

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES**

UNIVERSITY OF GHANA



**KNOWLEDGE, PRACTICES AND SELF - REPORTED SYMPTOMS OF
PESTICIDES USE AMONG VEGETABLE FARMERS: A CROSS SECTIONAL
STUDY IN THE OFFINSO NORTH DISTRICT**

BY

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**THIS DISSERTATION IS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH,
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DECLARATION

I, Akorfa Dzobo hereby declare that apart from references to other people's works which have been duly acknowledged, this theses has been written independently by me, has been supervised and has not been submitted for the award of any degree in any institution.

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ACKNOWLEDGEMENT

It has been the grace of God that has driven this project to its end.

My gratitude goes to my God for the grace, mercies and strength he made available to me to the end. I acknowledge my supervisor Dr. Reginald Quansah for all his contributions and inputs; and all lecturers of School of Public Health and helped in diverse ways in the completion of this write- up.

I acknowledge my ever loving classmates whose encouragements and support would always be a memory to cherish.



DEDICATION

I dedicate this to my family- my ever supportive husband, Moses Dewude-Ocansey who took over caring for the children in all aspects of their upkeep throughout my education and to the children (Akrofi, Ahuma and Adede) who never complained even once for my absence. And to Simon for his immense help while I was away.



ABSTRACT

Background: The effect of pesticide on human health and the environment is a major global public health issue. Knowledge of farmers on pesticide use and practices may contribute significantly to the burden of pesticide in human population and the environment.

Objectives: This study assesses knowledge, work practices and self-reported symptoms associated with pesticide use among vegetable farmers in the Offinso North District of the Ashanti region.

Methodology: The study was derived from the Offinso North district Farm Health study (ONFAHS). ONFAHS is a cross-sectional design involving 300 households in the Offinso-North district of the Ashanti region. Three hundred and ten (310) farmers who met the eligibility criteria formed the study population. Farmers were interviewed with a structured questionnaire.

Results: Most farmers (88.9%) had a good knowledge on the effects of pesticides on human health and the environment. But majority adopted either poor hygienic practices (64.5%) or bad protection and safety practices (92.3%) on the job. General body weakness (89.2%) and chronic cough were common among the farmers but very few also complained of wheezing (15.4%), shortness of breath (11.2%), sexual weakness (24.5%) and depression (14.3%). Poor knowledge was associated with both respiratory and non-respiratory symptoms. Poor hygienic practices was also associated with chronic cough, breathlessness, general body weakness and depression. Protection and safety practices was associated with chronic cough, wheezing but not with non-respiratory symptoms.

Conclusion

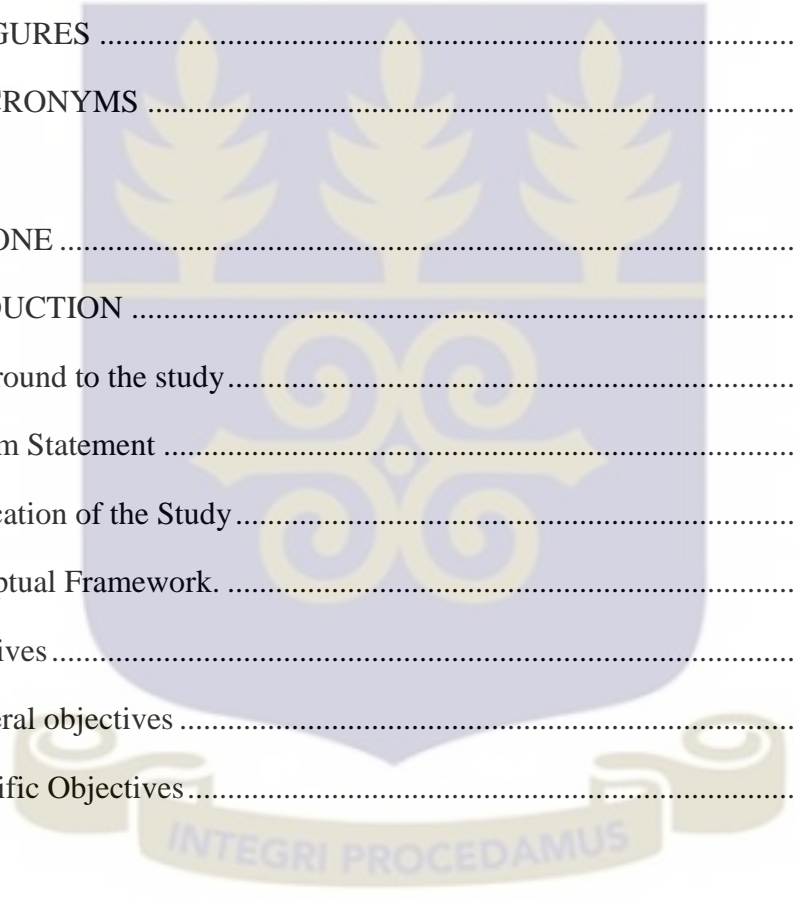
This study suggests that farmers have good knowledge of the effect of pesticides on human health and the environment, but this did not translate into good work practices.

General body pain was common among the farmers. Poor knowledge was associated with self-reported symptoms. However, poor work practices were associated with chronic cough and shortness of breath,



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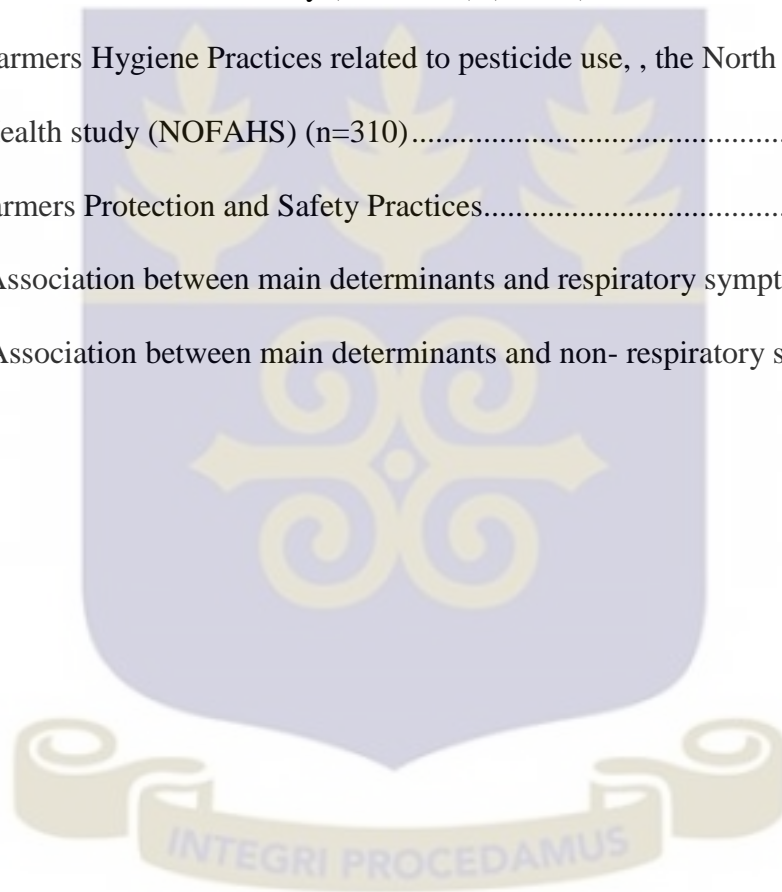
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LIST OF ACRONYMS



AEO.....	Agriculture Extension Officers
ChE.....	Cholinesterase
DDT.....	Dichlorodiphenyltrichloroethane
EPA.....	Environmental Protection Agency
FAO.....	Food and Agriculture Organization
GDP.....	Gross Domestic Product
IPM.....	Integrated Pest Management
KAP.....	Knowledge, Attitude, Practices
NPAS.....	Northern Presbyterian Agricultural Services
OC.....	Organochloride
OP.....	Organophosphate
PPE.....	Personal Protective Equipment
REI.....	Re-Entry Interval
WAAPP.....	West African Agriculture Productivity
WHO.....	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Increase in population and rising demand for food consumption has led to an increase in pesticide use globally. Though pesticides play a positive role in protecting crops against losses, due to the destructive nature of the different forms of pests, they harm humans and negatively affect the environment. In view of their prospective effects on humans, countries have developed rules to encourage the safe use and control, production, import and exporting of these chemicals (Lorenz et al, 2012).

Between 1973 -1990, the global consumption of pesticide use averaged 3,850 metric tons annually but had shot to a high 37,712 metric tons worldwide in 2000 (Dey, 2010). In Ghana, between 1995 and 2000, an average of 814 tons of pesticides was imported into the country every year. This increased from 7763 metric tons in 2002 to 27,886 metric tons in 2006 (Fianko *et al.*, 2011). In Ghana the Environmental Protection Agency (EPA) and the Pesticides and Fertilizer Regulatory Division of the Ministry of Food and Agriculture (MoFA) are responsible for the registration and permit issuance of pesticide use.

Pesticide use in developing countries is increasing though its use in the developed countries is stable or declining. Hence, though developed countries use 80% of the world's total agrochemicals, they experience about 1% of the total pesticide related deaths worldwide. The incidence of pesticide poisoning has increased as a result of intentional, accidental and occupational exposure to pesticide (Singh and Gupta, 2009). Pesticides were mishandled on farms, with very few i.e. <2% of the farm workers knowing the names of the pesticide they were using on farms; about one third of participants of the survey did not know the amount of pesticides to be applied on their crops, (Basem, Kalid and Jerome 2014). The Northern Presbyterian Agricultural Services (NPAS) 2012, in

Ghana found that the most common problems reported by farmers included skin irritations, headaches, general body weakness, difficulty in breathing and dizziness. They, among other things, found in a study in the Northern Region of Ghana that increasing numbers of farmers were dying as a result of pesticide poisoning related to ignorance coupled with the lack of knowledge of farmers on pesticide use.

Ghana is a developing agro-based country with agriculture contributing 41% of Gross Domestic Product (GDP). The use of crop protection chemicals have increased in order to maximize yields. Furthermore Ghana does not manufacture agrochemicals but imports them. About 87% of farmers in Ghana use agrochemicals, mostly Organophosphates, Organochlorines, Pyrethroids and Carbamates (Fianko *et al.*, 2011).

1.2 Problem Statement

Utilization of pesticides to control insect pests, has become recognized and accepted as an essential component of modern agricultural production. Pesticides are applied to vegetables in Ghana. Offinso North is the single largest vegetable farming district in Ghana. The farmers use a combination of two or more pesticide brands during spraying to increase yields (Ntow, 2009). They are involved in high –risk practices such as non-wearing of Personal Protective Equipment (PPE), mixing of pesticides with bare hands and poor knowledge on re-entry periods etc. (Ntow, 2006). Farmers do not apply safety measures, lacked knowledge on safe handling and application of pesticides (Fianko *et al.*, 2011). There is also inadequate training on safety measures and chemical application. The Ministry of Agriculture trains Agric Extension Officers in line with this to train farmers. Farmers in Akumadan use Organophosphates (OP) which are detrimental to human and environmental health; they are predominantly exposed to pesticides orally (food/water), dermally and nasally (Fianko *et al.*, 2011). It is estimated that about 96% of farmers in

Offinso North District use pesticides in order to increase yields (Razak, AEO, personal communication) In a workshop organized by the EPA and West African Agriculture Productivity (WAAPP) for the media in May 2014, Mr. Isaac Osei, the Ashanti Regional Director for EPA said they found it deeply worrying that in spite of intensive public education campaign, some farmers persist in high risk practices; he also expressed concerns about the growing misuse and unsafe handling practices of pesticides by farmers, (www.ghanaweb.com). In a study to assess the occupational exposure of farmers to pesticides in Akumadan, farmers did not use PPEs and lacked knowledge on re-entry intervals after spraying. Ninety- seven percent (97%) of the participants who were exposed to pesticides experienced weakness and frequent headaches (Ntow *et al.*, 2008). Good Knowledge of farmers on pesticide use and practices such as disposal, storage and transportation will significantly reduce the ways in which pesticides affect human health and the environment. Ntow *et al* (2008), reported farmers showed self-reported symptoms, while good handling practices among farmers were low in Akumadan. They have a poor knowledge about pesticide and corresponding practices surrounding its use, handling, PPE use and personal hygiene, (Osterlund *et al.*, 2014). Beyond farmers, pesticide residues in the food chain with potential risk to the general population in Ghana have also been documented (Ntow *et al.*, 2008). These poor practices nevertheless may result in a population who are highly exposed to these chemicals.

1.3 Justification of the Study

Studies carried out at the Offinso North farming communities have showed levels of pesticide residues in farmers' urine, blood and breastmilk. (Ntow, 2007). With Offinso North being the largest vegetable producing district, farmers are the single largest consumers of pesticides in Ghana (Ntow 2007). This study will show the association

between farmer safety practices, knowledge on pesticide effects on health and the environment and their resultant self-reported symptoms these farmers experienced when exposed to pesticides. The findings will confirm the various studies carried out and hence the results can be used to make a general inference on vegetable farmers in Ghana. This will add to academic knowledge and foster a good basis of policies for bodies that control matters pertaining to pesticides in Ghana.

1.4 Conceptual Framework.

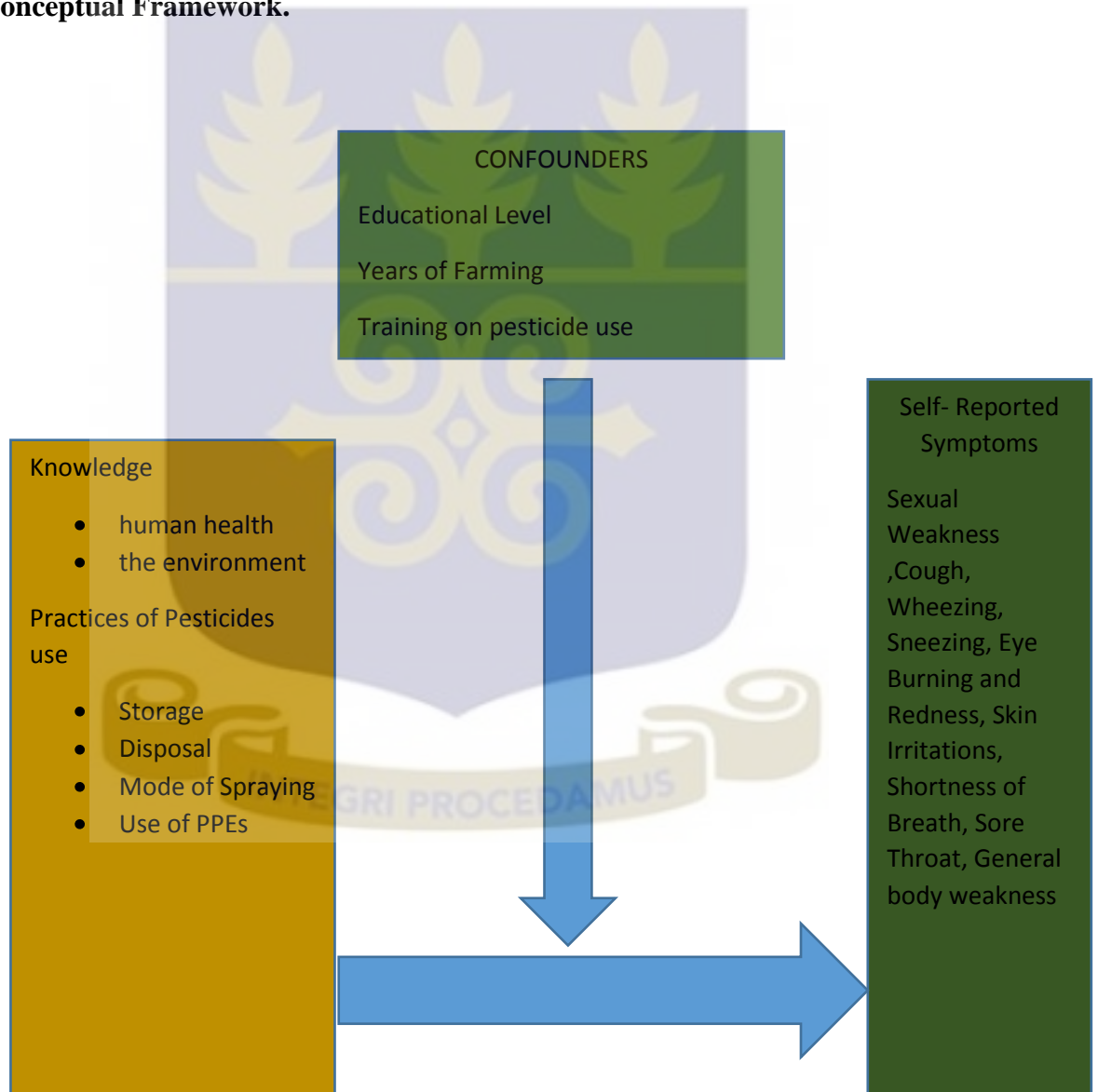


Figure 1: Conceptual framework of knowledge, practices of pesticide use and self – reported symptoms of pesticide exposure among farmers

Knowledge can make farmers become more aware of pesticide risks and thus lead to changes in deceptive approaches and harmful behaviors; those who are less informed of a condition might take high risks due to lack of knowledge, while those with more knowledge are more likely to have higher levels of risk perception. Knowledge is directly related to education and training and thus well-educated and skilled farmers are expected to be less likely to be involved in high-risk behaviors; improving farmers' knowledge could possibly reduce pesticide use by 10-15%. (Khan and Damalas, 2015). Training and provision of consistent practical support through visits are tremendously important to tackle risks of pesticide poisoning (Waichman et al, 2007).

Most pesticides are toxic to non-target species including humans and animals and can result in negative health effects which may be short term or long term (Remoundou, 2014). Occupational exposure may occur acutely as a result of mixing, loading, application or contact with sprayed crops. The risk of exposure increases when farmers ignore safety instructions on the proper use of pesticides, PPE use and adapting sanitary practices (Damalas, 2008)

The number of years of farming/ experience, training received or undergone, and level of education could impact one's level of knowledge of the effects of pesticide in humans and on the environment. Consequently the level of knowledge could also affect practices related to pesticide use; indirectly the number of farming experience, training received or undergone, and level of education can affect practices. All these factors such as number of farming experience, training received or undergone, and level of education, knowledge and practices may have a direct impact on the self-reported symptoms of exposure to pesticides such as skin irritations, redness of the eyes, sexual weakness, cough, wheezing, shortness of breath etc.

1.5 Objectives

1.5.1 General objectives

The general objectives of this study was to assess knowledge, work practices and self-reported symptoms associated with pesticide use among vegetable farmers in the Offinso North District in the Ashanti region.

1.5.2 Specific Objectives

1. To determine the prevalence of respiratory and non-respiratory symptoms associated with pesticide use.
2. To evaluate farmers' knowledge on the effect of pesticides on human health and the environment.
3. To evaluate work practices regarding the use of protective measures and hygiene practices with the potential for exposure to pesticides.
4. To determine the association between farmers' knowledge/work practices and respiratory symptoms.
5. To determine the association between farmers' knowledge/work practices and non-respiratory symptoms.



CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Scope of the Review

For the purpose of this study, a detailed literature review is made based on the knowledge of farmers on pesticides, practices and self-reported symptoms farmers experience when they are exposed to pesticides. It touches on types of pesticides, their exposure routes, effects on humans and the environment, how they are mixed, stored, disposed of and transported. It also describes the alternatives to pesticide use, recommended re-entry periods after spraying of pesticides, pesticide application techniques and equipment.

2.2 Pesticides

The EPA (Ghana) has defined pesticides as “Any substance, mixtures of substances or other agents used to control, destroy or prevent damage by or protect something from a pest. The definition also includes chemical substances that are used to attract and repel pests as well as those used to regulate plant growth or remove leaves/coats.

The Food and Agricultural Organization (FAO) has defined pesticide as “any substance intended for preventing, destroying or controlling pests. This include vectors of human or animal disease, unwanted species of plants or animals causing harm or interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs. The term include substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit and substances applied to crops either before or after harvest to protect the commodities from deteriorating during storage and transport”(WHO, 2005)

2.2.1 Pesticide Use/ Consumption in Ghana

As a developing and agro-based country, Ghana is experiencing economic growth and subsequently uses pesticides for national development, notwithstanding its effects on humans and the environment. Pesticide use in Ghana has increased in number of chemicals and quantities coupled with the increase in crop yield; a response to increase in demand. Areas of application of pesticides in Ghana is concentrated in vegetable and fruits sectors, cocoa, oil palm and the cereal sectors. Apart from physical inputs in crop production, which form less than 30%, the use/ application of pesticides is now widespread (Ntow et al, 2009). According to Ntow and co-workers, 21 different kinds of pesticides were imported into the country between 1995 and 2000. Furthermore, 87% of farmers used one or a combination of more than one pesticide on a crop, due to their cost effectiveness. Lindane, an OC, is widely used on cocoa, vegetable and maize plantations; whilst Endosulfan is mostly used on cotton, vegetables and coffee. Ultimately Lindane and DDT use have been banned in Ghana (EPA Ghana)

Pesticides mostly used to control foliar pests of pineapple in Ghana include chlorpyrifos, dimethoate, diazinon, cymethoate and fenitrothion while the fungicides maneb, carbendazim, imazil, copper hydroxide are used for post-harvest treatment. Lambda-cyhalothrin cypermethrin, dimethoate and endosulfan are also used by vegetable growers in tomato, pepper, okra, egg-plant, cabbage and lettuce farms. Glyphosate, fluazifopbutyl, ametryne, diuron or bromacil are normally employed in land clearing. Nonetheless, the most extensively used pesticides in the pepper, tomato, groundnut and beans cultivation are karate, cymbush, thiodine, diathane, lubillite and kocide. Eighty-seven per cent (87%) of farmers in Ghana use chemical pesticides to control pests and diseases on vegetables and fruits, with proportions of pesticides used popularly on vegetable farms as herbicides

(44%), fungicides (23%) and insecticides (33%). In a study encompassing 30 organized farms and 110 kraals distributed throughout the 10 regions of Ghana, it was found that 20 different pesticides were in use with the organochlorine -lindane being the most widely distributed and used pesticides, accounting for 35% of those applied on farms. Of the 20 pesticides, 45% were organophosphates, 30% were Pyrethroids, 15% were carbamates and 10% were organochlorines. (Ntow et al., 2009)

Analysis of pesticide trade flow patterns, recorded by Ghana's Statistical Service, in 1993 indicated that a total of 3,854,126 kg of pesticides were imported, besides, a survey conducted between 1992 and 1994 in the Ashanti, Brong Ahafo, Eastern and Western Regions of Ghana revealed that the most broadly used pesticides by farmers are copper(II) hydroxide (29.0%), mancozeb (11.0%), fenitrothion (6.0%), dimethoate (11.0%), pirimiphos methyl (11.0%), λ -cyhalothrin (22.0%), and endosulfan (10.0%) (EPA, Ghana, 2008). Moreover, it was established that insecticides constituted about 67% of pesticides employed by farmers while fungicides were about 30% and herbicides and other pesticides types form 3% of the total use. On the other hand, it is on record that between 1995 and 2000, an average of 814 tons of pesticides was imported into the country annually, the greatest quantity (70%) being insecticides, The amount of pesticides imported into the country from 2002 to 2006 increased. "Agrochemicals and the Ghanaian Environment", an updated register of pesticides from the Environmental Protection Agency in Ghana in 2008 indicated that about 141 different types of pesticide products have been registered in the country under the Part II of the Environmental Protection Agency Act, 1994 (Act 490). These consists of insecticides (41.84%), fungicides (16.31%), herbicides (0.43%) and others (0.01%), (Ntow et al 2006).

Articles reviewed during this study have not showed any concrete amount of pesticides used in Offinso north.

2.2.2 Pests and their control

Pests are unwanted plants or animals (which could be microbes) that are detrimental to humans or human concerns such as in agriculture or livestock production. They interfere with human activities, and cause nuisance and epidemics associated with high mortality. They could be found in homes, industrial settings and farms. Mechanical control methods of pest control include picking of pests or their larvae by the hand, removing the part or whole plant that is affected, using traps or catching them with the help of nets. Physical control methods are by heat (high temperature kills pests), low temperature and by X-rays or Gamma rays. Cultural methods include crop rotation, deep ploughing, clean cultivation, proper use of fertilizers and water, growing pest resistant varieties of plants, timely or late sowing and proper harvesting. Predators such as parasites, birds, animals and micro-organisms e.g., Chilonus, Crysopa, Tricogama, copidosoma, bacillus thuringensis are used to control pests biologically. Chemical methods involve the use of chemicals (pesticides) on a large scale to mitigate pests. It is effective and faster compared to other methods but is also the most hazardous to humans and the environment. Their improper use can result in resistance among various pests which could lead to extensive outbreaks resulting in cost increase of cultivation and losses.

2.3 Classification of Pesticides

Pesticides can be classified based on different factors. They may be classified according to the type of pests they destroy, how hazardous they are and their mode of action or chemical properties.

2.3.1 W.H.O classification of pesticides by hazards

Extremely Hazardous (Class 1a), Highly Hazardous (Class 1b), Moderately Hazardous (Class II), Slightly Hazardous (Class III)

2.3.2 Classification of Pesticides Based On Chemical Properties

Pesticides can be mainly classified into but not limited to Organochlorines (OC), Organophosphates (OP), Carbamates and Pyrethroids. Organochlorines, Carbamates, organophosphates and Pyrethroids are the four major types of pesticides in use in Ghana

2.3.2.1 Organochlorines

Though very commonly used in the past, many have been removed from the pesticide market as a result of their environmental and health repercussions and their persistence in the environment, e.g. DDT, Chlordane. Though forbidden in Ghana due to their health and environmental consequences and perseverance in the environment, some farmers illegally use Organochlorines (Donkor et al, 2015)

2.3.2.2 Organophosphates (OP)

These affect the nervous system by disrupting the acetylcholine regulator known as the acetylcholinesterase, which is a neurotransmitter. They cause acute muscarinic manifestations such as salivation, lacrimation, micturition, diarrhoea, vomiting, bradycardia, and some nicotinic symptoms such as muscle fasciculation and weakness. They are usually insecticides and were developed in the early 1900s; some can be very poisonous but are not persistent in the environment. They are absorbed through the gastrointestinal tract (GIT), lungs and skin. Acute symptoms of OP exposure are in addition to the above are wheezing and hypoxia, bradycardia and hypotension in severe cases. Central nervous system (CNS) toxicity is common, characterized by seizures,

excitability, lethargy and coma. Pancreatitis is common coupled with cardiac arrhythmias. Late symptoms consist of weakness of the proximal, cranial and respiratory muscles which usually resolve in 2-3 weeks. A few may cause axonal neuropathy. Long term effects include cognitive deficits and Parkinsonism (Lu, 2009).

2.3.2.3 Pyrethroids

Developed as the man-made or artificial varieties of the naturally occurring Pyrethrin from the Chrysanthemum flowers. Over the years they have been improved to increase their environmental stability. Some synthetic Pyrethroids are toxic to the nervous system. When properly used they have been found to pose very little risks to human health and the environment. Their discovery took place together with the identification of the problems associated with DDT. Pyrethroids are often used as insecticides to commercially control pests. Based on their mode of mixing (i.e. with water or oil), little amounts settle on the ground and on flat surfaces. They are degraded by the sunlight and atmospheric air, and are not easily taken up by plant roots since they are bound to the soil; therefore they do not contaminate ground water or water bodies but are eventually degraded in the soil. Exposure to large quantities may cause dizziness, headache nausea and diarrhea. There is no evidence that they are teratogenic, carcinogenic nor affect fecundity. Fortunately they are immediately excreted through the urine, feces and breathe (Neghab et al, 2014).

2.3.2.4 Carbamates

These are similar in action to the organophosphates, acting on the enzyme that regulates acetylcholine. Their effects are normally reversible.

2.4 Farmer Knowledge about Effects of pesticides on Human Health and Environment

Knowledge, attitudes, and practices (KAP) surveys help recognize knowledge gaps, behavioural patterns, and commonly-held beliefs in order to increase understanding of issues and clarify targets and subjects for interventions that may address any combination of these factors (Lorenz et al, 2012). KAP surveys focusing on pesticide use have been conducted in several countries including Brazil, Ghana, South Africa, Egypt, and Thailand.

In Ghana, farmers have a high risk perception with respect to hazards from pesticides, though only 30% wear full PPE covering (Ntow et al, 2006)

A KAP study of farmers by Zyoud et al (2010) in the Palestine West Bank, showed that 97% of participants were aware of the names of the pesticides they used on their farms and the factors influencing good knowledge in that study were as follows: good knowledge was significantly associated with secondary education level ($p < 0.001$), college education ($p < 0.01$), working experience over 10 years ($p = 0.001$), using pesticides for more than 10 years ($p = 0.03$). However, poor knowledge was associated with primary education i.e. $p < 0.001$ but was not statistically significant with respect to age and gender. Earlier, they had hypothesized that good knowledge among farmers is associated with safe use of pesticides while reported symptoms are associated with unsafe pesticide use; farmers were more prone to use recommended guidelines of pesticide use with respect to protective measures.

A KAP in Uganda also showed farmers on a small scale basis often farmed without proper means or the knowledge to properly use pesticides. Some farmers, even though had high knowledge levels on health effects, did not practice according to the knowledge they had (Ousterlund et al., 2014). Also, high illiteracy rates contributes to farmers' difficulty in

understanding and following instructions and safety advice on pesticide use (Remoundou, 2011). Atreya (2007) examined difference in gender in knowledge on pesticide use and practices in Nepal and found that female farmers had lower levels of education than male farmers, making them less likely to read and understand labels on pesticides.

Knowledge was not found to influence practices in Brazil because majority of farmers admitted receiving information/ training from the government and claimed reading labels' instructions and warning but do not take adequate protective measures. This was attributed to low levels of education of participants (Remoundou, 2014). Farmer education is therefore vital in the increase in knowledge in safety practices (Dey, 2010). 'High levels of knowledge and perception of risk are not enough to influence workers' and operators' self-protective behavior'. This need to be well-thought-out when planning training programs to increase safety. Other economic and sociocultural pressures may also need to be addressed. (Remoundou, 2014).

2.5 Exposure to pesticides

Exposure is the contact over time and space between a person and one or more biological, chemical or physical agents or the function of bio-available concentrations and the time over which the agent exerts its effects.

Types of exposures and their biological effects may be divided into:

- i. High level, single exposure where signs and symptoms are acute or immediate
- ii. Moderate and repeated exposure in which there are no acute signs and symptoms but subtle (overt) symptoms at some indeterminate time after exposure.

Low level but continuous exposure, where there is no real or perceived risks to health. These may lead to mutagenicity, carcinogenicity, impaired organ function, death or

impaired reproductive function. Exposure transport media consist of air water, soil, dust, food, product or items. Pathways for exposure include eating contaminated food, breathing contaminated workplace air or touching home surfaces. Routes of exposure comprise nasal (inhalation), integumentary/skin (dermal), mouth/oral (Ingestion) or multiple routes. Duration of an exposure could take seconds, minutes, hours, days, weeks, months, years or even a generation. Its frequency could be continuous, intermittent, cyclic and random or may be rare. ‘Occupational exposure to pesticides in agricultural workplace occurs during the preparation (mixing and loading) and application (spraying) of pesticides, with this exposure being several orders of magnitude higher than that of the general population’(Garcia-Garcia et al.,2015)

Most pesticides are toxic to non-target species including humans and animals and can result in negative health effects which may be short term or long term (Remoundou, 2014). Occupational exposure may occur acutely as a result of mixing, loading, application or contact with sprayed crops. The risk of exposure increases when farmers ignore safety instructions on the proper use of pesticides, PPE use and adapting sanitary practices (Damalas, 2007). Dey (2010) found considerable proportion of respondents (25%) who smoked or consumed other items while applying/ spraying, which is an unacceptable practice. Also, farmers sprayed in the wrong direction with respect to the wind which increased exposure; most of their equipment were not properly maintained nor checked for leakage before use.

2.6 Effects of Pesticides on Humans (Reported Symptoms)

The use of pesticide is a threat to human health and the environment. Their effects of long term work – related exposure at low amounts are problematic to detect since they include transitory and non-specific health repercussions. It may also hinge on the pesticide used,

means of exposure and regularity of exposure, period and application approaches, not forgetting personal protective equipment use (Garcia-Garcia et al, 2015).

Negative health consequences that occur due to exposure to pesticides differ according to the pesticide involved and the means of exposure, with the dermal route being the utmost, especially for sprinklers or applicators, (MacFarlane et al., 2013).

Due to their wide-ranging and well-known use in agronomy and in the home setting, pesticide exposure occur chiefly through the oral (ingestion), dermal, the eyes and nasal (inhalation); through food or from the environment. Contact with pesticides has been connected with numerous health effects such as malignancies, neurodegenerative conditions and reproductive disarrays, (Ghisan et al., 2015).

Sosan and his colleagues, found that almost all the farmers in their study confirmed typical symptoms of insecticide poisoning after each spraying task (Sosan et al.,2012). These symptoms comprised severe headache (66%), dizziness (58%), body weakness or being unusually tired (55%), nausea (53%), restlessness (37%), excessive sweating (41.3%), etc.

In a study to review the effects of Neurotoxic pesticides on hearing loss, Gatto et al. (2014) found that results from human studies suggest that exposure to neurotoxic pesticides can induce damage to the central auditory system. Pesticide sprayers report greater signs and symptoms of exposure such as skin irritations, stomach poisoning and eye irritations than other farm workers (Atreya, 2008).

A study conducted on 268 married male farmers in Iran showed that 68% of participants reported to their general practitioners of suffering from burning and skin irritations, eye burn, headaches, vertigo, nausea and vomiting during spraying; about 6.3% had offspring with congenital malformations, 7% showed impaired (fecundity) fertility rates after

working for over 10 years as sprayers. Still births among farmers' wives were greater than that of the average population (Neghab et al, 2014).

Chronic disease such as diabetes, Cardiovascular diseases (Hypertension), Chronic Respiratory diseases(e.g. asthma), Chronic Fatigue Syndrome, Systemic lupus erythematosus, rheumatoid arthritis, malignancies of all types, Alzheimer's, reproductive disorders, parkinsonism, nephropathy congenital anomalies etc. are key conditions affecting health of the public after exposure to pesticides, in the 21st century (Moustafalou and Abdollahi ,2013).

One of the causes of infertility is occupational exposures to harmful environmental factors where the decreased fertility rate in some occupations is much more significant than in the general population. There is also evidence linking reduced amount of semen to exposure to pesticides including damage to spermatogenesis (Mehrpour et al., 2014). Also, male reproductive activity is highly sensitive to many man- made physical and chemical agents produced by agricultural and industrial activities.

Formulations of pesticides differ in absorption ability e.g. emulsifiers are more readily absorbed than others. Hence rate of dermal absorption differs depending on the part of the body involved, e.g. rates of absorption are greater around the genitals(12 times faster) than in the fore arms.

The fact that neurons cannot regenerate makes neurotoxicity of the neurological system cause irreversible effects in an organism due cell death and loss of neurons. Due to the subtle affect and slow development of neurological signs and symptoms, most conditions are not recorded or observed.

2.7 Effects of pesticides on the Environment

Each type of pesticide is pest specific. In other words they are intentionally released into the environment to mitigate certain targeted pests. Yet, a large amount of it enter water bodies, air, sediments or food. These occur as a result of run-off after rains, escape tanks or spray drift i.e. the airborne movement of agrochemicals onto non-target areas at or shortly after application either by air or ground level; with the potential of injury or damage to humans, animals, plants or the environment (National Pesticide Information Center, NPIC, U.S.A. 2015)

Pesticide deposits in air, water and foods have serious health repercussions for the general public. Pesticides have been found in the air long even after use, leading to effect on humans, wildlife and biodiversity; they mount up and travel worldwide. “Pesticide use has caused domestic animal poisonings, the death of useful predators and parasites, residues in air, fishery and aquatic body losses, the damage of flora and fauna, unintentional crop exposures, death of birds and honeybees and undesirable residue in food items have all credited to pesticides. It has been recognized that the chemical pesticide residues are the key contributor to the destruction threats facing many endangered species” (Khan, 2012)

Haarstad reported in 2008 that a landfill comprising mainly of biological waste from a tree nursery and containing an estimated 900 kg of DDT was monitored since 1994. Later, downstream ground water was sampled from four wells. More than 10 years of monitoring of two of the wells in addition to sampling of the waste was carried out. A total of seven pesticides were detected in the ground water. In addition to DDT, there were two other insecticides and four fungicides occurring in the ground water downstream of the landfill (Haarstad, 2008)

2.8 Pesticides Application and Application Equipment

This refers to the practical ways where pesticides are delivered to their biological targets such as pests, crops or other plants. The effects of pesticides on humans and the environment, in recent times has necessitated their efficient use in order to minimize environmental and human exposures (i.e. operators, bystanders, produce consumers). The pest management practice of pesticide application considers seed treatment, spray application methods and techniques, weather conditions and application equipment (USA/CDC, 2000)

Pesticides can be applied to seeds prior to planting i.e. seed treatment or coating. This protects the seed/plant against soil-borne threats. The role of pesticides in pest management cannot be over emphasized, hence the equipment and the techniques used in their application are important to the success of pest control and ultimately better crop yield. Pesticide application is not limited to only the operation of the application equipment but is coupled with a thorough knowledge of the pest management, in order to cover the target crop with maximum efficiency, minimum efforts and minimum contamination of non-target crops, to keep the pest under control. A good pesticide application technique becomes paramount. It must be remembered that all pesticides are poisonous and can cause harm to living things and must thus be used meticulously; the most reason why application must be target- oriented to guarantee the safety of non-targets and the environment. This therefore calls for the proper selection of application equipment, knowledge of pest behavior, skillful dispersal methods and knowledge of the most susceptible stage of the pest, helps determine the time of pesticide application (Pal and Gupta, 1996).

It is also aimed at avoiding pollution. The success of controlling pest therefore depends on the quality of pesticide, timing of application and quality of application and coverage

,proper dosage being applied evenly ,ensuring the toxicant reaches the target , applying the proper droplet size and density and its target. Pesticides are dispersed by different methods like spraying or dusting. Most pesticides are applied as sprays, in liquid formulation (dilution), with water or oil being the diluent Spraying may be done in high, low or ultra-low volumes. One of the most common forms of pesticide application is the use of mechanical sprayers.

These may be operated manually or powered. Manual sprayers include syringes/slide pump, stirrup pumps, knap sack/shoulders hump (lever operated; piston pump, diaphragm pump, compression sprayer and the stationary type (Pal and Gupta, 1996).

Most pesticides are diluted from concentrates with water applied by forcing the liquid through a very small opening in a nozzle to form a spray, that is targeted at the intended surface', (Matthews, 2015).

The original knapsack sprayer was a hand operated pump which was part of a small tank carried on the users back. The knapsack sprayer is the most widely used, is lever - operated and designed to spray liquid rather air. It is suitable for small farm and areas that are inaccessible to vehicles and are designed to meet international standards of the FAO. The sprayer is mounted on the back of operator with help of a pair of mounting straps. The pump of the sprayer is activated by working a hand lever up and down by one hand of the operator while the other hand holds the cut off device for spraying purpose. It consists of liquid tank, hydraulic pump, operating lever, pressure chamber, agitator, delivery hose, spray lance and nozzle. A plastic tank of 14-16 liters capacity is commonly used. It is essential to operate the hand lever constantly at the rate of 15-20 strokes per minute.



Figure 2: A lever operated Knapsack sprayer

2.9 Restricted entry /Re-entry Intervals (REI)

This is the period of time after a field/farm is treated with a pesticide during which restrictions on entry are effected to protect persons from potential exposure to hazardous levels of pesticide residues. They are established by regulatory bodies in order to limit exposure of workers and other persons not involved in application (http://www.cdpr.ca.gov/docs/enfcmpli/emp_user.htm . Re-entry Intervals (REI) information are usually found on the labels of the original pesticide container, but differs from country to country. Some REI allow certain activities to be carried out sooner than others. Most pesticide labels provide specific times/periods when a person may not enter the treated area, except those involved directly in the application. Others may state that the spray should have dried or the dust settled before re-entry. It is therefore the responsibility of the applicator, in all cases, to ensure no person enters until the REI has expired, though there are exceptions. There are 4 fundamental types of re-entry namely:

- i. Entry by handlers: allows for completion of application except in PPEs.
- ii. No contact entry: prevents contact with any treated surface
- iii. Short term, limited-contact entry: permits up only 8 hours exposure in 24 hours

- iv. Short term, high-contact entry permits entry for up to only 1 hour.

The farmer must therefore ensure that for early entry, at least 4 hours must have elapsed since the end of application, must be in appropriate PPE such as coveralls, footwear, socks, goggles, gloves etc. Farmers must have knowledge of the information on Material Safety Data Sheet (MSDS) such as the possible hazards, symptoms of exposure/poisoning, emergency medical treatment; and recognition, prevention and treatment of heat-related illness. Furthermore the proper use, maintenance, laundry and storage of PPE, how to wash down thoroughly after exposure must be known. (http://www.cdpr.ca.gov/docs/enfcmpli/emp_user.htm.)

2.10 Disposal and Transportation of Pesticides

Health hazards such as empty pesticides containers pose as a threat to environmental contamination. A study in Greece found a common practice of dumping empty pesticide containers by fields, near, or into irrigation streams and canals, burning in open fire are well known practice of disposal farmers are involved in, coupled with using them for fuel storage, water and food storage (Haylamicheal and Dalvie, 2009).

Accidental and intentional poisonings have been encouraged by the presence of undesirable and outdated pesticides. These undesirable pesticides hence contribute to unsafe disposal of pesticides. According to the FAO, pesticides accumulate in the system as a result of storage beyond shelf-life, banning, inappropriate formulations, and poor assessment of required quantities, poor pest outbreak forecasting, substandard containers, excessive donation, poor storage systems, defective distribution or poor marketing strategies (Dalvie, Africa and London, 2009).

The above-mentioned problems tend to increase obsolete pesticides in developing countries, making their disposal another concern for Regulatory bodies. Most farmers burn pesticide containers. Some countries have initiated disposal awareness by re-calling all obsolete pesticides and send them to treatment and disposal sites in developed countries. E.g. Ethiopia sends its obsolete pesticides to Finland for combustion and disposal. In Africa lack of national capacity and farm worker training lead to unsafe practices (Dalvie, Africa and London, 2006).

Another study in rural Greece reported that farmers re-sprayed excess pesticide until their tanks were void, or sprayed it on any other crop itemized on the container. Some farmers confessed releasing left over into nearby streams and irrigation canal. After rinsing they poured the water into nearby uncultivated lands. Most containers were dumped on rubbish dumps or burned. (Damalas, Telidis and Thanos, 2008).

Re-spraying surplus mixtures have been said to be risky as it doubles the recommend dosages on the crops leading to toxicity, residues in soil and harvested crops. This also includes the disposal of rinsates on uncultivated lands. The best way recommended to dispose of left-over is to find other similar farms that will need application of the same chemical. Dalmalas, Telidis and Thano (2008) thought that disposal of containers onto nearby fields, streams, canals is unsafe practice totally; burning will undoubtedly release other chemicals into our atmosphere and should be discouraged. Pesticide wastes should be buried; the site must be chosen carefully to prevent contamination of surface water, runoff or groundwater. Pesticide wastes should be buried under at least 1/2 m of soil mixed with lime to enhance degradation. To begin with, the pit should be creased with 5-10 cm of clay and glazed with 2-3 cm of lime.

Wastes should be added to the pit in layers not more than 10-15 cm deep and inter-mixed with lime and bio-degradable household waste, to assist in biological degradation (Matthews, 2015)

When transporting pesticides, there is the need to keep them in their original containers with the labels securely attached. They should be placed in such a way to prevent spillage or leakage, in a plastic material to hold the spillage in case of an accident. If transporting in the rear of a car or an open trunk they should be secured and the whole load covered. Passengers must also not share any compartment of the vehicle with pesticides, likewise groceries and food for animals.

2.11 Storage of Pesticides, PPEs and Equipment

Unsafe practices are prevalent among farmers and operators in developing countries e.g. In Egypt, almost all farmers stored pesticides in bedrooms; likewise in Kenya and Palestine (Remoundou, 2014).

A study on the occupational insecticide exposure and perception of safety measures among cocoa farmers in southwestern Nigeria showed that about 61% of the farmers stored pesticides in their homes, 31% had a separate store for pesticides, and 8% kept them on the farm. However only a few correctly disposed of empty containers (i.e. burn, destroy, bury). Almost half washed the containers and put them into various uses such as for storing palm oil and kerosene, with some throwing them away in anywhere including places to which children had access. A few resold the containers to buyers. Almost all the farmers cleaned up their spraying equipment after use. Leftover spray mixture was sometimes used to spray already sprayed cacao trees or was emptied into streams or near a well at the village. (Sosan and Akingbohunge, 2009)

In order to protect the content of pesticide, containers are made of materials that have the capacity to withstand the chemical. These containers are to be stored with their original labelling including directions on application and disposal, names of the components, emergency information in case of spillage or exposure. It also includes temperatures at which the pesticides should be stored, since extremes of temperatures can change the chemical structures of the product or damage the container. For safety reasons, it is best to keep the pesticide inventory to the lowest, i.e. buying only what you need per season and mixing only what you will use in a day. It is not advisable to store pesticides in food and drink containers for the safety of especially children. If a spill is anticipated, bottled pesticides are to be stored in a larger container and tightly covered. Equipment are supposed to be stored separately away from chemicals. In the developed countries, they are stored in well lit, ventilated and fire resistant buildings. They are to be inspected annually, must be sited away from flood prone areas, wells, drains, ground and surface water. The building must be dry, with appropriate signs for warning, secured under lock and key against theft and with suitable exits routes. Personal protective equipment must be kept and washed daily, separately from other clothes; work clothes must not be considered as PPEs. Clean water must be available /accessible for eye flushing/irrigation in case of splashes on the face. A clean pesticide-free area for changing into and out of PPEs and for storing of clean clothes and personal belongings must be available, with soap and water (National Pesticide Information Center, NPIC, U.S.A. 2015)

2.12 Farmers' Protective and Safety Practices

A study by Sosan and Akingbohunge (2009) on the occupational insecticide exposure and perception of safety measures among cocoa farmers in southwestern Nigeria showed that 44% of farmers wore overalls, 94% wore caps/hats, 28.7% wore rubber boots, and

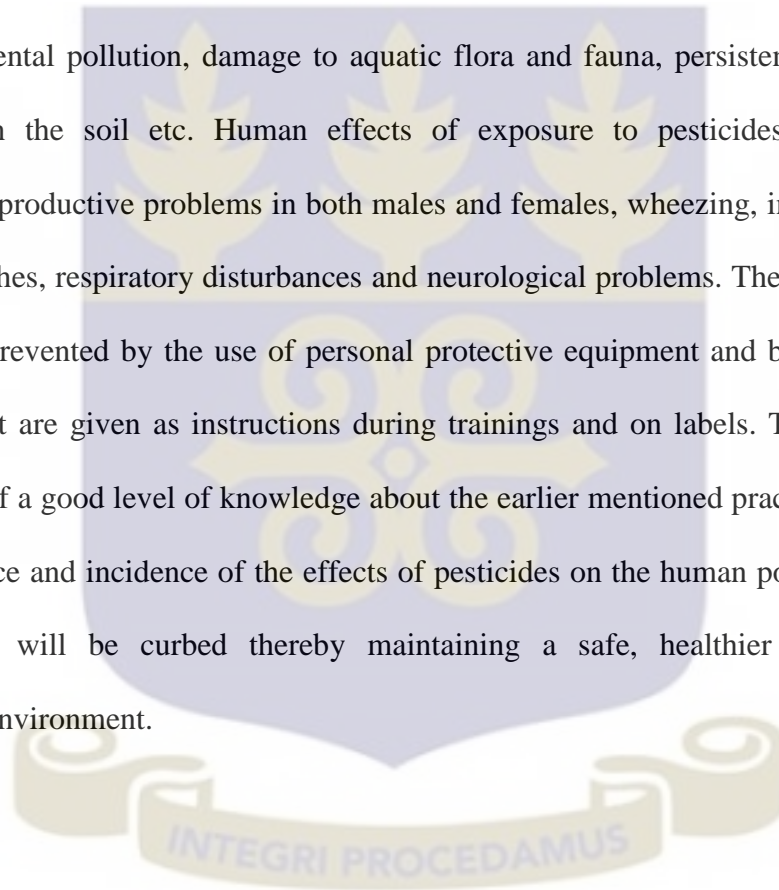
9.3% wore cover shoes. Only 4.7% and 2.7% used hand gloves and eye goggles, respectively. Some of the farmers' habits during and after insecticide spraying operations revealed that a majority change clothing immediately afterward and wash their protective clothing after a spraying operation. More than half wash their clothes at the village stream, while others either wash their protective clothing at the village square or near a well.

2.13 Alternatives to pesticide use (Integrated Pest Management (IPM))

The food and agriculture organization (FAO), defines IPM as the consideration of all pest control techniques and other measures available that discourage the pest population development or emergence, while in the meantime minimizing the risks to human health and the environment. Being the best combination of cultural, biological and chemical measures used in the management of diseases insects etc., IPM seems to be the best for farmers. Whilst it takes into account all relevant control techniques and methods that are available locally by evaluating their potential effectiveness, IPM does not consist of any absolute or rigid criteria.

The need for IPM includes the increase in the global population hence the increase in food demand which will subsequently require increase in crop yield and improvement. It calls for a decrease in crop loss while ultimately protecting the environment in doing so. In order to minimize crop losses due to pests, maintain sustainable agriculture for adequate, safe and quality food, improve farmer livelihood and conserve renewable resources, IPM is increasingly being accepted and adopted in both developed and developing countries in the long term. Ghana embraced IPM in 1995. It was piloted in Dawhenya in the Greater Accra region, which was the first attempt by the FAO to transfer the experience of South/East Asia Rice IPM programme to another region by training Agriculture Extension Officers.

In conclusion, pesticides are chemicals, mostly man-made, which are used to get rid of pests on crops in order to increase yields, thereby increasing the economic status of the farmer. However, their persistent misuse can adversely affect human health and the environment. Exposure to pesticides can occur in diverse ways be it in the home, farm, workplace etc. Humans are exposed normally through the nose, mouth, skin and the eyes. The environment can also be exposed through practices such as disposal of pesticides and used containers onto uncultivated land, rivers and by burning the containers. These result in environmental pollution, damage to aquatic flora and fauna, persistence of dangerous chemicals in the soil etc. Human effects of exposure to pesticides include sexual weakness, reproductive problems in both males and females, wheezing, inflamed skin and eyes, headaches, respiratory disturbances and neurological problems. These human effects are chiefly prevented by the use of personal protective equipment and by adopting good practices that are given as instructions during trainings and on labels. These lead to the acquisition of a good level of knowledge about the earlier mentioned practices. Ultimately the prevalence and incidence of the effects of pesticides on the human population and the environment will be curbed thereby maintaining a safe, healthier population and sustainable environment.



CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

The study reported here is part of the North Offinso Farm Health study (NOFAHS). The study is a cross-sectional one among 300 households (i.e. including children under five and their parent(s) in the Offinso-North district of the Ashanti region. This study concentrated on the adult population.

3.2 Study Area

The Offinso North District of Ashanti Region is about 95km north –west of Kumasi, the administrative capital of the Ashanti Region. The district is divided into three (3) geographical zones and each zone comprises a major farming community and surrounding villages. The communities are Akumadan (the largest), Nkenkenso and Afrancho, all on the Kumasi –Techiman main road. Afrancho is to the left of Akumadan while Nkenkenso is to the right. The district has a hetero-ethnic habitation with a population of over twenty-five thousand (25,000), of which about 85% are engaged in vegetable cultivation. It is well known for its agricultural activities, producing more tomatoes than any other district in Ghana. The major vegetables cultivated are pepper, garden eggs, okra and tomatoes with tomato constituting about 80 % (Ntow *et al.*, 2008). Other crops cultivated are maize, cassava, plantain and cocoa. Because of this, the farmers use a comprehensive and varying collection of pesticides. They are likely to use one or a blend of two or three pesticides on their crops, depending on the severity of the infestation (Ntow, 2009). Furthermore, there is no statistics on the annual consumption of pesticides in the district, but evidence has it that vegetable farmers in the Offinso north district utilized pesticides more than any other farming community in Ghana. (Ntow *et al* 2007). The district has a natural vegetation of

semi-deciduous forest type, most of which have been destroyed due to extensive farming and logging activities. It lies in the transitional zone of Ghana with two rainfall seasons: major and minor with a mean maximum of 200mm and 120mm respectively. The major season begins from April to July. The shorter and minor season is from September to October. The district has an irrigation dam located in Akumadan for provision of water during the dry season. With respect to the traditional land tenure system in Ghana, every member of a family or clan is entitled to a portion of inherited lands for farming purposes. Indigenes have polygamous families which farm 2-3 acres each, forcing every single member of the family into the workforce even if they have other forms of livelihood. Farmers have access to as much land as they wish in the community, but are restricted from the protected forest zones. For farming purposes they clear the land from the semi-deciduous vegetation which serves as a cover of the landscape. Their produce is negotiated by the farmers' association with buyers. For the purposes of division of labour, women are responsible for the planting and harvesting, whereas, men are responsible for land preparation, chemical application and management of the farm (Agriculture Extension Officers, personal communication).

3.3 Study Variables:

3.3.1 Main Determinants

The main determinants of interest include (i) knowledge on the effects of pesticides on human health and environment, (ii) hygiene practices and (iii) protection and safety practices. For knowledge of the effect of pesticide on human health and environment farmers answered questions on whether pesticide use/exposure has effect on health, whether the use of pesticide affect the soil, whether pesticide affect fish and other animals in the surrounding river, whether they are aware that pesticide affect the natural

environment and whether they are aware that pesticide can remain in the soil for a long time. Hygiene practices inquired about how long farmers work with the same pair of gloves changing into new set, how often they mix pesticide with bare hands, how often did they eat while spraying, and how often did they drink water while spraying. Questions on protection and safety inquired whether they wore the following PPE's while spraying: boots, hat, cartridge respirator, gas mask, dust mask, full face shield, chemically resistant gloves, disposable outer clothing, and goggles.

3.3.2 Dependent variable(s):

The main dependent variable is self –reported symptoms which are defined as respiratory and non-respiratory symptoms. Respiratory symptoms include experience of chronic cough, wheezing and breathlessness in the last 12 months; whilst non-respiratory symptoms include sexual weakness, depression, general body weakness, blurred vision and memory loss.

3.3.3 Confounders

Potential confounders include gender, age, marital status, cooking fuel type, education and smoking and drinking habit. Selection of these variables was based on literature and their significant association with the parameters of interest, $p < 0.05$ (Zyoud, 2010).

3.3.4 Source population/Study population

The source population for this study was all farmers in the three (3) geographical zones: Afrancho, Nkenkenso and Akumadan of the Offinso-North District (see section 3.2). The study population included 310 farmers (see section 3.5 for sampling procedure and sample size calculation) and was derived from the Offinso North district Farm Health

study (ONFAHS). Any farmer who was included in the present study met the eligibility criteria (see section 3.3.4.1 and 3.3.4.2).

3.3.4.1 Inclusion criteria

The eligibility criteria included (i) The farmer being above 18 years (ii) a permanent resident in the study area and (iii) willingness to follow the study protocol and complete the study

3.3.4.2 Exclusion criteria

The exclusion criteria included (i) a non-farmer, (ii) below 18 years and (iii) were non-permanent resident in the study area.

3.3.5 Sample Size and sampling procedure

3.3.5.1 Sampling Procedure

A simple random method was applied in the study. A sample size of 310 was calculated (see section 3.3.5.2) and randomly selected using computer generated numbers from adult population of 620 in the ONFAHS. The ONFAHS used convenient sampling to enroll the participants from the 3 geographical zones in the district.

3.3.5.2 Sample size calculation

The sample size was determined for self-reported wheezing due challenges in obtaining prevalence data for the other outcomes of interest. Using the method of Cochran (1977) the following parameters were applied: 95% confidence level ($z=1.96$), margin of error ($\epsilon=0.05$), the prevalence of wheezing in adult population at Akumadan was 27% (Abdul-Rahaman 2015).

$$n = \frac{z_{\alpha/2}^2 pq}{\epsilon^2}$$

Where; n = the sample size.

$Z_{\alpha/2}$ = the critical value=1.96.

$p = 0.27$; $q=1-p=0.73$

ϵ = the level of precision or sampling error=0.05

P =prevalence of wheezing in adult population at Akumadan was 27%

$$n = \frac{1.96^2 \times 0.27 \times .73}{0.05^2}$$

$$n = \frac{0.757}{0.05^2}$$

$$n = 302$$

With this, an estimated population of 310 farmers was selected from the North Offinso Farm Health study (NOFAHS).

3.3.6 Data Collection Procedure

As indicated in section 3.1, this study was part of the North Offinso Farm Health study (NOFAHS). The field study was implemented in three (3) phases: (i) stakeholder meeting, (ii) enrollment of study participants, (iii) data collection.

Stage 1: Stakeholder meeting: The research team (including the principal investigator) first had a meeting with the director of Agriculture Extension Service and the Agriculture Extension Officers to discuss the study, after which the principal researcher and research assistants met the chief, assembly man and other relevant heads of the community. The

extension services department which is an active institution involved in farming issues was met as well for the purpose of introducing the project and its details to them so the needed permission and assistance was made available.

Phase 2: Participant Enrollment: Prior to enrollment into the study, a written consent form was read to the farmers in a local language and any questions raised by them answered. Farmers who agreed to be part after the consent has been explained and their questions answered, were made to sign or thumbprint the consent form before they were enrolled. These and more are explained in the inclusion and exclusion criteria explained in sections 3.6.2 and 3.6.3.

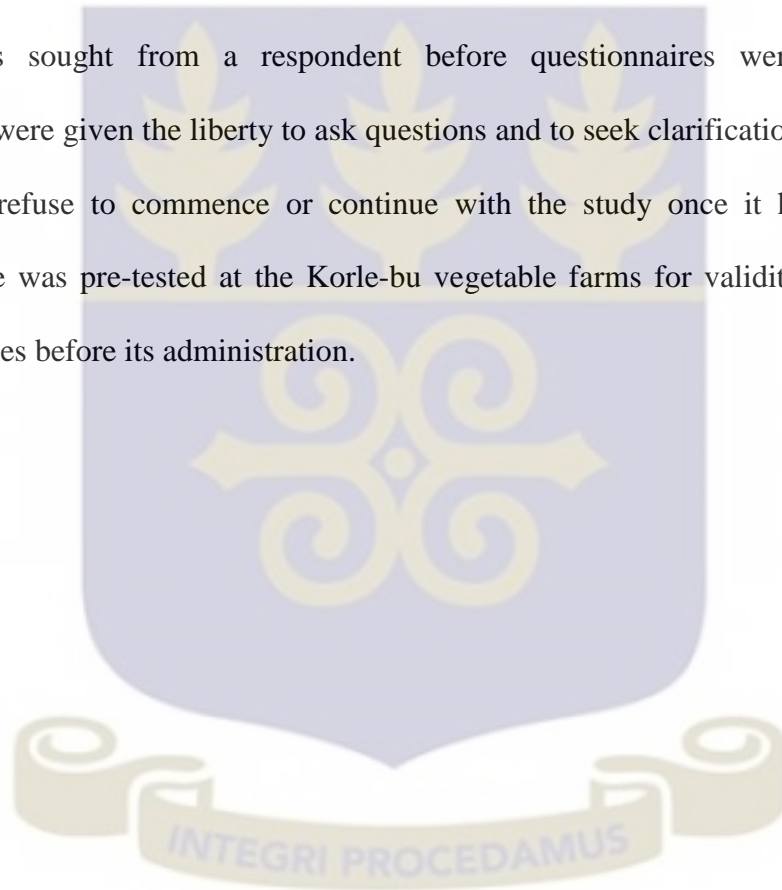
Phase 3: Data Collection: First, research assistants were provided extensive one (1) day training on interviewing techniques. Each farmer was interviewed with a structured questionnaire. The questionnaire asked questions on age, gender, education, farming experience in years, life style, knowledge on the effects of pesticide on human health, soil, and fish and rivers, the use of boots, dust mask, goggles, hats, and face shield. Farmers were also asked whether they mix pesticides with bare hands, number times they change their gloves into new sets, whether they eat or drink water while applying pesticides. Detailed questionnaire is attached (Appendix 2).

3.7 Data Analysis

Proportions were computed for categorical variables. The effect measure is prevalence ratio (PR). The following variables were significant at $p < 0.05$ and were controlled for in the analysis: age, gender, education, farming experience in years, and life style.

3.8 Ethical Considerations

Permission was sought from the Ghana Health Service Ethical Review Board for ethical clearance. The chiefs and elders of the Offinso North District Vegetable Farming community were contacted as the first step at this stage of the methodology. The farmers and their leaders, through Farmers Associations and Agricultural Extension Officers were gathered, in order to hold a forum to afford me the opportunity to explain the purpose of the study and the benefits and timeline for data collection. During the collection of data, consent was sought from a respondent before questionnaires were administered. Participants were given the liberty to ask questions and to seek clarifications. They had the freedom to refuse to commence or continue with the study once it had started. The questionnaire was pre-tested at the Korle-bu vegetable farms for validity and to correct inconsistencies before its administration.



CHAPTER FOUR

4.0 RESULTS

4.1 Characteristic of the study population

A total of 310 farmers who were contacted participated in the study (participation rate =100%). Majority of the study participants were males (74.4%), were between 35 to 55 years (81.2%), were married (94.5%), used highly polluted fuels (41.1%), were illiterates (59.2%), were full-time farmers (69.2%), (Table 4.1).

Table 4.1. Socio- demographic characteristics of study population, the North Offinso Farm Health study (NOFAHS) (n=310)

Characteristics of study population	N	%
Gender		
Male	230	74.4
Female	80	25.57
Age		
≤35	44	14.24
35-45	123	39.81
45-55	128	41.42
>55	15	4.53
Marital status		
Married	264	94.96
Single	14	5.04
Missing		
	32	
Cooking fuel type		
High pollution fuel	127	41.10
Medium pollution fuel	163	52.75
Low pollution fuel	20	6.15
Level of education		
Have not been to school	182	59.15
JHS/middle school/primary school	122	39.22
SHS/secondary school/vocational or technical	6	1.63
education		
Smoking habit		
Never smoked	294	94.82
Past smoker	10	3.24
Current smoker	6	1.94

Table 4.1 continued.

Characteristics of study population	n	%
<i>Drinking habit</i>		
Never drunk	231	74.52
Past drinker	48	15.48
Current drinker	31	10.00
<i>Work shift</i>		
Full-time	215	69.26
Part-time	94	30.42
Size of land (acres)		
≤6	107	34.53
6-9	53	16.94
9-12	54	17.59
≥12	96	30.94
<i>Duration of employment (year)</i>		
<12	80	26.06
12-17	81	26.06
17-22	73	23.45
>22	76	24.43
<i>Average annual Income (GHS)</i>		
≤4500	89	29.87
4500-6500	65	21.81
6500-15000	80	26.85
≥15000	64	21.48
<i>Missing</i>	12	

4.2 Prevalence of Respiratory and Non- respiratory Symptoms

Table 4.2 showed that, 114 (37.8%), 35 (25.4%) and 30 (11.2%) of farmers experienced chronic cough, wheezing and shortness of breath after experience with pesticides respectively. For non-respiratory symptoms, 257 (89.2%), 65 (24.5%), 84 (32.3%), 125 (48.3%), 39 (15.2%) and 37 (14.3%) experienced general body weakness, sexual weakness, fatigue, blurred vision, memory loss and depression respectively.

Table 4.2 Symptoms related to pesticide use among farmers, the North Offinso Farm Health study (NOFAHS) (n=310)

Outcomes of Interest	Yes		No	
	N	%	N	%
Respiratory Symptoms				
Chronic Cough	114	37.8	188	62.3
Wheezing	35	15.4	190	83.7
Shortness of breath	30	11.2	237	88.8
Non-Respiratory symptoms				
General body weakness	257	89.2	31	10.8
Sexual weakness	65	24.5	200	75.5
Depression	37	14.3	221	85.7

4.3 Farmers Knowledge on the effects of pesticides on human health and the environment.

The definition of the effects of pesticide on human health and the environment is given in section 3.3.1. About 82.4% of farmers had knowledge on effects pesticides had on human health, 92.2% knew that pesticides have effects on the soil, and 90.7% affirmed that pesticides could have effect on fish and rivers (**Appendix 5, Table 1**). In all, 88.9% and 11.1% of farmers had good or poor knowledge of the effects of pesticide on human health and the environment respectively. Education ($p=0.0049$) and duration of employment ($p=0.0192$) were significantly related to farmers knowledge. However, gender, age, marital status, smoking, drinking habit, work shifts, farm size and annual income were not

significantly related to farmers knowledge on the environmental and health effects of pesticides (Table 4.3).

Table 4.3 Farmers knowledge on environmental and health effects of pesticides, the North Offinso Farm Health study (NOFAHS) (n=310)

Characteristics of study population	Good Knowledge 249 (88.93%)		Poor Knowledge 31 (11.37%)		Chi-squared statistics	
	N	%	N	%	Test statistics	p-value
Gender						
Male	188	75.50	20	64.52	1.7418	0.1869
Female	61	24.50	11	35.48		
Age						
≤35	31	12.45	6	19.35	31.0382	<.0001
35-45	101	40.56	12	38.71		
45-55	107	42.97	11	35.48		
>55	10	4.02	2	6.45		
Marital status						
Married	218	96.46	28	96.55	0.3965	
Single	8	3.54	1	3.54		
Cooking fuel type						
High pollution fuel	101	40.56	6	19.35	31.0382	<.0001
Medium pollution fuel	139	55.82	16	51.61		
Low pollution fuel	9	3.61	9	29.03		
Level of education						
Have not been to school	160	64.78	12	38.71	0.0049*	
JSS/middle school/primary school	84	34.01	17	54.84		
SSS/secondary school/vocational or technical education	3	1.21	2	6.45		
Smoking habit						
Never smoked	18	7.32	-	-	0.3710	
Past smoker	22	8.94	3	9.68		
Current smoker	206	83.74	28	90.32		
Drinking habit						
Never drank	24	9.64	1	3.23	0.1252	
Past drinker	34	13.65	1	3.23		
Current drinker	191	76.71	29	93.55		
Work shift						
Full-time	161	64.66	25	80.65	0.2043	
Part-time	87	34.94	6	19.35		
Size of land (acres)						
≤9	124	49.80	11	36.67	2.8959	0.2350
9-12	44	17.67	9	30.00		
≥12	81	32.53	10	33.33		
Duration of employment (year)						
<12	61	24.50	12	38.71	0.0192*	
12-17	75	30.12	4	12.90		
17-22	63	25.30	4	12.90		

>22	50	20.08	11	35.48	
Average annual Income (GHS)					
≤4500	65	27.08	10	32.26	
4500-6500	53	22.08	9	29.03	0.1146
6500-15000	64	26.67	10	32.26	
≥15000	58	24.17	2	6.45	

*=p-value from Fischer exact test

4.4 Farmers hygiene practices during pesticide use.

Again the definition of farmers' hygiene practices as used in this study is reported in section 3.3.1. Of the farmers, 78.6% wore the same pair of gloves all the time when mixing pesticides, 90.5% mix pesticides with their bare hands, 61.6% eat while spraying pesticide and 90.7% drink water while spraying pesticide (**Appendix 5, Table 2**). Generally, 64.5% of farmers are engaged in poor hygiene practices whereas 19.4% are engaged in poor hygiene practices. A significant relationship was however found to exist between educational status ($p=0.0083$), smoking status ($p=0.0007$), drinking status ($p=0.0015$), average annual income ($p=0.0005$) and work shifts ($p=0.0001$) and hygiene practices. There was however, no significant relationship gender, age, marital status and duration of employment and between hygiene practices (Table 4.4).



Table 4. 4. Farmers Hygiene Practices during pesticide use, the North Offinso Farm Health study (NOFAHS) (n=310)

Characteristics of study population	Good Hygiene Practices 60 (19.35%)		Poor Hygiene Practices 200(64.52%)		Chi-squared statistics	
	N	%	n	%	Test statistics	p-value
Gender						
Male	39	65.00	151	75.50	2.5863	0.1078
Female	21	35.00	49	24.50		
Age						
≤35	10	16.67	16	8.00	0.1996	
35-45	25	41.67	81	40.50		
45-55	24	40.00	94	47.00		
>55	1	1.67	9	4.50		
Marital status						
Married	43	91.49	180	95.74	0.2646	
Single	4	8.51	8	4.26		
Cooking fuel type						
High pollution fuel	22	36.67	82	41.00	0.1007	
Medium pollution fuel	38	63.33	107	53.50		
Low pollution fuel	-	-	11	5.50		

*=*p*-value from Fischer exact test**Table 4. 4 continued.**

Characteristics of study population	Poor Hygiene Practices 60(19.35%)		Good Hygiene Practices 200(64.52%)		Chi-squared statistics	
	N	%	N	%	Test statistics	p-value
Level of education						
Have not been to school	29	48.33	136	69.04	14.5857	0.0083*
JSS/middle school/primary school	30	50.00	57	28.93		
SSS/secondary school/vocational or technical education	1	1.67	4	2.03		
Smoking habit						
Never smoked	40	67.80	170	85.86	14.5857	0.0007
Past smoker	7	11.86	18	9.09		
Current smoker	12	20.34	10	5.05		
Drinking habit						
Never drank	34	56.67	155	77.50	13.0455	0.0015
Past drinker	12	20.00	29	14.50		
Current drinker	14	23.33	16	8.00		
Work shift						

Full-time	53	88.33	120	60.30	21.1294	<.0001
Part-time	6	10.00	79	39.70		
Size of land (acres)						
≤9	33	55.00	99	49.75		
9-12	9	15.00	36	18.09	0.5708	0.7517
≥12	18	30.00	64	32.16		
Duration of employment (year)						
<12	21	35.00	44	22.11		
12-17	17	28.33	55	27.64	6.7295	0.0810
17-22	8	13.33	54	27.14		
>22	14	23.33	46	23.12		
Average annual Income (GHS)						
≤4500	27	45.76	41	21.35		
4500-6500	14	23.73	43	22.40	17.8358	0.0005
6500-15000	13	22.03	55	28.65		
≥15000	5	8.47	53	27.60		

*=p-value from Fischer exact test

4.5 Protection and Safety Practices during pesticide use.

In this study the definition of protection and safety is provided in section 3.3.1. Very few farmers used boots (11.4%), hats (12.9%), cartridge gas mask (12.9%), dust mask (11.1%), face shield (9.6%), gloves (14.1%), and goggles (12.4%) (**Appendix 5, Table 3**). In all, protection and safety practices were poor (92.25) (Table 4.5). Marital status ($p=0.0598$) and farm size (0.0124) were significantly related to farmer's protection and safety practices. However, there was no significant association gender, age, educational status, smoking status, drinking status, work shift, duration of employment and annual income and farmer's protection and safety practices (Table 4.5).

Table 4.5: Farmers Protection and Safety Practices

Characteristics of study population	Poor Safety Practices 119 (92.25%)		Good Safety Practices 10 (7.75%)		Chi-squared statistics	
	N	%	N	%	Test statistics	p-value
Gender						
Male	89	74.79	6	60.00		0.4538
Female	30	25.21	4	40.00		
Age						
≤35	21	17.65	1	10.00		0.7661
35-45	46	38.66	6	60.00		
45-55	46	38.66	3	30.00		
>55	6	5.04	-	-		
Marital status						
Married	101	95.28	5	71.43		0.0598*
Single	5	4.72	2	28.57		
Cooking fuel type						
High pollution fuel	58	48.74	2	20.00		0.1449
Medium pollution fuel	48	40.34	6	60.00		
Low pollution fuel	13	10.92	2	20.00		
Level of education						
Have not been to school	54	45.38	5	50.00		0.2432
JSS/middle school/primary school	63	52.94	4	40.00		
SSS/secondary school/vocational or technical education	2	1.68	1	10.00		
Smoking habit						
Never smoked	94	79.66	9	90.00		0.8365
Past smoker	12	10.17	-	-		
Current smoker	12	10.17	1	10		

*=p-value from Fischer exact test

Table 4.5 continued.

Characteristics of study population	Poor Safety Practices 119 (92.25%)		Good Safety Practices 10 (7.75%)		Chi-squared statistics	
	N	%	N	%	Test statistics	p-value
Drinking habit						
Never drank	77	64.71	7	70.00		0.9306
Past drinker	26	21.85	2	20.00		
Current drinker	16	13.45	1	10.00		
Work shift						
Full-time	111	93.28	9	90.00		0.5280
Part-time	7	5.88	1	10.00		
Size of land (acres)						
≤9	84	71.19	4	40.00		0.0124*
9-12	15	12.71	2	20.00		
≥12	19	16.10	4	40.00		
Duration of employment (year)						
<12	28	23.53	3	30.00		0.2333
12-17	26	21.85	4	40.00		
17-22	19	15.97	2	20.00		
>22	46	38.66	1	10.00		
Average annual Income (GHS)						
≤4500	37	31.90	3	30.00		0.2080
4500-6500	16	13.79	-	-		
6500-15000	30	25.86	1	10.00		
≥15000	25.86	28.45	6	60.00		

* = p-value from Fischer exact test

4.6. Association between farmers' knowledge, hygiene practices and protection and safety practices and self- reported symptoms

The association between knowledge on environmental and human health effects of pesticides, hygiene practices, and protection and safety practices and respiratory symptoms (Table 4.6a) and non-respiratory symptoms (Table 4.6b) are show below. Farmers knowledge was significantly associated with chronic cough (Prevalence ratio (PR) =2.56, confidence interval (CI) 1.99-3.30), wheezing (4.06, 2.25-7.32) and breathlessness (3.97, 2.05-7.68). Similarly, hygiene practices was significantly associated with chronic cough (3.92, 2.88-5.33), wheezing (2.11, 1.08-4.14) and breathlessness (3.62-

8.30). There was not enough data to examine the relationship between protection and safety practices and breathlessness, but protection and safety practices was significantly associated with chronic cough (2.35, 1.21-4.04) and wheezing (2.44, 1.00-7.01). The relation between the main determinants and non-respiratory symptoms was also examined (Table 4.6b). Farmer's knowledge was significantly associated with sexual weakness (2.04, 1.24-3.36) and depression (3.28, 1.73-6.21) but not general body weakness. Similarly, hygiene practice was associated with sexual weakness (2.03, 1.24-3.18) and depression (3.83, 1.88-7.77) but not general body weakness. However, there was no significant association between protection and safety practices and the non-respiratory symptoms.

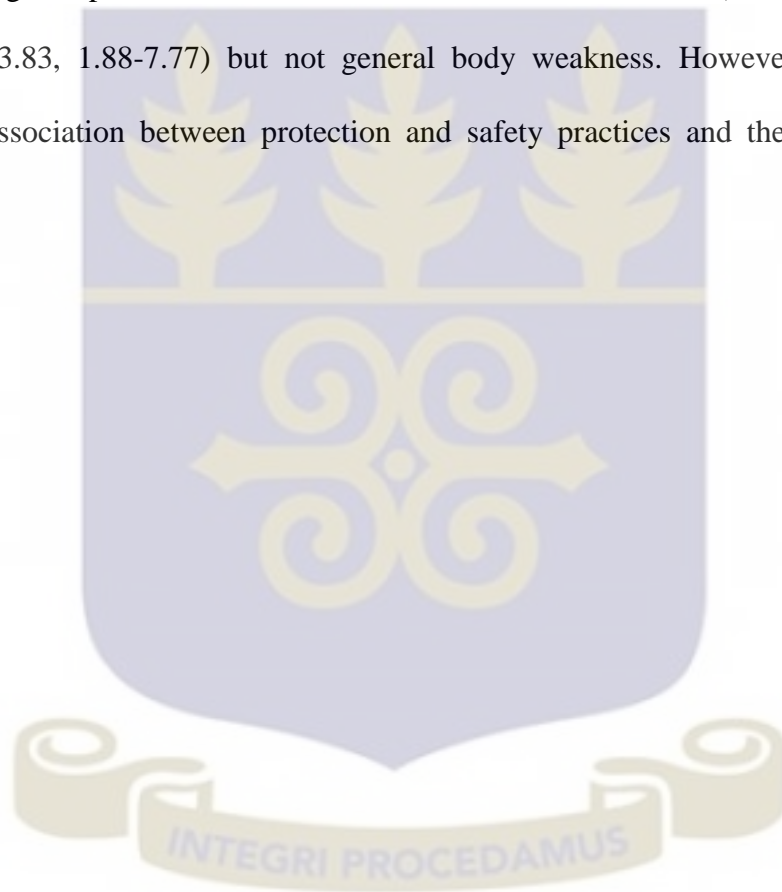


Table 4.6a. Association between main determinants and respiratory symptoms

Exposure Indicators	Respiratory symptoms					
	Cough		Wheezing		Breathlessness	
	Crude PR	Adjusted PR*	Crude PR	Adjusted PR*	Crude PR	Adjusted PR*
Knowledge						
<i>Good</i>	1.00	1.00	1.00	1.00	1.00	1.00
<i>Poor</i>	2.43 (1.85-3.20)	2.56 (1.99-3.30)	3.72 (2.08-6.64)	4.06 (2.25-7.32)	3.84 (1.20-7.46)	3.97 (2.05-7.68)
Hygiene Practices						
<i>Good</i>	1.00	1.00	1.00	1.00	1.00	
<i>Poor</i>	3.79 (2.76-5.20)	3.92 (2.88-5.33)	1.62 (0.80-3.28)	2.11 (1.08-4.14)	1.76 (0.98-3.67)	3.62 (1.58-8.30)
Protection and Safety Practices						
<i>Good</i>	1.00	1.00	1.00	1.00	-	-
<i>Poor</i>	1.97 (1.35-2.87)	2.54 (1.21-4.04)	2.01 (0.99-6.04)	2.44 (1.00-7.01)		

Table 4.6b. Association between main determinants and non- respiratory symptoms

Exposure Indicators	Sexual Weakness		General Body Weakness		Depression	
	Crude PR	Adjusted PR*	Crude PR	Adjusted PR*	Crude PR	Adjusted PR*
Knowledge						
<i>Good</i>	1.00	1.00	1.00	1.00	1.00	1.00
<i>Poor</i>	2.01 (1.28-3.16)	2.04 (1.24-3.36)	0.93 (0.80-1.08)	0.96 (0.83-1.12)	3.21 (1.70-6.04)	3.28 (1.73-6.21)
Hygiene Practices						
<i>Good</i>	1.00	1.00	1.00	1.00	1.00	1.00
<i>Poor</i>	1.78 (1.15-2.76)	2.03 (1.30-3.18)	0.97 (0.88-1.10)	0.97 (0.87-1.08)	3.15 (1.56-6.38)	3.83 (1.88-7.77)
Safety Practices						
<i>Good</i>	1.00	1.00	1.00	1.00	1.00	1.00
<i>Poor</i>	1.10 (0.49-2.46)	1.21 (0.54-2.73)	0.83 (0.55-1.26)	0.85 (0.56-1.29)	0.39 (0.06-2.52)	0.42 (0.06-2.77)

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Main Findings

The study assessed farmers' knowledge on environmental and human health effects of pesticides, work practices and self-reported symptoms associated with pesticide use among vegetable farmers in the Offinso North District in the Ashanti region. Most farmers (88.9%) had a good knowledge on the effects of pesticides on human health and the environment. But majority adopt either poor hygienic practices (64.5%) or bad protection and safety practices (92.3%) on the job. General body weakness (89.2%) and chronic cough were common among the farmers but very few also complained of wheezing (15.4%), shortness of breathlessness (11.2%), sexual weakness (24.5%) and depression (14.3%). Poor knowledge was associated with both respiratory and non-respiratory symptoms. Poor hygienic was also associated with chronic, breathlessness, general body weakness and depression. Protection and safety practices was associated with chronic cough, wheezing but not with non-respiratory symptoms.

5.2 Methodological Validity

This study has a number of strengths. To the best of my knowledge, this is first study on knowledge and practices among farmers in Ghana. This study population was derived from a population-based cross-sectional design, the Offinso north Farm Health study (ONFAHS) involving over 900 individuals. Couple with the high participation rate, the effect of selection bias was minimal. The research assistants were well educated and enlightened agricultural extension officers in the district who hitherto had been involved in various forms of data collection exercises; their orientation to the study and subsequent training was rendered easy. However, they carefully followed the study protocol in order

to reduce bias. The main study recruited study participants from major farming communities in the 3 geographical zones in the Offinso north district and I carefully randomly selected 310 participants for this study. In spite of these strengths, the present study has a number of limitations. First, the design of this study was cross-sectional and it was not possible to establish temporality. The study was also carried out during the holy month of Ramadan and it was possible that certain tribes that belong to the Islamic religion could have been oversampled. The study was likely to miss women (farmers) who have to go to the market to sell their produce on market days and farmers who left home to their farm early. However, the effect of this on the observed associations could be described as non-differential. Some questions were however not answered probably due to recall bias and farmer being in a hurry to go harvest or market farm produce. Possible confounding variables were measured and adjusted for during data analysis one of which was the number of years of farming which was controlled for. Nevertheless, there could be residual confounders.

5.3 Comparison with Other Studies

In this study, there was no statistically significant relationship between good knowledge and gender, age, marital status, personal smoking and drinking habits, fulltime or part - time work shifts, farm size nor annual income. However, there seemed to be a statistically significant relationship between levels of knowledge and educational status ($p=0.0049$) and the number of years of farming experience ($p=0.0192$). Atreya (2007) examined the difference in gender on knowledge on pesticide use practices in Nepal and found, on the contrary, that female farmers had lower levels of education than male farmers, making females less likely to read and understand labels on pesticides. A similar study of farmers by Zyoud et al (2010) in the Palestine West Bank, showed that 97% of participants were

aware of the names of the pesticides they used on their farms and the factors influencing good knowledge in that study were as follows: good knowledge was significantly associated with secondary education level ($p < 0.001$), college education ($p < 0.01$), working experience over 10 years ($p = 0.001$), using pesticides for more than 10 years ($p = 0.03$). However, poor knowledge was associated with primary education i.e. $p < 0.001$ but was not statistically significant with respect to age and gender. Another KAP study in Uganda also showed that some farmers, even though had high knowledge levels on health effects, did not practice according to the knowledge they had. (Ousterlund et al, 2014). Also, high illiteracy rates contribute to farmers' difficulty in understanding and following instructions and safety advice on pesticide use (Remoundou, 2011). Knowledge was not found to influence practices in Brazil because majority of farmers admitted receiving information/training and claimed reading labels' instructions and warning but do not take adequate protective measures. This was attributed to low levels of education of participants. 'High levels of knowledge and perception of risk were not enough to influence workers' and operators' self-protective behavior. (Remoundou, 2014). In this study more farmers were involved in poor hygiene practices either on the farm or at home. A previous study by Damalas, Telidis and Thanos in 2008 on assessing farmers' practices on disposal of pesticide waste after use showed that some farmers confessed releasing left over into nearby streams and irrigation canal. After rinsing they poured the water into nearby uncultivated lands. Most containers were dumped on rubbish dumps or burned. In this study, probably due to education, the farmers who were below the age of 35 years engaged in poor practices (8%), majority (81.67%) above 35 years engaged in poor practices. It further indicates that there is no statistically significant association between good hygiene practices and many years of farming experience. On the other hand, there was a statistically significant relationship between level of education ($p = 0.0083$) and poor

hygienic practices. Telidis and Thanos (2008) noted that re-spraying surplus mixtures is said to be risky as it doubles the recommended dosages on the crops leading to toxicity, residues in soil and harvested crops. This also includes the disposal of rinsates on uncultivated lands. The best way recommended to dispose of left-over is to find other similar farms that will need application of the same chemical. (Damalas, C., Telidis, G. K., & Thanos, S. D. (2008). A study in Greece found a common practice of dumping empty pesticide containers by fields, near, or into irrigation streams and canals, burning in open fire are well known practice of disposal farmers are involved in, coupled with using them for fuel storage, water and food storage (Haylamicheal and Dalvie, 2009). In this study an association was found between poor practices and self-reported symptoms such as sexual weakness, respiratory symptoms and general body weakness. This confirms the previous study by Sosan and his colleague (2012), who likewise found that almost all the farmers in their study who engaged in poor practices confirmed typical symptoms of insecticide poisoning after each spraying task. These symptoms comprised severe headache (66%), dizziness (58%), body weakness or being unusually tired (55%), nausea (53%), restlessness (37%) and excessive sweating (41.3%). Atreya, (2008) also found that pesticide sprayers report greater signs and symptoms of exposure such as skin irritations, stomach poisoning and eye irritations than other farm workers. Another study conducted on 268 by Neghab et al in 2014, on married male farmers in Iran showed that 68% of participants reported to their general practitioners of suffering from burning and skin irritations, eye burn, headaches, vertigo, nausea and vomiting during spraying; about 6.3% had offspring with congenital malformations, 7% showed impaired fertility/ sexual weakness after working for over 10 years as sprayers; farmers' wives were greater than that of the average population.

CHAPTER SIX

6.0 CONCLUSION/ RECOMMENDATIONS

6.1 Conclusion

This study suggests that farmers have good knowledge of the effect of pesticides on human health and the environment, but this did not translate into good hygiene and work ethic practices. General body weakness was common among the farmers. Poor knowledge was associated with self-reported symptoms. However, poor work practices were associated with chronic cough and shortness of breath,

6.2 Recommendations

In view of the above findings, it is recommended that Agencies that are responsible for farmer education such as the Ministry of Agriculture be financially empowered to carry out vigorous training and frequent monitoring of farmers' work practices. Secondly, there should be routine biomonitoring of farmers. Again, there should be a policy that encourages the alternatives to pesticide use. It is also recommended that Integrated Pest Management programs be enforced. Longitudinal studies should be carried out to confirm the findings of the present study.



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APPENDIX 1

PARTICIPANT CONSENT LETTER

I am Akorfa Dzobo from the School of Public Health, University of Ghana pursuing a Master of Science in Occupational Hygiene. As part of the course and requirement for graduating, I am conducting a research titled “Knowledge, practices and self- reported symptoms of pesticide use among farmers: a study at a vegetable farming community”.

The rationale behind this project is to assess the level of knowledge, practices with respect to pesticide use and self-reported symptoms they experience after pesticide use.

The risk to you by participating is minimal. The only discomfort associated with this study is the discomfort of sharing of personal information but be assured that confidentiality and anonymity will be used. Participation is completely voluntary and you are free to opt out if you wish not to continue with this study. There will be no form of monetary compensation but for taking time off to participate in the study, you might be refreshed with water or soft drinks based on my discretion.

For any enquiries and explanation on the project, you are free to email me via (akorfadzobo@gmail.com) or call on me 0244896631. You are also free to call Madam Hannah Frimpong on 0243235225. By completing and submitting this survey, you are giving your consent.

Thank you

Akorfa Dzobo

University of Ghana

College of Health Sciences

School of Public Health

Masters in Occupational Hygiene

Participant's signature.....

Participant's phone number.....



APPENDIX 2

CONSENT FORM

I..... Have been thoroughly briefed on the entire methodology and significance of the on-going research which is being conducted by Akorfa Dzobo (MSc Occupational Hygiene

On my own accord, I hereby consent to be part of the study based on my understanding of what the study entails.

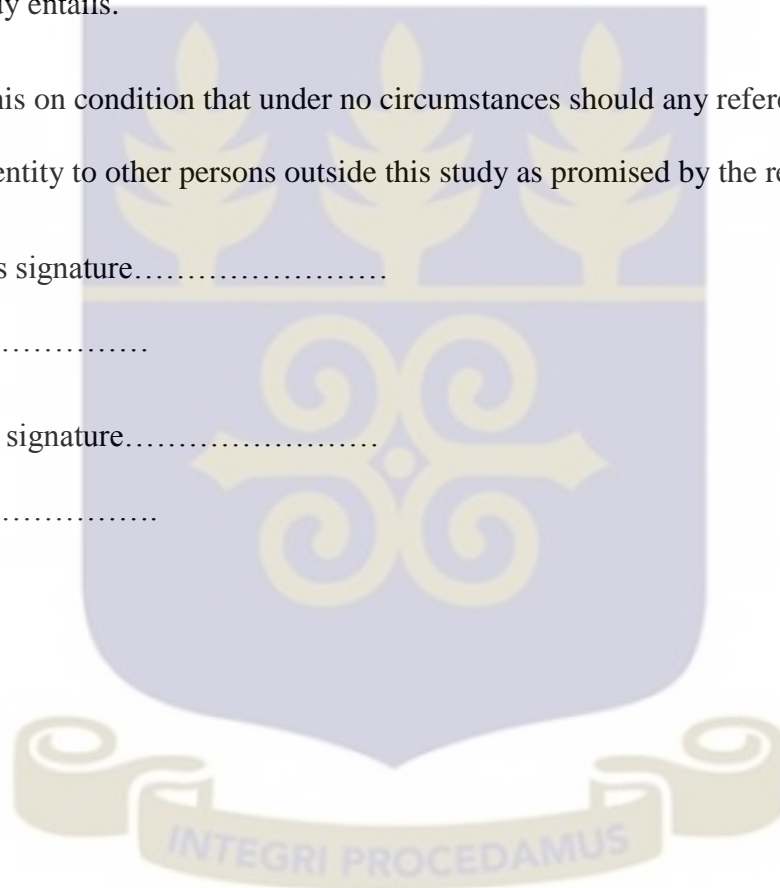
I am doing this on condition that under no circumstances should any reference be made to my actual identity to other persons outside this study as promised by the researcher

Respondent's signature.....

Date.....

Researcher's signature.....

Date.....



APPENDIX 3

QUESTIONNAIRE

KNOWLEDGE AND PRACTICES AND SELF- REPORTED SYMPTOMS OF PESTICIDE USE AMONG VEGETABLE FARMERS: A CROSS- SECTIONAL STUDY IN THE OFFINSO NORTH DISTRICT.

Dear participant,

This questionnaire is designed to assess the level of knowledge, practices and self-reported symptoms of pesticides use among farmers. Please read each item carefully and provide you candid opinion and answers to them. There are no harmful implications in the filling of this questionnaire. For the success of this study you are strongly assured of confidentiality and thus information gathered in this study is strictly for the purpose of academic work and will have no overt implications. Participating in this study is voluntary and where any participant finds the question uncomfortable, one is at liberty not to answer or choose to withdraw from the study at any time. However, I hope that you participate fully in this study since your views are extremely important.

Please tick where appropriate.

DEMOGRAPHIC DATA (PART 1)

1. Sex : () Male () Female
2. Age : < 20 () 21-30 () 31-40 () 41- 50 () 51 -60 () >60 ()
3. Educational level: None () Primary /JSS () Secondary () Tertiary ()
4. Years of Farming: () 1-5 years () 6-10 years () 11-20 years () > 20 years.
5. What fuel do you use in cooking? Electricity () Gas () Kerosene stove () Charcoal () Firewood ()
6. What is your smoking Habit? Past smoker() Current () Never ()
7. What is your alcohol Habit? Past drinker() Current () Never ()

8. For how long have you been a farmer.....
9. Are you a full time or part time farmer? Part- time () full Time ()

PART TWO

Knowledge on the effects of pesticides on Human health and the Environment

1. Does pesticides affect the health of humans? () Yes () No () I don't know.
2. Do you think pesticides affect the environment? () Yes () No () I don't know.
3. What are the pesticide(s) you use on your farm?
4. How do think pesticides enter your body? () Skin () Nose () Mouth () Eyes
5. Have you ever had any training on pesticide use? () Yes () No
6. Who trained you? () Pesticide Dealers () Agric. Extension Officers () NGO
7. Are you aware that pesticides can remain in the soil for a long time? Yes() No()
8. Does pesticides have effect on fish and rivers? () Yes () No () I don't know.

PART THREE

Practices with respect to pesticides use

1. How do you store your pesticides? () Home () Farmhouse () A designated store () I don't store, use immediately () Animal house
2. What do you do with surplus pesticide mixture? () Re-spray the crops () Throw away on uncultivated land () Spray similar farms
3. What do you do to empty pesticide containers? () Wash and re-use to store water () Bury () Burn () Throw away on rubbish dump () Re-use to store pesticides () Return to Dealer
4. Who sprays your farm? () Self () Trained/ Hired sprayer () Other
5. Are you able to read label on pesticides container? () Yes () No

6. Do you wear any protective clothes before spraying? () Always () sometimes () Never
7. Are you comfortable in them? () Yes () No
8. What protective clothing do you wear? () Gloves only () Face Mask only () respirator () Boots only () Overall only () All of the above
9. Where do you keep your working clothes () Home () Farmhouse () Other
10. Do you wash them together with your personal clothes? () Yes () No
11. Are you able to bath with soap and water after pesticide application? () Yes () No
12. What spraying methods do you use? () Knapsack () Hand- held can () Tractor () Aerial
13. Do you eat while spraying Yes () No ()
14. Do you drink water while spraying Yes () No ()

Symptoms experienced after exposure to pesticides

1. Which of the following symptoms do you experience after you are exposed to pesticides? () Red itchy eyes () Nausea and vomiting () Coughs () Wheezing () Running nose () Salivation () Skin rash/itching () Excessive sweating () Headaches () Sexual weakness () Shortness of breath
2. When do you experience these symptoms? () Immediately after spraying () within 24 hours. () After 48 hours () More than 3 days.
3. What do you do when you experience these symptoms? () Self-medication () Report to the hospital () Report to the Agric. Officer () Other

APPENDIX 5

Table 1. Participants response on knowledge on the effects of pesticides on human health and environment

Indicator variables of knowledge	n	%
Knowledge on the effects of pesticide on human health and environment	31	11.07
Bad	249	88.93
Good		
Missing	30	
Knowledge on the effects pesticides on human health		
Yes	24	8.79
No	225	82.42
Missing	61	
Knowledge on the effects pesticides on the soil		
Yes	20	7.8
No	236	92.19
Missing	54	
Knowledge on the effects of pesticides on fish and rivers		
Yes	24	9.30
No	234	90.70
Missing	52	

Table 2. Participants response to hygiene practices related to pesticide use

Indicator variables of hygiene practices	n	%
Hygiene Practices		
Poor	200	19.35
Good	60	64.65
Missing	50	
When mixing pesticides do you work with the same pair of gloves all the time		
Yes	198	78.57
No	54	21.43
Missing	58	
Do you mix pesticide with bare hands		
Yes	201	90.54
No	21	9.46
Missing	88	
Do you eat while spraying pesticide?		
Yes	109	61.58
No	68	38.42
Missing	133	
Do you drink water while spraying pesticide?		
Yes	204	90.67
No	21	9.33
Missing	85	

Table 3. Participants response to protection and safety practices related to pesticide use

Indicator variables for protection and safety practices	n	%
Protection and safety practices		
Poor	119	92.25
Good	10	7.75
Missing	181	
Do you use Boots when applying pesticide?		
Yes	14	11.38
No	109	88.62
Missing	187	
Do you wear hats when applying pesticide?		
Yes	18	12.95
No	121	87.05
Missing	171	
Do you wear cartridge gas masks when applying pesticide?		
Yes	18	12.95
No	121	87.05
Missing	171	
Do you wear dust mask when applying pesticide?		
Yes	15	11.11
No	120	88.89
Missing	175	
Do you wear face shield when applying pesticide?		
Yes	12	9.6
No	113	90.4
Missing	185	
Do you wear gloves when applying pesticide?		
Yes	18	14.06
No	110	85.94
Missing	182	
Do you wear goggles when applying pesticide?		
Yes	16	12.40
No	113	87.60
Missing	181	