses and help keep food prices low. Hareau, Mills and Norton (2006) estimated that plant biotechnology and pest control activities have enabled consumers to save about 58% on food products. Thus, without crop protection chemicals, food production would decline, many fruits and vegetables would be in short supply and prices would rise. Helping to keep food prices in check for the consumer is, therefore, another large benefit of pesticides.

Pesticides are an important part of significantly increasing food production. The ability to improve farm yields means farmers can produce more food to meet the current needs without expanding their land base. This in turn protects biodiversity. The more wildlife habitats, forests, wetlands and grasslands that are left untouched by agricultural production, the better it is to protect the biodiversity (Kolady & Lesser, 2007). According to Sadlo et al., (2007), without the use of pest control products and plant biotechnology, Canada would need to turn 37 million more acres into agricultural land to generate the same production it currently does. Pesticides also play an important role in protecting food crops as well as forests and other wildlife habitats from invasive species of plants and non-native insects and other pests (Ospina et al., 2009).

Pesticides allow consumers to consume high-quality produce that is free of insect blemishes and insect contamination. Crop protection chemicals that reduce and, in some cases, eliminate, insect damage allow the consumer to purchase high-quality produce free of insect fragments. Faria et al., (2009) posited that many agricultural commodities are vulnerable to attack by aflatoxins and insect control is necessary to prevent its passage from insect to plant. Aflatoxin, a carcinogen, can cause liver and other cancers in humans, lower the body's normal immune response, and can impair growth in children (Parker et al., 2010). Crop protection chemicals are used to control insect damage that leads to aflatoxin contamination.

This section highlighted on the benefits associated with the need for women and women farmer groups' participation in extension programme.

## 2.6 Agriculture and pesticide use in Ghana

Agriculture is the main sector of the Ghanaian economy. According to political and social strategies, accelerated growth of the agricultural sector is necessary in boosting overall economic development (Ntow et al., 2006). The share of agricultural products in the export earnings is high. The population is mainly in rural areas, depending to a large extent on small-scale farming. Ghana's agricultural policy is based on five main objectives. The predominant goals are:

- i. To ensure food security and adequate nutrition for all the people in the country,
- ii. To promote the supply of raw materials and inputs to other sectors of the economy, and
- iii. To contribute to export earnings (Ntow et al., 2008).

These goals were defined in the early days of independence and have not been changed substantially. Furthermore, agricultural development aims at:

- i. Increasing employment opportunities and income for the rural population and
- ii. Generating resources for general economic development (Horna et al., 2007).

Linked to the intensification and structural changes in agricultural production is the potentially increased use of pesticides. To policy makers, the increased use of inputs like fertilizers and chemical pesticides often seems to be one of the most effective ways to increase production and food supply, since a good part of produce is lost through diseases, pests and weeds in the field and in storage (Amoako, 2010). However, Armah (2011) argues that to reach a sustainable development of the agricultural sector, it is necessary to do more than just increase input use. Within the

context of efforts to intensify agricultural production on a sustainable basis, crop protection policies play a crucial role.

However, there is no comprehensive crop protection policy in place in Ghana, especially for pesticide use. According to Amoah et al., (2006), current crop protection approaches have been primarily shaped by technical expertise without taking economic arguments into proper consideration. In addition, implementations of legal instruments are currently inadequate for controlling and mitigating negative side effects of pesticides (Bempah & Donkor, 2010). Essumang et al., (2008) indicated that specific effects of pesticides, e.g. the risks to human health and the environment, have been partly taken into account by government decisions and are receiving in general the necessary attention. Moreover, Armah (2011) emphasised that farmers' knowledge and practices in crop protection are not sufficiently known to provide a sound basis for policy and extension planning. Handling and application of pesticides at farmers' and retailers' level are not satisfactory in terms of effectiveness, safety, the health of farmers, the prevention of side-effects on consumers and the environment (Amoako, 2010). However, EPA (2007) reported that the current level of pesticide use is generally low, in spite of overuse on some crops. Due to the government strategy of intensified agricultural production, it can be expected that pesticide use will increase in the near future.

## **2.7 Summary**

This chapter gave an overview and application of pesticides in agricultural production. The influence of training on knowledge, attitude, and practices in the use of pesticides, socio-economic factors and knowledge, attitude and practice of

safety mechanisms in pesticide utilization were also reviewed; socio-economic challenges and benefits associated with the use of pesticides use were also discussed. The chapter ended with a discussion on agriculture and pesticide use in Ghana.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.0 Introduction**

This chapter presents the processes by which the study arrived at the findings of the study. It captures issues such as the research design, study population, sample and sampling techniques, instrument design, method of data collection, field challenges, and data analysis.

#### **3.1 Research design**

The study adopted a descriptive research design. According to Creswell (2002), descriptive research design enables researchers to describe the behaviour of a phenomenon using both qualitative and quantitative techniques. It involves the use of both qualitative and quantitative techniques to describe, record, analyse, and interpret conditions that exist (Sarantakos, 2005). Neuman (2006) indicates that descriptive research design involves gathering data that describe events and then organises, tabulates, depicts, and describes the data. As a result, the descriptive research design enabled the researcher to describe how socio-economic factors influence the knowledge, attitudes and practices of farmers.

#### **3.2 Study population**

Population of the study comprised all vegetable farmers in the Accra Metropolitan Assembly who benefited from the training programme for safe and responsible use of pesticides and fertilizer products organised by the Metropolitan Agricultural Development Unit in conjunction with the Regional Agricultural Development Unit.

Per records from the MoFA on the beneficiaries of the training programme, there were a total 135 farmers who benefitted from the programme.

### **3.3 Sample and sampling procedures**

Sampling enables the researcher to study a relatively small number of a unit of a given population so as to obtain data representativeness of the whole population. Due to time and financial constraint, 100 farmers out of a population of 135 was used. Consequently, the sample size for the study was 100. Simple random sampling technique was used to sample the 100 respondents. With the sampling process, the list of beneficiary farmers was obtained from the Metropolitan Agricultural Development Unit. The names were written on equally sized papers and folded into a bowl. The papers were shuffled to make sure that they were not in any pre-determined position. The aim was to ensure that each member in the population had equal chance of being selected into the sample. After the shuffling, the first draw was made without replacement. The name of the person was noted. Subsequent draws were made until all the 100 respondents were selected.

### **3.4 Instrument design**

Interview schedule was used as instruments to gather data from the respondents. Creswell (2002) explains that interview schedule is appropriate for collecting both quantitative and qualitative data from illiterate respondents. Thus, it was envisaged that not all the farmers could read, understand and self-administer the research instrument, and as a result, interview schedule should be appropriate. The interview schedule was organised under four sections. The first section was on the background characteristics of respondents. It captured issues such as gender, age, level of

education, acreage of farm land, and average seasonal income from farming. Section two was on the contribution of socio-economic factors that influence the application of knowledge acquired through training. Some of the issues considered under the section were knowledge about the effect of pesticides use on the health of farmers, level of knowledge with the use of pesticides, understanding on how pesticides should be mixed, and satisfaction with lessons from the training programme.

The third section was on the contribution of socio-economic factors to the type of attitudes developed through training. Issues considered under the section included perceptions on attitudinal statements such as pesticides improve crop yield, pesticides improve the shelf life of crops, pesticides are not harmful to farmers, and frequent application of pesticides improve the growth of crops. Section four was on the contribution of socio-economic factors on the application of skills acquired through training in the use of pesticides. Some of the issues captured under the section were frequency of applying pesticides to crops before and after training, protective gears used by farmers when applying pesticides to crops before and after the training, eating during the application of pesticides, and reading and following label instructions before and after the training. Both close and open-ended questions were used to solicit views from the respondents.

### **3.5 Method of data collection**

The researcher first introduced herself to the respondents with an introductory letter from school, indicating the name, title and purpose of the study. The aim was to secure the consent of the respondents and their readiness to participate in the study before carrying out with the data collection exercise. After securing their consent,

the researcher verbally administered the questionnaire to the farmers and recorded the appropriate responses. Further probing was done to seek better clarification of certain responses. It took the researcher a month to gather the data.

### **3.6 Field challenges**

Some of the challenges encountered in the data collection process were resistance from some of the farmers to participate in the study, difficulty locating some of the sampled farmers, and rain-offs. Thus, some of the farmers initially thought the study was from the EPA to assess the safety of the production processes of vegetables in the metropolis. In addition, the data collection had to be postponed on three occasions due to rains. The researcher had to schedule different appointments with the farmers to enable them being interviewed.

### **3.7 Data analysis**

The data was first edited to check for consistencies and grammatical errors. Each instrument was given an identification number to avoid double entries and data loss. The edited data were coded and processed with Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics such as mean, frequencies, and percentages were used to analyse the quantitative data, while content analysis was used to analyse the qualitative data. The conventional content analysis approach was used where coding categories were derived directly from the text data. Inferences were made from the narratives and appropriate explanations were given.

### **3.8 Summary**

This chapter deliberated upon the means within which the study was undertaken. It made discussions on the research design adopted, the sample size and sampling technique and the research instrument used. A mixed model research was used in the study where both quantitative and qualitative data were collected. A simple random sampling method was employed to select 100 vegetable farmers in the Accra Metropolitan area.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.0 Introduction

This chapter presents the results and discussion of the data gathered from the field. The chapter is organised under the background characteristics of respondents, contribution of socio-economic factors to respondents' knowledge acquired on pesticide use, contribution of socio-economic factors to respondents' attitudes towards pesticide use, and contribution of socio-economic factors to the application of skills acquired through training on pesticide use.

#### 4.1 Background characteristics of respondents

##### 4.1.1 Gender of respondents

This section presents the background characteristics of respondents. It included gender, age, level of education, and acreage of farm land. From Table 1, the majority (85%) of the respondents were males, whereas 15% were females.

**Table 1: Gender of respondents**

Gender	Frequency	Percentage (%)
Male	85	85
Female	15	15
<b>Total</b>	<b>100</b>	<b>100</b>

Source: Field survey, 2015

#### 4.1.2 Age of respondents

This section presents the age characteristics of the respondents. Table 2 shows that 60% of the respondents belong to the young age group that is between 21 and 40 years, 36% belong to the middle age thus between 41 and 60 years of age, while 4% belong to the old age thus above 60 years of age, respectively. The results show that the majority (60%) of the respondents were within the economically active working age of 21 and 40 years. The mean age of the respondents was 38.3 years with a standard deviation of 6.2.

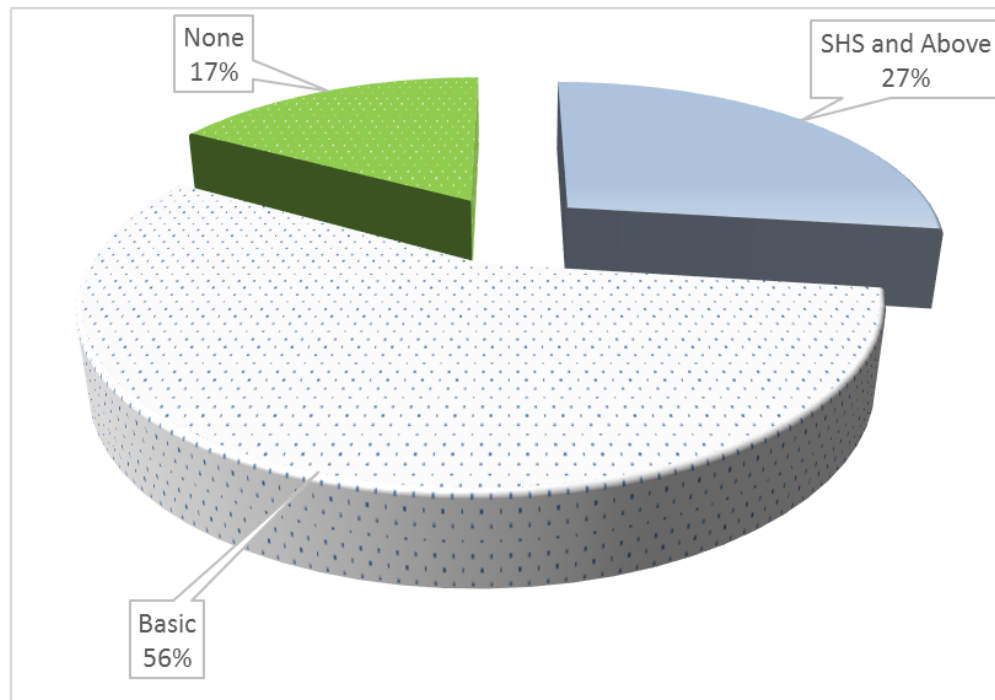
**Table 2: Age characteristics of respondents**

Age group	Frequency	Percentage (%)
Young	60	60
Middle age	36	36
Old	4	4
<b>Total</b>	<b>100</b>	<b>100.0</b>

Source: Field survey, 2015

#### 4.1.3 Level of education of respondents

The study further examined the level of education of the respondents. This was necessary because Armah (2011) posited that farmers with high level of educational qualification have better understanding on improved and modern practices in the use of pesticides than those with low level of education. The results are presented in Figure 1.



**Figure 1: Level of education of respondents**

Source: Field survey, 2015

Figure 1 shows that 17% of the respondents had not attained any formal educational qualification, the majority (56%) had basic education as their highest level of education, whereas 27% had Senior High School (SHS) and above as their high levels of educational attainment. The results show that the respondents had varied levels of educational attainment. This is likely to influence their level of understanding and practices in the use of pesticides as indicated by Armah (2011) that attitudes and practices of farmers with the use of pesticides vary across various levels of educational attainment.

#### **4.1.4 Average seasonal income of respondents**

The respondents were asked to indicate their average seasonal income from farming (Table 3). This was essential because it was perceived that a farmer's level of

income from farming could influence his or her willingness to secure the necessary safety equipment to use pesticides.

**Table 3: Average seasonal income of respondents**

Income	Frequency	Percentage (%)
Low	50	50
Middle	42	42
High	8	8
<b>Total</b>	<b>100</b>	<b>100.0</b>

Source: Field survey, 2015

The study found that the average seasonal income from farming ranged from GH¢ 300 to GH¢ 1,500. The mean seasonal income from farming was GH¢ 563.4 with a standard deviation of 89.6. The implication is that it is part of such seasonal income that farmers have to use to secure the necessary safety and protective equipment to use during the application of pesticides.

#### **4.1.5. Number of farming years**

The number of years the respondents had engaged in farming activities ranged from three years and seventeen years. The mean number of years of engaging in farming activities among the respondents was 7.9 with a standard deviation of 1.6. The results imply that the farmers have been engaging in the use of pesticides for some considerable number of years, which is likely to build their experience and attitude in pesticide use.

## **4.2 Contribution of socio-economic factors to respondents' knowledge acquired on pesticide use**

The first research objective sought to examine the contribution of socio-economic factors to farmers' knowledge acquired through training. This was necessary because one of the main objectives of the training programme from MoFA was to improve farmers' knowledge and level of understanding with the use of pesticides. According to Horna et al., (2007) farmers' attitudes and practices with the use of pesticides emanate from their knowledge levels in pesticide use. Ospina et al., (2009) suggest that efforts to improve farmers' knowledge on pesticide use are critical to help guarantee safety in the application of pesticides as well as to ensure the wholesomeness of foods. Some of the issues considered under the section were effects of pesticides on the health of farmers, understanding on how pesticides should be mixed and understanding on the correct rate and time of pesticide application.

### **4.2.1 Contribution of gender to knowledge acquired on pesticide use**

The study examined the knowledge of the respondents on the effect of pesticides on the health of farmers. Some of the effects indicated by the farmers were skin rashes, eye infections, breathing problems, stomach problems, vomiting and heart problems. The results show that the farmers had knowledge on effects of pesticide use on their health. The following narratives represent the typical response of vegetable farmers understanding on the effect of pesticides on their health;

*“Pesticides can cause rashes and other irritations to the skin if not properly used and also you sometimes do not feel like eating after spraying or when someone close to your farm sprays his or her crops” (Cabbage farmer from Korle Bu).*

*“Pesticides could cause liver and kidney diseases if not used according to the recommended instructions”. (Lettuce farmer Ablekuma )*

*“It was after the training that I realised that the persistent itching of my eyes was not piles but rather poor body protection and practices when using pesticides”.(Pepper farmer from Korle Bu)*

These narratives show that the farmers had practical knowledge as well as experience on the health implications associated with the use of pesticides. Thus, the farmers were directly able to associate some of the physical symptoms the experience with some of the illnesses to understand the cause of such diseases. This is likely to encourage them to adopt safety practices in pesticide use as indicated by Recena and Caldas (2008) that knowledge about the health implications with pesticide use compels farmers to adopt improved and safe practices in the application and use of pesticides.

The narratives are in line with the training the farmers benefitted from because the training programme also aimed at sensitizing farmers on the health implications of using pesticides wrongly. This is an indication that the farmers understand that the frequent and continuous use of pesticides could be generally harmful to their health if not used accordingly.

The study further examined the understanding of the respondents on how pesticides should be mixed. From the study, some of the issues indicated were ensuring the right quantity of pesticides mixed for the farm, right quantity of water used to mix the pesticides, wearing protective gears in the mixing to avoid negative health

implications on farmers, and mixing pesticides on the farm and not to mix it from the house. The results show that the farmers had various understanding about the mixing of pesticides. The following narratives represent statement typical of vegetable farmers understanding on how pesticides should be mixed;

*“In mixing pesticides I have to be in protective cloths and also ensure that chemicals with the same efficacy are mixed together in order to maintain the strength of the chemical when I spray”.* (Lettuce farmer from Dzorwulu)

*“I understood after the training that pesticides should be mixed according to the specification and instruction given and also keep children, food and dishes away from the area where the mixing is done”.* (Cabbage farmer from Korle bu)

*“I always ensure that the right quantity of pesticide is mixed with the correct quantity of water in order to maintain the correct concentration of chemical needed for my crops”.* (Onion farmer from Plant Pool)

The above narratives suggest that the respondents have excellent understanding on how pesticides should be mixed.

Another issue considered under the first research objective was the understanding of the respondents on the correct rate of pesticide application. From the study, some of the issues indicated were applying pesticides twice in a season, when one identifies sizeable number of pests in a farm, and when the crops starts bearing fruits and should not be done so close to harvest. The results show that the respondents had various levels of understanding on the rate of pesticide application on farms. However, it was specified that the correct rate of pesticide application depended on the type of crop cultivated by a farmer. Vegetable farmers' general views on the correct rate of pesticide application are express in the following narratives;

*“We learnt after the training that when we apply pesticides we should allow reasonable amount of time at least two weeks before the next spraying”. (Pepper farmer at Dzorwulu )*

*“I learnt it is ideal to avoid spraying of our vegetables a week to harvest so as to reduce the pesticide residue in the crops”. (Lettuce farmer at Plant Pool)*

*“I understand that it is best to apply pesticide when there are a sizeable number of pests on the field and at the recommended spraying interval”. (Cauliflower farmer, Ayawaso)*

The above narratives are a clear indication that vegetable farmers in the area have good understanding regarding the correct rate of pesticide application.

The respondents were also requested to indicate their level of understanding on the correct time of applying pesticide on crops. The study found that the respondents understood the correct time to be before the rains and after the rains. The idea was that during the rains the pesticide could easily be washed away. Most of the respondents in the study admitted acquiring the right knowledge on the correct time of pesticide application after the training and this is shown in the following narratives;

*“I understood after the training that pesticides should be applied on a calm day, preferably in the morning when there is less wind”. (Tomato farmer from Plant Pool)*

*“Spraying late in the evening is one thing I learnt from the training”. (Cabbage farmer from Osu klottey)*

These narratives imply that all the respondents who benefitted from the training had indeed acquired the right and relevant knowledge on the correct time of pesticide application.

#### **4.2.2 Contribution of level of education to knowledge acquired by respondents on pesticide use**

The knowledge of respondents with none education, basic, SHS and above educational qualifications were examined.

The issue on the effect of pesticides on the health of farmers, the respondents with no and basic education expressed the general view that;

*“Pesticides could cause liver and kidney diseases if not used according to the recommended instructions”. (Cabbage farmer from Korle Bu )*

*“It was after the training that I understood why I sometimes feel dizzy and nausea after spraying”. (Sweet pepper farmer Dzorwulu)*

On the other hand, respondents with SHS and above expressed the following views;

*“I read on the issue before the training and this enabled me ask all the relevant questions during the training and as such I now understand better that pesticides could cause liver and kidney diseases if not used according to the recommended instructions”. (Lettuce farmer Ablekuma )*

*“Pesticides can cause skin irritations if not used properly”. (Lettuce farmer from Osu Klottey)*

On respondents understanding on how pesticide should be mixed, all the farmers of the various educational qualifications had similar views. The

following narratives are the typical views of farmers on how pesticides should be mixed;

*“Pesticides with similar efficacy should be mixed together so as to maintain the needed concentrations for the crops”.* (Spring onion farmer from Dzorwulu)

*“I have learnt from the training that in mixing pesticides I have to be in my protective gears in order to avoid infections”.* (Sweet pepper farmer from Plant Pool)

*“I have learnt from the training that in mixing pesticides I have to follow all the recommended instructions on the label”.* (Cabbage farmer from Plant Pool)

On respondents understanding on the correct rate of pesticide application all the respondents had similar views on this issue. The following narratives are the typical views of the respondents on the correct rate of applying pesticides;

*“I have learnt from the training that when we spray we should allow reasonable intervals before spraying again”.* (Sweet pepper farmer from Plant Pool)

*“After the training I understood the importance of allowing at least two weeks before the next spraying”.* (Cabbage farmer from Plant Dzorwulu)

With respect to the respondents understanding on the correct time of applying pesticides; they expressed the general view that;

*“I have learnt from the training that to spray early in the morning and late in the evening is the best time to spray”.* (Sweet pepper farmer from Osu Klottey)

*“I understood after the training that spraying should be done on a less windy day and when the weather is windy the spraying should be done in the direction of the wind”.* (Sweet pepper farmer from Plant Pool)

The above narratives on respondents understanding on how pesticides can affect their health, how pesticide should be mixed, the correct rate and time of pesticide

application is a clear indication that the respondents of the various educational attainment acquired the right knowledge in the use of pesticides because the views they expressed are exactly in line with what the organizers of the training programme taught them. This has been confirmed by Bhanti and Taneja (2005) that agricultural training courses exert high influence on farmers' knowledge. It can also be deduce from the narratives that respondents with higher educational qualifications might have previously read on the various issues and as such the training helped them to understand better than those with none or low educational levels. This explains why Deressa, et al., (2009) reported that higher level of education is believed to be associated with access to information and knowledge enhancement.

#### **4.2.3 Contribution of age to knowledge acquired by respondents on pesticide use**

The study further examined the age of respondents and their understanding on how pesticides can affect their health, how pesticide should be mixed, the correct rate and time of pesticide application.

On the issue of the effect of pesticides on the health of farmers, the respondents of the various age groups expressed the following typical views;

*“I understood after the training that pesticides can be harmful to the body if it is inhaled”*. (Sweet pepper farmer from Plant Pool)

*“I understood after the training that spraying eye diseases if it enters ones eye”*. (Cabbage farmer from Plant Pool)

With regards to respondents understanding on how pesticides should be mixed the young, old and middle age farmers generally expressed the following views;

*“I understood after the training that pesticides should be mixed according to the specifications on the label”.* (Lettuce farmer from Dzorwulu)

*“I understood after the training that pesticides should always be mixed on the farm and not in the house”.* (Lettuce farmer from Korle Bu)

*“I understood that the right quantity of water needed should be mixed with the right quantity of chemical because it is likely left over chemicals might be poured into drains nearby”* (Cabbage farmer from Korle Bu)

In relation to respondents knowledge on the correct rate of pesticide application, all the farmers of the various age group were of the view that;

*“It was after the training that I realized the need why pesticides should be sprayed according to the recommended spraying interval”.* (Spring onion farmer from Dzorwulu)

*“I use to spray every week but I have to stop because I learnt from the training that frequent spraying could increase the residual effect of the chemical in the crops”.* (Cauliflower farmer from Plant Pool)

On the issue of farmers knowledge on the correct time of applying pesticides, all the respondent of the various age groups had similar views. The following represent the typical views of farmers on the issue;

*“I learnt from the training that spraying should be done in the direction of the wind”.* (Lettuce farmer from Dzorwulu)

*“The training helped me to understand that when spraying is done in the mornings one is always sure of spraying the target and nothing else”.* (Cabbage farmer from Dzorwulu)

The above narratives on respondents understanding on how pesticides can affect their health, how pesticide should be mixed, the correct rate and time of pesticide application in relation to age of respondents suggest that, the farmers of the various age groups had similar understanding. It means that the age of the respondents in the area has no influence on knowledge acquisition. This support a study by Ntow et al., (2006) that age has no influence on having knowledge on safety use of pesticides. It can therefore be concluded that age does not influence knowledge acquisition. Whether one is young, old or middle age the can acquire the same knowledge. However, this is inconsistent with the findings by Kumari and Reddy (2013) who identified that age and experience of farm workers influence their knowledge and attitudes and as well as on their practices.

#### **4.2.4 Contribution of income to knowledge acquired by respondents on pesticide use**

Another issue considered was the average seasonal income of the respondents and their understanding on how pesticides can affect their health, how pesticide should be mixed, the correct rate and time of pesticide application. The following narratives represent the general views of respondents on the issue;

*It was after the training that I realised that the persistent itching of my eyes was not piles but rather poor body protection and practices when using pesticides".(Cabbage farmer from Korle Bu)*

*"It was after the training that I understood why I sometimes feel dizzy and nausea after spraying". (Lettuce farmer Dzorwulu)*

On respondents understanding on how pesticide should be mixed, all the farmers of the various income levels had similar views. The following narratives are the typical views of farmers on how pesticides should be mixed;

*“I understood the importance of keeping children, food and dishes away from the area where the mixing is done after the training”.* (Sweet pepper farmer from Korle Bu)

*“I have learnt from the training that in mixing pesticides I have to be in my protective gears in order to avoid infections”.* (Cabbage farmer from Plant Pool)

*“I understood after the training that pesticides should always be mixed on the farm and not in the house”.* (Lettuce farmer from Korle Bu)

On respondents understanding on the correct rate of pesticide application all the respondents of low income levels shared their views on this issue. The following narratives are the typical views of the respondents on the correct rate of applying pesticides;

*“I use to spray very often but I learnt after the training that it is ideal to avoid spraying of our vegetables a week to harvest”.* (Spring onion farmer from Plant Pool)

*“I understood the importance of following the recommended spraying rate on the label of pesticide before using any new chemical”* (Sweet pepper farmer, Plant Pool)

On the other hand, respondents with high income levels expressed the following typical views on the issue;

*“Although participating in several agricultural programmes improved my knowledge in the use of chemical I now appreciate better after this particular training the need to spray at a reasonable interval to reduce the residual effect of chemical in my crops”* (Lettuce farmer, Korle Bu)

*“I understand after the training that it is best to apply pesticide when there are a sizeable number of pests on the field and at the recommended spraying interval”. (Cauliflower farmer, Ayawaso)*

With respect to the respondents understanding on the correct time of applying pesticides; they expressed the following general views;

*“Spraying late in the evening is one thing I learnt from the training”. (Cabbage farmer from Osu Klottey)*

*“Although I learnt from other trainings I understood better after the training the need why pesticides should be applied on a calm day, preferably in the morning when there is less wind”. (Tomato farmer from Plant Pool)*

The above narratives on respondents understanding on how pesticides can affect their health, how pesticide should be mixed, the correct rate and time of pesticide application in relation to their incomes shows that the respondents indeed acquired almost all the information on the various issues. It can be inferred from the narratives of high income earning respondents that they had better understanding of issues than low and middle income earners. This could be due to the fact that most high income farmers usually participate and adopt innovation introduced to them and might have previously learnt on some safe practices in the use of pesticides. This explains why Rogers (2010) in the diffusion theory classified farmers with high financial status as innovator because they have the ability to understand and apply complex technical knowledge. The observation from study support the findings by Ribhoi (2013) who identified that, income is one of the factors influencing the increase of knowledge level of farmers towards the use of recommended practices. This is an indication that the higher the level of income of a farmer the higher would be his or her level of knowledge in the use of pesticides.

### **4.3 Contribution of socio-economic factors to farmers' attitudes towards pesticide use**

The second research objective sought to investigate the impact of socio-economic factors to the type of attitudes developed through training on pesticide use. The focus was to examine how socio-economic factors contribute to farmers attitudes towards the use of pesticides. Some of the issues considered under the section were improving crop yield, improving the shelf life of crops, harmful to farmers, and improving the taste of crops.

#### **4.3.1 Contribution of gender to respondents' attitude towards pesticide use**

This section assesses the contribution of gender to respondents' attitudes towards pesticide use. A chi-square test was performed to examine the relationship between gender and the various attitudinal statements. With reference to Table 4 the relationship between these variables was significant, ( $\chi^2 = 10.34$ ;  $df = 4$ ;  $p = 0.01$ ). This means that the gender of respondent is likely to demonstrate positive attitudes towards pesticide use. It is interesting to note that, higher proportion (75%) of the male respondents had positive attitudes towards the contribution of pesticides to crop yield, also majority (66.6%) of female respondents also had positive attitude towards pesticide use. This shows that, the male respondents have more positive attitudes towards pesticide use than the female respondents. The result agrees with Atreya, (2007) and Garcia (2003) who identified that, knowledge, perceptions, and practices of pesticide use differ by gender. The high positive attitude of the male respondents may be due to the fact that men are more likely to attend trainings, participants in group discussions and, usually the household visit respondents and might have more information on pesticides than the females.

This is shown in the following narratives by the male respondents;

*“I have benefitted from several agricultural programmes on agrochemicals and I have learnt that applying pesticides appropriately is one of the surest way of getting good yield in areas of high pest infestation”.* (Sweet pepper farmer from Korle Bu)

*“My frequent interaction with the extension officer has helped to increase the yields of my crops partly because he helped me develop pesticides application schedule which I have been following strictly”.* (Cabbage farmer from Plant Pool)

**Table 4: Gender and farmers attitudes towards pesticides use**

Gender	Attitudinal statement					Total
	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	
Male	20(23.6)	45(52.9)	11(12.9)	7(8.3)	2(2.3)	85(100)
Female	5(33.3)	5(33.3)	2(13.4)	3(20)	-	15(100)
Total	25	50	13	10	2	100

Source: Field survey, 2015. ( $\chi^2 = 10.34$ ,  $df = 4$ ,  $p$  value = 0.01, and  $p < 0.050$ )

The above narratives which are typical of the respondents show that knowledge has influence on their perceptions and attitudes towards pesticide use and this could be attributed to their access to information and education.

#### **4.3.2 Contribution of level of education to respondents’ attitudes towards pesticides use**

It has been observed that there is significant relationship ( $\chi^2 = 5.91$ ,  $df=8$ ,  $p$  value = 0.02, and  $p < 0.050$ ) (Table 5) between level of education of the respondents and their attitudes towards pesticide use. Table 5 shows that, while all the respondents

with SHS and above educational status strongly agreed and agreed that pesticides are harmful to consumers' health, the majority of the respondents without any formal educational qualification (66.5%) and those with basic educational qualification (66.1%) disagreed and strongly disagreed. The results show that, while the respondents with high levels of education had negative attitudes towards pesticides and their effect on consumer health, those with low levels of education had positive attitude towards it. This can be attributed to the fact that farmers with higher educational attainment have better understanding of issues than those with no or low educational status and this is likely to influence their attitudes. This is supported by a research finding according to Asfaw & Admassie (2004) who stated that farm workers with higher educational backgrounds exhibited better understanding of issues during trainings on chemical and fertilizer use.

**Table 5: Level of education to respondents' attitude towards pesticides use**

Educational level	Attitudinal statement					Total
	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	
No education	5(18.5)	13(48)	2(7.6)	7(25.9)	-	27(100.0)
Basic education	13(23.2)	24(42.9)	7(12.5)	9(16)	3(5.4)	56(100.0)
SHS & Above	2(11.8)	2(11.8)	2(11.8)	7(41.1)	2(11.8)	17(100.0)
Total	20	39	11	23	7	100

Source: Field survey, 2015. ( $\chi^2 = 5.91$ ,  $df = 8$ ,  $p$  value = 0.02, and  $p < 0.050$ )

This agrees with the findings of Ngowi et al., (2002) that socio-economic characteristics such as educational level play a critical role in the determination of farmers' attitude towards the use of pesticides. The implication is that farmers with high levels of education are more likely to reduce the rate of pesticide applications

on their crops than those with low levels of education. The results show that more farmer education is needed to correct such negative attitudes of farmers towards the use of pesticides. According to Ntow et al., (2006) attitudinal changes requires more training and consultations since attitudes form part of people and are used to practice particular lifestyle over a long period of time.

The following narratives are the general views of farmers with positive attitudes towards pesticides improving the shelf life of crops.

*“My vegetables are able to store well and look bright even three days after harvest”.*(Spring onion farmer Osu Klottey)

*“The pesticides prevent pests and other insects from eating our crops and this help to maintain the market value of our crops even days after harvest compared to when we do not use pesticides”.*(Lettuce farmer Ablekuma)

The study, however, found that the farmers were more interested in the crop life under their care to avoid losses and as such will do everything possible to enhance the market value of their crops. This implies that they will continue to use more pesticides as much as possible. This shows that economic factors sometimes determine the attitudes of farmers towards the use of pesticides on crops. The results agree with the assertion of Ospina et al., (2009) that socio-economic factors play a critical role in the acceptance and changing of farmers’ attitudes with respect to the use of pesticides and other improved farming methods. On the other hand the following narratives are examples typical of how respondents with negative attitudes expressed their concerns;

*“I understand that pesticides can cause harm to humans and their environment and as such I only apply pesticides as and when the need be”* (Spring onion farmer Osu Klottey)

*“I ever a new pesticide is introduced I take my time to read all the information on it before applying because I know it can easily cause harm to my body”*(Cabbage farmer, Dzorwulu)

It can be deduced from the above statements from vegetable farmers with high educational qualification that their knowledge on the adverse effect of pesticides are relatively accurate which could mean that they might have understood almost all the information they have received on pesticides, in effect the reason why they have developed negative attitudes towards pesticide use.

#### **4.3.3 Contribution of age of respondents’ to attitudes attitude towards pesticides use**

Another issue considered under the section was the contribution of age to farmers’ attitude towards pesticide use. With reference to Table 6, the chi square result shows that the relationship between the two variables (age and attitudes towards pesticide use) was significant, ( $\chi^2 = 6.01$ ;  $df = 8$ ;  $p = 0.03$ ). The result means that age has a relationship with attitude towards pesticide use. Table 6 shows that majority (93.3%) of the respondents belonging to the young age group and (88.6%) of those belonging to the middle age strongly disagreed and disagreed that pesticides are not harmful to farmers, however, majority (75%) of the respondents of the old age group agreed and strongly agreed pesticides are not harmful to farmers.

**Table 6: Age and farmers attitude towards pesticides use**

Age	Attitudinal statement					Total
	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	
Young	-	-	4(6.7)	33(55)	23(38.3)	60(100)
Middle age	-	4(11.1)	-	30(83.3)	2(5.6)	36(100)
Old	2(50)	2(50)	-	-	-	4(100)
Total	2	6	4	63	25	100

Source: Field survey, 2015. ( $\chi^2 = 6.01$ ,  $df = 8$ ,  $p$  value = 0.03, and  $p < 0.050$ )

It can be deduced from the table that the farmers generally perceived pesticides as harmful to their health. This is likely to compel them to adopt safety practices to avoid bodily harm and infections as specified by Recena and Caldas (2008) that farmers' attitudes and perceptions influence their practices with the use of pesticides.

Table 5 further shows that apart from the respondents of the old age group, who had positive attitude towards the harmful nature of pesticides to farmers, the majority of the remaining respondents from the various age cohorts had negative attitude towards the use of pesticides and farmers health. Thus, the majority of respondents from various age cohorts were aware of the dangers pesticides could cause to them. This is how some respondents who had positive attitude towards the use of pesticide expressed their typical views;

*“I have been using pesticides for so many years but I have not experienced any of such negative health implications”.*  
(Cabbage farmer from Korle Bu)

*“Next year will be twenty years since I started using pesticides but as you can see I am still strong and I hardly fall sick”.*  
(Lettuce farmer from Korle Bu)

The results show that some of the farmers still hold their old attitudes towards the use of pesticides after the training programme. The result agrees with Kumari and Reddy (2013) who identified that age and experience of farm workers influence their knowledge and attitudes and as well as on their practices. Thus, some of the farmers either want personal experience with some of the harmful effects from pesticides before they can change their attitude or were not convinced by the lessons from the training programme.

#### 4.3.4 Contribution of income to respondents’ attitude towards pesticides use

The study further examines the contribution of income to respondents’ attitude towards pesticide use. Result of the chi square tests from Table 6 shows that the relationship between the two variables was significant, ( $\chi^2 = 7.11$ ;  $df = 8$ ;  $p = 0.01$ ) (Table 7).

**Table 7: Contribution of income to respondents’ attitude towards pesticide use**

Average seasonal income	Attitudinal statement					Total
	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	
Low	-	7(25.9)	4(14.8)	13(48.1)	3(11.2)	27(100)
Middle	12(21.4)	12(21.4)	11(19.7)	14(25)	7(12.5)	56(100)
High	7(41.2)	8(47.0)	-	2(11)	-	17(100)
Total	19	27	15	29	10	100

Source: Field survey, 2015. ( $\chi^2 = 7.11$ ,  $df = 8$ ,  $p$  value = 0.01, and  $p < 0.050$ )

The table shows that majority (42.8%) of middle income earners and (88.2%) of high income farmers had positive attitude towards pesticide use. This is how they expressed their views on the issue;

*“Because I can afford I often purchase and apply any chemical recommended to me because is the best alternative method to control the high pest infestation on my farms”. (Sweet pepper from Dzorwulu)*

*“I invest a lot into my farming business because all I want is to increase my yields as such I mostly apply pesticides to my crops to protect them from pest attack”. (Cabbage farmer from Korle Bu)*

*“We are always sure of good harvest when we regularly apply pesticides to our crops if not everything will be lost to these pests”. (Lecttuce farmers Korle Bu)*

The above narratives show that the majority of the respondents had positive attitude towards the use of pesticides to improve the growth of crops. This implies that with the frequent use of pesticides they are sure of protecting their crops against pests as this will increase their harvest and eventually increase their incomes from farming. This therefore is likely to encourage them to continue to apply pesticides on their crops as argued by Karunamoorthi et al. (2011) that farmers’ attitudes towards the use of pesticides are mostly driven by economic factors.

#### **4.4 Contribution of socio-economic factors to the application of skills acquired through training**

The third research objective sought to examine the contribution of socio-economic factors on the application of skills acquired through training in the use of pesticides. The aim was to determine if socio-economic factors had influence in changing the bad practices with the use of pesticides among farmers in the Accra Metropolitan

Assembly after the training programme. Some of the issues considered under the section were protective gears used by the farmers when applying pesticides to crops before and after the training, frequency of applying pesticides on crops before and after the training programme, reading of label instructions and how leftover pesticides and containers are disposed of before and after the training programme.

#### 4.4.1 Contribution of gender to the application of skills acquired

The contribution of gender to the application of skills acquired through training was examined. This table present an analysis between gender and the use of personal protective equipment. The results of the study shows that prior to the training, 14% of the females used hand gloves against 21% males Table8. Comparing to the results after the study shows the percentage of males increasing to 66%. Thus an increase of about 45% for males and 1% for females. This implies that majority of the farmers showing responsive attitude to observing the use of hand gloves at the farm were males.

**Table 8: Gender and the use of Personal Protective Equipment**

	Before			After		
	Male %	Female%	Total	Male%	Female%	Total
Hand gloves	21	14	35	66	15	81
Nose mask	85	15	100	85	15	100
Goggles	44	12	56	62	13	75
Overall coat	8	13	21	38	14	52
Wellington boots	14	11	25	45	15	60
Head gear	20	9	29	44	14	58

Source: Field survey, 2015

\*n = 100 (multiple responses)

Similarly, the table shows the percentage of male famers increasing in the use of overall coat, wellington boots and head gear relative to that of females. The

relations of gender to farm practices reveals that more males put into practices the safety practises learnt during the training farm programme than females.

On the issue of frequency of pesticide application a higher proportion of male and female respondents expressed the following typical views;

*“I learnt after the training that indiscriminate spaying can be harmful to my health as a result I have reduce the number of times I spray”.* (Lecttuce farmers Korle Bu)

*“I used to spray every week but I have to stop because I realised after the training programme that my usual loss of appetite after each spraying was possibly due to the constant spraying I use to do”.* (Sweent pepper farmers Korle Bu)

The above narratives give an indication that there is reduction in the number of times pesticides were applied on crops and this could mean that the respondents acquired almost all the knowledge on the negative effects of pesticides on both farmers and consumers, and probably realized that some of the applications were not necessary. The results show that the training programme has contributed to change the rate at which pesticides was applied on crops. This observation might explain why Ntow et al., (2008), recommended that training programmes should be organised for farmers to improve their knowledge, attitudes and practices with the application of pesticides in agricultural production.

The study further examined how gender contributed to the reading of label instructions. The following responses are the general views of the female respondents on the issue;

*“I have never been to school so reading is one thing I do not do”*. (Cabbage farmers Korle Bu)

*“I find it difficult understanding the information I read on pesticide labels because of that I fall on friends and the agrochemical sellers to do my spraying”*. (Lettuce farmer Korle Bu)

This can be deduced from the above narratives that the training programme did not influence the farmers' interest in reading label instructions on pesticide containers. This can be attributed to the fact most of them are of poor educational background and this has been confirmed by Atreya (2007) that most female farmers have never been to school and such have influence on their understanding on issues. This therefore means that reading and understanding precautions on the labels by this group of farmers will be low and in effect they might be at a higher risk due to lower level of pesticide use safety. This gives an indication that most of the female farmers obtain information on farming from other people and not through their own readings. It can therefore be suggested that MoFA should assist the vegetable farmers by providing them regular information especially on safe use of pesticides.

On the issue of how leftover pesticides are treated after application before and after the training programme. The respondents were requested to indicate how they treated leftover pesticide solution before and after the training programme. From the study, the respondents admitted to pouring leftover solutions in the farm, continuing spraying the remaining solution on crops, selling the remaining solution to other farmers, pour them into gutters, and pouring them into water bodies. The results show that the farmers caused a lot of environmental damage before the training

programme. The respondents expressed the following general view on how they treated leftover pesticides after the training;

*“I am always in a hurry to do other things so I pour the left over solution somewhere on the farm even though I know is not a good thing to do”*. (Cabbage farmers Korle Bu)

*“I pour the left over solution into the big gutter behind my farm because is the most convenient way of disposing it of”*. (Lettuce farmers Osu Klottey)

*“I always add plenty water to the leftover solution before pouring it away”*. (Lettuce farmer Korle Bu)

The above narratives show that even though some of the farmers adopted best practices in using pesticides others still maintain their bad practice despite knowing the environmental impact of the pesticides. This gives an indication that their practices are not in consistent with their knowledge and attitudes. This could explain why Barr (2004) reported on ‘Attitude-behaviour inconsistency’. Thus what a farmer knows and believes in does not always reflect in his or her behaviour.

#### **4.4.2 Contribution of educational level to the application of skills acquired**

This table gives details of farm practices in relation to farmers’ educational level. The table shows that 6% of wellington boots users have had no formal education. 10% have had basic education and 9% have gained SHS and higher educational level (Table 9). It was also noted that after the training, 6% of wellington boots users have had no formal education, 33% of wellington boots users were basic school graduate and 21% have had SHS and above education. It was revealed that after the training, famers who have had no formal education had increased in the use of hand gloves, nose mask, overall coat and goggles but not in the use of wellington

boots and head gear. However, others who have had some considerable level of formal education had increase in the use of the safety farm practices.

This implies that farmers who have some level of education observe more safety farm practices. This might be because they can read and have better understanding on the adverse effect of pesticide application without the use of safety devices.

**Table 9: Contribution of educational level and the use of personal protective gears**

	Before training				After training			
	None %	Basic %	SHS & above%	Total	None %	Basic %	SHS & Above%	Total
Hand gloves	2	18	15	35	8	51	22	81%
Nose mask	17	56	27	100%	17	56	27	100%
Goggles	9	27	20	56	11	40	24	75
Overall coat	1	7	13	21	6	25	21	52
Wellington boots	6	10	9	25	6	33	21	60
Head gear	8	12	9	29	25	41	9	58

This is in support with a finding by Zyoud et al., (2010) that, farm workers with higher educational status have good pesticide knowledge and are more inclined to use pesticides according to the recommended guidelines for protective measures. It can therefore be stated that the education on farm practices and its safety to farmers increased their awareness to farm practises and their related health effects.

On the issue of frequency of pesticide application, respondents with none or low levels of educational qualification expressed these general views;

*“Because of the high pest infestation on my farm I do spray almost every week even though I learnt is not the best”.* (Lettuce farmer Korle Bu)

In relation to reading and following label instructions, respondents with none or basic education expressed the concerns that they do not know how to read and even if they do they do not understand some of the instructions. This is typical of how they expressed their concerns,

*“I have never been to school so reading is one thing I do not do”.* (Cabbage farmer Korle Bu)

*“I find it difficult understanding the information I read on pesticide labels because of that I fall on friends and the agrochemical sellers to do my spraying”.* (Lettuce farmers Korle Bu)

This is an indication that their poor educational backgrounds have influence on their understanding of issues. However on the issue of how leftover pesticide solutions are treated respondents with high educational levels after the training expressed their general concerns on the issue through these statements;

*“I do not pour the leftover into the drain anymore because it could be harmful to the environment”.* (Spring onion farmers Korle Bu)

*“I learnt that continuing spraying the crops with the remaining solution could increase the concentration of the chemical the crop so I have stopped”.* (Sweet pepper farmers Korle Bu)

The above narratives suggest that farmers with high educational qualification have better understanding on the issue, hence the current practices they have adopted. This confirms a study by Hammond et al., (2006) who reported that, higher level of education is believed to be associated with access to information and the adoption of improved practices. This means that, farmers with higher levels of education are more likely to adapt recommended practices in the use of pesticides.

#### 4.4.3 Contribution of age to the application of skills acquired

The table shows tabulations of age of farmers against the use of protective gears before and after the training programme. It was observed that before the training 17% of the farmers using hand gloves fell in the young age group, 14% using gloves were in the middle age bracket while 4% of them were in the old age group (Table 10).

**Table 10: Age and the use of Personal Protective Equipment**

	Before training				After training			
	Young age	Middle age	Old age	Total	Young Age	Middle age	Old Age	Total
Hand gloves	17%	14%	4%	35%	55%	22%	4%	81%
Nose mask	60%	36%	4%	100%	60%	36%	4%	100%
Goggles	37%	34%	3%	56%	36%	36%	3%	75%
Overall coat	5%	14%	2%	21%	35%	15%	2%	52%
Wellington boots	12%	12%	1%	25%	23%	34%	3%	60%
Head gear	15%	12%	2%	29%	25%	30%	3%	58%

Source: Field survey, 2015

\*n = 100 (multiple responses)

It was also noticed that after the training 55% of farmers who used gloves were young aged, while 25% were in the middle age group, 4% were in the old age group. This means that more of the comparatively younger age group increased in the use of glove, nose mask, goggles, overall coat, and wellington boots and head gear while the percentage of people in the old age group remained relatively constant. The table hence shows a gradual progression in farm practices by young and active farmers after the training. In that, more of the age group saw an increase in safe farm practices. This is similar to a finding by Kumari and Reddy (2013) that older farmers with long years of farming are likely to be careless in practicing good measures while using pesticides. This could be attributed to the fact that the younger

farmers do more of the spraying than the older ones partly because of the energy involved.

#### 4.4.4 Contribution of income to the application of skills acquired

It was observed that 1% of the farmers using overall coat had low incomes (Table 11). After the training, 10% of the farmers using overall coat were within this income group. This shows a 9% increase in usage of overall coat. Also, 8% of overall coat users earned middle incomes. After the training, 28% of overall coat users were in the same income group. Much more, 12% of overall coat users were high income earners, correspondingly the percentage increased to 14%. It can be stated from the table, that the higher the average seasonal income of a farmer the higher the chance of the farmer practicing better farming practices.

**Table 11: Average seasonal income and the use of Personal Protective Equipment**

	Before training			Total	After training		
	Low income	Middle income	High income		Low income	Middle income	High income
Hand gloves	9%	12%	14%	35%	11%	55%	15%
Nose mask	27%	56%	17%	100%	27%	56%	17%
Goggles	14%	29%	13%	56%	16%	43%	16%
Overall coat	1%	8%	12%	21%	10%	28%	14%
Wellington boots	3%	12%	10%	25%	14%	31%	15%
Head gear	2%	12%	15%	29%	13%	30%	15%

Source: Field survey, 2015

\*n = 100 (multiple responses)

Thus, the ability of a farmer to observe farm practices depends on the average seasonal income of the farmer. The higher the seasonal income the higher the safety practices observed. This agrees with a finding by Knowler and Bradshaw (2007) that

the adoption of improved agricultural practices requires sufficient financial wellbeing.

With respect to the frequency of pesticides application respondents of low and middle income levels were of the general view that;

*“We have been taught to reduce the amount of pesticides we apply but if we do that we will loss all our crops to the pest because pest infestation here is here”.* (Sweet pepper farmers Korle Bu)

*“I often apply pesticides because it help our crops to grow well and also enhance our yields because that is all we want”.* (Sweet pepper farmer Dzorwulu)

It can be inferred from the above narratives that the respondents are more interested in the yields of their crop but careless about the wholesomeness of their produce. This could be that because of their low income levels they attach much importance to their yields and will do anything possible to enhance it. This observation has been supported by Karunamoorthi et al., (2011) that farmers’ practices in the use of pesticides are mostly driven by economic factors. This therefore is likely to encourage them to often apply pesticides on their crops.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.0 Introduction**

The chapter presents the summary of major findings and the overall conclusion for the study. It also presents recommendations on how to improve the knowledge, attitude and practices on the safe use of pesticides among farmers in the Accra Metropolitan Assembly.

#### **5.1 Summary**

The purpose of the study was to examine how socio-economic factors influence the application of knowledge, attitudes and practices acquired through training among vegetable farmers in the Accra Metropolitan Assembly on the use of pesticides. The study adopted a descriptive research design. Simple random sampling technique was used to sample 100 MoFA training beneficiary farmers from a population of 137. The study used interview schedule as instrument to gather data from the respondents. Statistical Package for the Social Sciences (SPSS) version 20.0 was used to process the data. Descriptive statistics such as mean, frequencies, and percentages were used to analyse the quantitative data, while content analysis was used to analyse the qualitative data.

#### **5.2 Major findings**

This section presents the major findings of the study. The section is organised under the research objectives.

### **5.2.1 Contribution of socio-economic factors to farmers' knowledge on pesticide use**

- i. The study found that the use of computers and projectors to show pictures and videos on some of the illnesses related to bad practices in pesticide applications enabled the farmers to acquire practical knowledge as well as experience on the health implications associated with the use of pesticides. Thus, the farmers were directly able to associate some of the physical symptoms they experience with some of the illnesses to understand the cause of such diseases.
- ii. The training programme has contributed to change some of the wrong perceptions about the use of pesticides in vegetable production.

### **5.2.2 Contribution of socio-economic factors to farmers' attitudes towards pesticide use**

- i. The study found that economic factors sometimes determine the attitudes of farmers towards the use of pesticides on crops. As a result, some of the farmers preferred using pesticides to get higher yield and get produce ripened to avoid losses than considering the wholesomeness of their produce.
- ii. Some of the farmers still hold their old attitudes towards the use of pesticides after the training programme. Thus, some of the farmers either want personal experience with some of the harmful effects from pesticides before they can change their attitude or were not convinced by the lessons from the training programme.
- iii. Many of the respondents had positive attitude towards pesticides. The implication is that many of the respondents were aware of the public health concerns about the use of pesticides on crops.

- iv. From the study, while the respondents with high levels of education had negative attitudes towards pesticides and their effect on consumer health, those with low levels of education had positive attitude towards it. The implication is that farmers with high levels of education are more likely to reduce the rate of pesticide applications on their crops than those with low levels of education.

### **5.2.3 Contribution of socio-economic factors to farmers' practices on pesticide use**

- i. The study found that the training programme has contributed to change the rate at which pesticides was applied on crops among respondents with higher educational qualifications however, the practices of farmers with poor educational background remained unchanged.
- ii. It was found from the study that there has been a gradual improvement in the use of protective gears when applying pesticides to crops after the training programme.
- i. The training programme has contributed to develop the interest in reading label instructions on pesticide containers and following such instructions among respondents with higher educational qualification in the application of pesticides on crops.

## **5.3 Conclusions**

Application of pesticides to crops has become necessary because most farm lands are not allowed to undergo natural fallowing to replenish its nutrients. Pesticides help to protect crops from pests and insects as well as help to boost nutrients crops need to grow. However, the appropriateness of the modes of applying pesticides has been the bane of MoFA. As a result, MoFA organised a training programme to

improve the knowledge, attitudes and practices of vegetable farmers in line with their socio economic characteristics in the Accra Metropolis. The focus of the study was to examine the contribution of socio-economic factors improving the level of knowledge, attitude and practices of farmers.

The study found that the farmers were using a number of practices that are injurious to themselves, consumers and the environment even after benefiting from the training programme from the MoFA. Although the use of protective gears has improved there is the need to continually encourage them to use them more often. Most farmers perceived applying more pesticides guarantees high farm yield.

Educational level of farmers was the main socio-economic variable that explained differences in the attitudes of farmers. Thus, while the respondents with high levels of education had negative attitudes towards pesticides and their effect on consumer health, those with low levels of education had positive attitude towards it. This is because farmers with high level of education can read and understand how poisonous pesticides are and will tend to take adequate precautions in handling pesticides hence will develop negative attitudes towards pesticides use. On the other hand information from the field indicate that uneducated or less educated farmers usually receive inadequate information on pesticides by word of mouth either from friends or families and might not have better understanding of the adverse effect of pesticides. This will likely influence their positive attitudes towards pesticide use since they always depend on what they have been told.

Nevertheless, the study found that the training programme contributed to change some of the poor attitudes and practices associated with the use of pesticides. The implication is that farmer training programmes are essential in improving farmers' knowledge, attitudes and practices with the use of pesticides. This could also contribute to protect the health and safety of both farmers and consumers. The study concludes that farmer training programmes play a critical role in the development and changing of knowledge, attitudes and practices of farmers.

#### **5.4 Recommendations**

Based on the major findings of the study, the following recommendations were made to improve the safe use of pesticides among vegetable farmers in the Accra Metropolis.

- i. The study recommends that subsequent training programmes by MoFA should involve testimonies from the farmers about the negative health implications they have experienced due to bad practices with the use of pesticides on their farms. This is expected to convince some of the farmers who still possess certain attitude that compels them to use bad practices with the use of pesticides on their farms. This is necessary because some of the farmers perceived the pictures and demonstrations of some of the negative health implications as foreign. As a result, testimonies from among them could help reduce bad practices associated with the use of pesticides.
- ii. The study suggests that MoFA should organise more training programmes for the farmers to help change some of the negative attitudes towards the use of pesticides. This is important because attitudes are part of the lifestyle of the farmers and require more training programmes and monitoring to change them.

Thus, more training programmes would help bridge and improve knowledge, attitude and practice gap among farmers with different levels of education.

- iii. The study recommends that MoFA should provide extension services to the farmers to monitor and continue encourage them to adopt improved practices in the use of pesticides. The monitoring activities from extension officers may also help to address some practical challenges farmers may be encountering in the pesticide application process.

### **5.5 Suggestion for further study**

The study suggests that further study should compare the knowledge, attitudes and practices of beneficiary and non-beneficiary farmers. Such a study would inform how well the beneficiary farmers are able to influence the others through the knowledge acquired from the training programme.

## References

- Abdulai, A., & Huffman, W. (2014). The adoption and impact of soil and water conservation technology: An endogenous switching regression application. *Land Economics*, 90(1), 26-43.
- Akudugu, M. A., Guo, E., & Dadzie, S. K. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions. *Journal of Biology, Agriculture and Healthcare*, 2(3).
- Amoah, P., Drechsel, P., Abaidoo, R. C., & Ntow, W. J. (2006). Pesticide and pathogen contamination of vegetables in Ghana's urban markets. *Archives of environmental contamination and toxicology*, 50(1), 1-6.
- Amoako, P. K. (2010). *Assessment of pesticides used to control insect pests and their effects on storage of cabbage (Brassica oleracea var capitata)-A case study in Ejisu-Juaben Municipal Area*. Unpublished Doctoral Thesis.
- Anaeto, F. C., Asiabaka, C. C., Nnadi, F. N., Ajaero, J. O., Aja, O. O., Ugwoke, F. O., ... & Onweagba, A. E. (2012). The role of extension officers and extension services in the development of agriculture in Nigeria. *Wudpecker Journal of Agricultural Research Vol. 1 (6)*, 180-185.
- Armah, F. A. (2011). Assessment of pesticide residues in vegetables at the farm gate: Cabbage (*Brassica oleracea*) cultivation in Cape Coast, Ghana. *Research Journal of Environmental Toxicology*, 5(3), 180-202.
- Asfaw, A., & Admassie, A. (2004). The role of education on the adoption of chemical fertiliser under different socioeconomic environments in Ethiopia. *Agricultural Economics*, 30(3), 215-228.

- Atkin, J., & Leisinger, K. M. (2000). *Safe and effective use of crop protection products in developing countries*. CABI Publishing.
- Atreya, K. (2007). Pesticide use knowledge and practices: A gender differences in Nepal. *Environmental Research*, 104(2), 305-311.
- Badrie, N. (2006). Pesticide Use and Human Health in Northwestern Jamaica from. In *The 2006 West Indies Agricultural Economics Conference* (pp. 137-147).
- Baker, E. W., Al-Gahtani, S. S., & Hubona, G. S. (2007). The effects of gender and age on new technology implementation in a developing country: Testing the theory of planned behavior (TPB). *Information Technology & People*, 20(4), 352-375.
- Bandara, B. M. D. P., Abeynayake, N. R., Bandara, L., & Anjalee, G. H. I. (2013). Farmers' perception and willingness to pay for pesticides concerning quality and efficacy. *The Journal of Agricultural Sciences*, 8(3), 153.
- Barr, S. (2007). Factors influencing environmental attitudes and behaviors A UK case study of household waste management. *Environment and behavior*, 39(4), 435-473.
- Bempah, C. K., & Donkor, A. K. (2010). Pesticide residues in fruits at the market level in Accra Metropolis, Ghana, a preliminary study. *Environmental monitoring and assessment*, 175(1-4), 551-561.
- Bhanti, M., & Taneja, A. (2007). Contamination of vegetables of different seasons with organophosphorous pesticides and related health risk assessment in northern India. *Chemosphere*, 69(1), 63-68.
- Bowman, M. S., & Zilberman, D. (2013). Economic factors affecting diversified farming systems. *Ecology and Society*, 18(1), 33.

- Cantor, A., & Young-Holt, B. (2002). Pesticide-related symptoms among farm workers in rural Honduras. *International journal of occupational and environmental health*, 8(1), 41-45.
- Chowdhury, M. T. I., Razzaque, M. A., & Khan, M. S. I. (2011). Chlorinated pesticide residue status in tomato, potato and carrot. *Journal of Experimental Sciences*, 2(1).
- Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative*. Prentice Hall.
- Davis, K. (2008). Extension in sub-Saharan Africa: Overview and assessment of past and current models and future prospects. *Journal of International Agricultural and Extension Education*, 15(3), 15-28.
- David, S. (2007). Learning to think for ourselves: Knowledge improvement and social benefits among farmer field school participants in Cameroon. *Learning*, 14(2).
- Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global environmental change*, 19(2), 248-255.
- Dwyer, C. M., & Turner, S. P. (2007). Welfare assessment in extensive animal production systems: challenges and opportunities. *ANIMAL WELFARE-POTTERS BAR THEN WHEATHAMPSTEAD*-, 16(2), 189.
- Food and Agriculture Organization of the United Nations & Geneva, United Nations Environment Programme [Available at: <http://www.pic.int/>]
- Edmeades, S., & Smale, M. (2006). A trait-based model of the potential demand for a genetically engineered food crop in a developing economy. *Agricultural Economics*, 35(3), 351-361.

- EPA (2007). National Profile to Assess the Chemicals Management Infrastructure in Ghana. Environmental Protection Agency: Accra.
- Essumang, D. K., Doodoo, D. K., Adokoh, C. K., & Fumador, E. A. (2008). Analysis of some pesticide residues in tomatoes in Ghana. *Human and ecological risk assessment, 14*(4), 796-806.
- Fantke, P., Friedrich, R., & Jolliet, O. (2012). Health impact and damage cost assessment of pesticides in Europe. *Environment international, 49*, 9-17.
- FAO, (2002). International code of conduct on the distribution and use of pesticides. *UN Food and Agricultural Organization, Rome, Italy.*
- FAO, (2007). International code of conduct on the distribution and use of pesticides. *UN Non-Governmental Liaison Service, Rome, Italy.*
- Farag, R. S., Latif, A., Abd El-Gawad, A. E., & Dogheim, S. M. (2011). Monitoring of pesticide residues in some Egyptian herbs, fruits and vegetables. *International food research Journal, 18*(2).
- Faria, N. M. X., Rosa, J. A. R. D., & Facchini, L. A. (2009). Poisoning by pesticides among family fruit farmers, Bento Gonçalves, Southern Brazil. *Revista de saúde pública, 43*(2), 335-344.
- Garcia, A. M. (2003). Pesticide exposure and women's health. *American journal of industrial medicine, 44*(6), 584-594.
- Gyau, A., & Spiller, A. (2007). The role of organizational culture in modeling buyerseller relationships in the fresh fruit and vegetable trade between Ghana and Europe.
- Hammond, C. M., Luschei, E. C., Boerboom, C. M., & Nowak, P. J. (2006). Adoption of Integrated Pest Management Tactics by Wisconsin Farmers 1. *Weed Technology, 20*(3), 756-767.

- Hareau, G. G., Mills, B. F., & Norton, G. W. (2006). The potential benefits of herbicide-resistant transgenic rice in Uruguay: Lessons for small developing countries. *Food Policy*, 31(2), 162-179.
- Helmers, F. L. C. (2012). *Project planning and income distribution* (Vol. 9). Springer Science & Business Media.
- Horna, D., Timpo, S., Al-Hassan, R. M., Smale, M., & Falck-Zepeda, J. (2007). Vegetable Production and Pesticide Use in Ghana: Would GM Varieties Have an Impact at the Farm Level?. In *AAAE Conference proceedings* (pp. 473-477).
- Jurewicz, J., & Hanke, W. (2008a). Prenatal and childhood exposure to pesticides and neurobehavioral development: review of epidemiological studies. *International journal of occupational medicine and environmental health*, 21(2), 121-132.
- Jurewicz, J., & Hanke W., (2008b) Explosive to Pesticide and Childhood Career risk: Has there been any progress in epidemiological studies? *International Journal of Occupational Medicine and Environmental Health* 19(3), 152-169.
- Kabii, T., & Horwitz, P. (2006). A review of landholder motivations and determinants for participation in conservation covenanting programmes. *Environmental Conservation*, 33(01), 11-20.
- Karlsson, S. I. (2004). Agricultural pesticides in developing countries. *Environment*, 46(4), 22.
- Karami, E., & Mansoorabadi, A. (2008). Sustainable agricultural attitudes and behaviors: a gender analysis of Iranian farmers. *Environment, development and sustainability*, 10(6), 883-898.

- Karunamoorthi, K., Mohammed, A., & Jemal, Z. (2011). Peasant association member's knowledge, attitudes, and practices towards safe use of pesticide management. *American journal of industrial medicine*, 54(12), 965-970.
- Khaila, S., Tchuwa, F., Franzel, S., & Simpson, S. (2015). *The Farmer-to-Farmer Extension Approach in Malawi: A Survey of Lead Farmers* (No. 189). ICRAF Working Paper.
- Khan, S. I., Chowdhury, M. T. I., & Razzaque, M. A. (2011). Chlorinated pesticide residue status in tomato, potato and carrot. *Journal of Experimental Sciences*, 2(1).
- Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food policy*, 32(1), 25-48.
- Kolady, D. E., & Lesser, W. (2008). Is genetically engineered technology a good alternative to pesticide use: The case of GE eggplant in India. *International Journal of Biotechnology*, 10(2-3), 132-147.
- Kromann, P., Pradel, W., Cole, D., Taipe, A., & Forbes, G. A. (2011). Use of the environmental impact quotient to estimate health and environmental impacts of pesticide usage in Peruvian and Ecuadorian potato production. *Journal of Environmental Protection*, 2(05), 581.
- Kumari, P. L., & Reddy, K. G. (2013). Knowledge and Practices of safety use of Pesticides among Farm workers. *IOSR J. Agric. Vet. Sci*, 6(2), 1-8.
- Leeuwis, C., Leeuwis, C., & Ban, A. (2004). *Communication for rural innovation*. Blackwell Publishers.
- Liu, E. M., & Huang, J. (2013). Risk preferences and pesticide use by cotton farmers in China. *Journal of Development Economics*, 103, 202-215.

- MoFA. (2010). Medium Term Agriculture Sector Investment Plan (METASIP)-2011–2015. *Accra, Ghana*.
- Muchoki, L. W. (2015). FACTORS INFLUENCING STAKEHOLDER PARTICIPATION ON CONSTITUENCY DEVELOPMENT FUNDS PROJECTS: A CASE OF MWEA CONSTITUENCY, KENYA. *Strategic Journal of Business & Change Management*, 2(2).
- Mundial, B. (2009). Gender in Agriculture Source Book.
- Neuman, L. W. (2006). *Social research methods: Qualitative and quantitative approaches* (6<sup>th</sup> ed.). New York: Allyn and Bacon.
- Ngowi, A. V., Maeda, D. N., & Partanen, T. J. (2001). Knowledge, attitudes and practices (KAP) among agricultural extension workers concerning the reduction of the adverse impact of pesticides in agricultural areas in Tanzania. *La Medicina del lavoro*, 93(4), 338-346.
- Nhemachena, C., & Hassan, R. (2007). *Micro-level analysis of farmers adaption to climate change in Southern Africa*. Intl Food Policy Res Inst.
- Ntow, W. J., Gijzen, H. J., Kelderman, P., & Drechsel, P. (2006). Farmer perceptions and pesticide use practices in vegetable production in Ghana. *Pest management science*, 62(4), 356-365.
- Ntow, W. J., Tagoe, L. M., Drechsel, P., Kelderman, P., Gijzen, H. J., & Nyarko, E. (2008). Accumulation of persistent organochlorine contaminants in milk and serum of farmers from Ghana. *Environmental research*, 106(1), 17-26.
- Ospina, J. M., Manrique-Abril, F. G., & Ariza, N. E. (2009). Educational intervention concerning knowledge and practices regarding work-related risks in potato farmers in Boyacá, Colombia. *Revista de Salud Pública*, 11(2), 182-190.

- Parker, B. Q., Osei, B. A., Armah, F. A., & Yawson, D. O. (2010). Impact of biomass burning on soil organic carbon and the release of carbon dioxide into the atmosphere in the coastal savanna ecosystem of Ghana. *Journal of Renewable and Sustainable Energy*, 2(3), 033106.
- Qaim, M., & Matuschke, I. (2005). Impacts of genetically modified crops in developing countries: a survey. *Quarterly Journal of International Agriculture*, 44(3), 207-228.
- Ransom, P. (2002). Women, pesticides and Sustainable Agriculture: Position papers: Sustainable Agriculture.
- Randall C. (2013). *National Pesticide Applicator Certification Core Manual* National Association of State Departments of Agriculture Research Foundation, Washington, DC.
- Recena, M. C. P., & Caldas, E. D. (2008). Risk perception, attitudes and practices on pesticide use among farmers of a city in Midwestern Brazil. *Revista de saude publica*, 42(2), 294-301.
- Ribhoi, K. V. K. (2013). Determinants of Resource Conservation Technologies (RCTs) Adoption in Rice (*Oryza Sativa L.*) Cultivation under Rainfed Farming Condition.
- Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.
- Sadati, S. A., Shaabanali Fami, H., Asadi, A., & Sadati, S. A. (2010). Farmer's attitude on sustainable agriculture and its determinants: A case study in Behbahan County of Iran. *Research Journal of Applied Sciences, Engineering and Technology*, 2(5), 422-427.

- Sadlo, S., Szpyrka, E., Jazwa, A., & Zawislak, A. (2007). Pesticide residues in fruit and vegetables from Southeastern Poland, 2004-05. *Polish Journal of Environmental Studies*, 2(16), 124-129.
- Sarantakos, S. (2005). *Social research*. New York: Macmillan Press.
- Sa'ed, H. Z., Sawalha, A. F., Sweileh, W. M., Awang, R., Al-Khalil, S. I., Al-Jabi, S. W., & Bsharat, N. M. (2010). Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications. *Environmental health and preventive medicine*, 15(4), 252-261.
- Shankar, B., & Thirtle, C. (2005). Pesticide productivity and transgenic cotton technology: The South African smallholder case. *Journal of Agricultural Economics*, 56(1), 97-116.
- Smale, M., Zambrano, P., Falck-Zepeda, J., & Gruère, G. (2006). *Parables: Applied economics literature about the impact of genetically engineered crop varieties in developing economies*. Intl Food Policy Res Inst.
- Stoorvogel, J. J., Antle, J. M., Crissman, C. C., & Bowen, W. (2004). The tradeoff analysis model: integrated bio-physical and economic modeling of agricultural production systems. *Agricultural systems*, 80(1), 43-66.
- Tadesse, D. (2008). Access and utilization of agricultural information by resettler farming households: the case of Metema Woreda, North Gondar, Ethiopia. *An M. Sc. Research Thesis Department of Rural Development and Agricultural Extension, School of Graduate Studies Haramaya University Ethiopia. Retrieved on, 12.*
- Tenge, A. J., De Graaff, J., & Hella, J. P. (2004). Social and economic factors for adoption of soil and water conservation in West Usambara highlands, Tanzania. *Land degradation and development*, 15(2), 99-114.

- Toze, S. (2006). Reuse of effluent water—benefits and risks. *Agricultural water management*, 80(1), 147-159.
- Trauger, A., Sachs, C., Barbercheck, M., Kiernan, N. E., Brasier, K., & Findeis, J. (2008). Agricultural education: Gender identity and knowledge exchange. *Journal of Rural Studies*, 24(4), 432-439.
- United Nations. 2005. Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (revised version). Rome.)
- U.S. Environmental Protection Agency (2007), Pesticides: Health and Safety. National Assessment of the Worker Protection Workshop
- U.S. National Library of Medicine (2007), Pesticides use by smallholder farmers in vegetable production in North Tanzania.
- Van den Berg, H., & Jiggins, J. (2007). Investing in farmers—the impacts of farmer field schools in relation to integrated pest management. *World Development*, 35(4), 663-686.
- Vaughan, G., & Hogg, M. A. (2005). *Introduction to social psychology*. Pearson Education Australia.
- Veisi, H. (2012). Exploring the determinants of adoption behaviour of clean technologies in agriculture: a case of integrated pest management. *Asian Journal of Technology Innovation*, 20(1), 67-82.
- Waichman, A. V., Eve, E., & da Silva Nina, N. C. (2007). Do farmers understand the information displayed on pesticide product labels? A key question to reduce pesticides exposure and risk of poisoning in the Brazilian Amazon. *Crop Protection*, 26(4), 576-583.

- WHO, (2004). Water, Sanitation and Health. (6 August 2004; [www\\_who\\_int/entity/water\\_sanitation\\_health/en/](http://www.who.int/entity/water_sanitation_health/en/)).
- Yeboah, I. (2013). Urban Agriculture and pesticide overdose: a case study of vegetable production at Dzorwulu-Accra.
- Zhang, H., & Lu, Y. (2007). End-users' knowledge, attitude, and behaviour towards safe use of pesticides: a case study in the Guanting Reservoir area, China. *Environmental geochemistry and health*, 29(6), 513-520.
- Zyoud, S. H., Sawalha, A. F., Sweileh, W. M., Awang Rahmat, Al-Khalil Suleiman I., Al-Jabi S. W., & Bsharat, N. M. (2010). Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications. *Environ Health Prev Med*. 2010 Jul; 15(4): 252–261.

**APPENDIX****INTERVIEW SCHEDULE FOR FARMERS**

Dear Sir/Madam,

This interview schedule is designed to assess the effectiveness of the training programme organised by the Accra Department of Food and Agriculture on the knowledge, attitudes and practices of farmers in the use of pesticides. This is in partial fulfilment for the award of a Master's degree in Agricultural Extension at the University of Ghana. As a result, any information given would be treated with utmost confidentiality.

Thank you

**Section A: Background characteristics of respondents**

1. Gender: [1] Male [2] Female
2. Age: [1] 21 – 30 [2] 31 – 40 [3] 41 – 50 [4] 51 – 60 [5] Above 60
3. Level of education: [1] None [2] Basic [3] SHS [4] Tertiary
4. Acreage of farm land: [1] 0.5 -1.5 acres [2] 1.6-2.9 acres [3] 3-5 acres
5. What is your average seasonal income from farming:
  - [1] GH¢ 300 and below [2] GH¢ 301-600
  - [3] GH¢601-1500
6. Household size: .....
7. Off-farm income generating activities: .....
8. For how long have you been farming: .....

**Section B: Contribution of training to farmers' knowledge on pesticide use**

9. How does the use of pesticides affect the health of farmers?  
.....  
.....
10. How was the training organised?

.....  
.....

11. How would you now rate your level of knowledge with the use of pesticides?

[1] Very high [2] High [3] Normal [4] Low [5] Very low

Reason(s) for your answer:

.....  
.....  
.....

12. Are there things you were taught but you could not understand well?

[1] Yes [2] No

13. If yes, what are they?

.....  
.....  
.....

14. How satisfied are you with the lessons from the training programme?

[1] Very satisfied [2] Satisfied [3] Do not know [4]

Less satisfied [5] Least satisfied

15. What is your understanding on how pesticide should be mix?

.....  
.....  
.....  
.....

16. What is your understanding on the correct rate of pesticide application?

.....  
.....  
.....  
.....

17. What is your understanding on the correct time of pesticide application?

.....  
.....  
.....  
.....

**Section C: Contribution of training to farmers’ attitudes towards pesticide use**

18. How do you agree to the following about pesticides? Using 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree

<b>Attitudinal statements</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Pesticides improve crop yield					
Pesticides improve the shelf life of crops					
Pesticides are not harmful to farmers					
Pesticides are not harmful to consumers’ health					
Frequent application of pesticides improve the growth of crops					
Pesticides improve the taste of crops					

**Section D: Contribution of training to farmers’ practices on pesticide use**

19. How often did you apply pesticides to your crops before the training?

.....

20. Reason(s) for your answer:

.....  
 .....

21. How often do you apply pesticides to your crops after the training?

.....

22. Reason(s) for your answer:

.....  
 .....

23. Which of the following protective gears did you use before the training programme when applying pesticides to your crops? [1]

Hand gloves [2] Goggles [3] Overall coat [4]

Nose mask [5] Wellington boots [6] Head gear

[7] Others (specify) .....

24. Reason(s) for using the selected protective gears:

.....  
 .....

25. Which of the following protective gears do you use when applying pesticides to your crops? [1] Hand gloves [2] Goggles [3]

Overall coat [4] Nose mask [5] Wellington boots [6] Head

gear [7] Others (specify) .....

26. Reason(s) for using the selected protective gears:

.....  
.....

27. Do you eat during the application of pesticides? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

28. Do you drink during the application of pesticides? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

29. Do you smoke during the application of pesticides? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

30. Do you follow label instructions? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

31. Do you read label instructions? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

32. Do you wash your hands after pesticide application? Yes.... No.....

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

33. How do you treat leftover pesticide solution?

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

34. How do you dispose of pesticide containers after use?

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

35. How do you handle contaminated clothes after pesticide use?

Before the training: .....

Give reasons.....

After the training: .....

Give reasons.....

36. Any additional information:

.....