# PESTICIDES HANDLING AND USE IN FOUR SELECTED AGRO – ECOLOGICAL ZONES IN GHANA




BY

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NOVEMBER, 2013.

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI, GHANA

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF CROP AND SOIL SCIENCES



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# ECOLOGICAL ZONES IN GHANA



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A THESIS SUBMITTED TO THE DEPARTMENT OF CROP AND SOIL SCIENCES, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY - KUMASI, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE CROP PROTECTION (ENTOMOLOGY)

NOVEMBER, 2013.

## DECLARATION

I, Yaw Mensah Ofosu hereby declare that this submission is my own work towards the MSc. degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University or elsewhere, except where due acknowledgement has been made in the text.



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**DEDICATION**

This work is dedicated to my dearest mother Madam Paulina Asiedu.

## ABSTRACT

This study which focused on farmers‟ handling and use of pesticides was conducted in four selected agro – ecological zones in Ghana. The study aimed at determining the types of crops on which pesticides are applied, the type of pesticides of used by farmers, the level of protection of farmers and farmers‟ perceptions about pesticides handling and use within the four selected agro – ecological zones. Data were gathered from two randomly selected farming communities of each zone selected; namely Techiman and Agogo (Transition zone), Mankranso and Akomadan (Forest zone),

Tamale and Navorongo (Savannah zone) and Amasaman and Abokobi (CoastalSavannah zone). Data were obtained through the administration of questionnaire in August, 2011. A total of 400 farmers were randomly interviewed. The results showed that about 70 % of the farmers have had formal education up to the Basic level with only 1 % having Tertiary education. Male farmers (92 %) mostly handled and applied pesticides. The study also revealed that insecticides and herbicides are by far the most frequently used pesticides across the ecological zones. Vegetables and cash crops like cocoa and citrus are the crops mostly treated with pesticides. The protective devices used by the farmers were not standard due to poverty. About 81 % know about expiry date of pesticides but 49 % really check expiry date on pesticides. Although 62.3 % are not aware of Specific Restricted Entry Interval, only about 3.7 % usually enter sprayed field few hours after application. The study also revealed that more than half (58 %) of the farmers have had no agricultural extension education on the handling and use of pesticides. About 26 % of the farmers use empty pesticides containers to keep drinks and food items for future use, which poses serious health threat to the farmers. There is therefore the need to intensify agricultural extension services and various awareness programmes on pesticides handling and use in Ghana.

## ACKNOWLEDGEMENT

I express my sincere gratitude to the Almighty God for His protection throughout the work. My appreciation goes to my academic supervisor Dr. E.A. Osekre, the Head of the Entomology section and the entire lecturers of the Department of Crop and Soil Sciences. They have really equipped me with both the academic and technical knowledge which have enabled me to carry out this study. To them I say bravo. My heartfelt appreciation also goes to the authorities of the Graduate School, Faculty of Renewable Natural Resource and GRASAG – KNUST for making all facilities readily available.

I am also much grateful to Mr. and Mrs. Felix Oteng Dwaah of MOFA – Tamale and Mr. Phanuel Akoto of MOFA – Navrongo for their immense support during my data collection.

Special thanks to the Staff of Ahmed Uwaisi Islamic Basic School, whose advice, help and comfort made this research possible. I must however, say how indebted I am to the respondent farmers of the various agro – ecological zones without whose responses this research may not have been conducted at this time.

My sincerest appreciation goes to my family especially to my mother, Madam Paulina Asiedu, who‟s financial and prayer support made this research a reality.

Finally, I wish to express my sincere gratitude to all those from whose books and articles references were cited to complete this thesis.

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# CHAPTER ONE

## 1.0 INTRODUCTION

Any substance or a mixture of substances intended for preventing, destroying, repelling or palliating any pest is referred to as pesticide. Pesticides have numerous beneficial effects in today‟s agriculture. These include crop protection, preservation of food and materials and prevention of vector-borne diseases. In fact, without pesticides farmers‟ crops would be totally devastated by insect pests, diseases and weeds and severe loss of food production would undoubtedly occur. However, besides the beneficial effects of pesticides, improper handling and use of pesticides could have adverse effects on human health through contamination of food, ground waters, soil and even the air as well as on environmental health and biodiversity (PAN Germany, 2003).

Reports indicated that over 98 % of sprayed insecticides and 95 % of herbicides reached a destination other than their target species, including non-target species, air, water bottom sediment and food [http://en.wikipedia.org/wiki/en_impact_pesticide].

In US, 90 % of streams and 50 % of wells tested proved positive for at least one pesticide [http://ca.water.usgs.gov/pnsp] and also in Ghana, Ntow (2001) reported that some contamination of pesticides do exist in water bodies, food and human fluids in areas of highly intensive vegetable production.

Currently, pesticides use in today‟s agriculture seems to be common in many developing countries like Ghana, due to the preponderance of pest. It is estimated that 87 % of farmers in Ghana use chemical pesticides to control pests and diseases on vegetables (Dinham, 2003). Of the pesticides used in Ghana, 44 % are herbicides, 33 % are insecticides and 23 % are fungicides (Ntow *et al*., 2006). Regrettably, the safe

handling and use of pesticides is not equally common to farmers. Although many famers are much aware of the potential health risks of pesticides, hardly do they take appropriate measures to minimize these effects. They rather tend to use pesticides extensively as part of efforts to minimize the destructive effects on their crops as well as obtaining optimum yield.

WHO (2008) estimated that about 25 % of the pesticides produced worldwide is used by developing countries; their populations however, suffer 99 % of global deaths from pesticides poisoning. Some of the factors which are thought to have contributed to human poisoning include; inadequate education among users and handlers on the dangers of pesticides and the safety precautions to minimize or prevent their environmental and health effects. Also, pesticides use tends to be more intense and the regulatory system seems to be weaker in developing countries.

In Ghana, it has been estimated that about 33 – 60 % of cotton and cowpea farmers are adversely affected by pesticide poisoning each season after spraying pesticides (PAN UK, 2007). Pesticides kill and deter the destructive activity of the target organism and they possess inherent toxicities that endanger the health of farmers, consumers and the environment as a whole. The risk of human poisoning and environmental damage could only be minimized if everyone knows how to handle and apply pesticides safely (Jeroen *et al.,* 2004). This leads to a need to study pesticides handling and usage by farmers within the four selected agro – ecological zones, hence the main objective of the study was to provide information on pesticides use and management in Ghana. The specific objectives were to determine:

i. the types of crops on which pesticides are applied

ii. the type of pesticides often used by farmers iii. the level of protection of farmers during pesticides handling iv. farmers‟ perceptions about pesticides handling and use.

# CHAPTER TWO

# 2.0. LITERATURE REVIEW

## 2.1. Definition of Pesticides

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

## 2.2. Classification of Pesticides

Pesticides are grouped in various ways based on a person‟s interest. Some of the ways are by their target organism (pest species), their chemical structure, and their mode of action.

### 2.2.1. Classification by Target Pest Species

Most pesticides are classified according to the pests they kill. The word ending or suffix - cide means to kill. The types of pesticides which are used to kill specific kinds of pests are presented in Table 2.2.1:

**Table 2.2.1.: Classification of pesticides according to target pests' species**

| Pesticide | Target pest |
|---|---|
| algicide | algae |
| avicide | birds |
| bactericide | bacteria |
| fungicide | fungi |
| herbicide | weeds |
| insecticide | insects |
| nematicide | nematodes |
| rodenticide | rodents |
| miticide | mites |
| molluscide | snails and slugs |
| piscicide | fish |



### 2.2.2. Classification by chemical structure

One of the most common means of classifying a pesticide is on the basis of similarities in chemical structure. Based on this mode of classification, there are 3 classes of pesticides commonly used in the structural pest control industry. These are the inorganic, botanical (natural plant or extract) and synthetic organic insecticides (Koehler and Belmont, 1998).

#### 2.2.2.1. Inorganic Pesticides

Inorganic pesticides are those made from compounds that do not contain carbon. Inorganic pesticides are typically derived from minerals or chemical compounds that occur as deposits in nature. Most of these compounds are quite stable and tend to accumulate in the environment. Some act as stomach poisons (borates and boric acid).

Others are considered as sorptive dusts (silica aerogel, diatomaceous earth) that absorb the waxy layer from the cuticle of pests. Many of the inorganic pesticides are relatively expensive and are only moderately effective in controlling insects and other pests. Common inorganic pesticides are silica aerogel, boric acid, borates, diatomaceous earth, cryolite, copper, and sulphur (Koehler and Belmont, 1998).



#### 2.2.2.2. Botanicals

The botanical pesticides are extracted from various parts (stems, seeds, roots and flower heads) of different plant species. Botanical pesticides usually have a short residual activity and do not accumulate in the environment or in fatty tissues of warm blooded animals. Many botanical pesticides act as stomach poisons, although pyrethrins act mainly as a contact poison. Common examples of botanical pesticides are pyrethrins, sabidilla, rotenone, nicotine, ryania, neem, and limonene (Koehler and Belmont, 1998).

#### 2.2.2.3: Synthetic Organic Pesticides

Synthetic organic insecticides do not naturally occur in the environment, but are synthesized by man. Since all these compounds have carbon and hydrogen atoms as the basis of their molecules, they are referred to as organic compounds. The four basic types of synthetic organic insecticides are the chlorinated hydrocarbons, organophosphates, carbamates, and pyrethroids (Koehler and Belmont, 1998).

### 2.2.3 Classification by mode of action

Mode of action refers to the mechanism by which the pesticide kills or interacts with the target organism. Pesticides enter the pest body by three common ways; by contact, as stomach poisons or as fumigants. Many pesticides may enter the body by more than one of these possible routes (Koehler and Belmont, 1998).

### 2.2.3.1. Contact Pesticides

Pesticides in this class kill pests by contacting and entering their bodies either directly through the pest integument (skin) into the blood or by entering the respiratory system through the spiracles. These materials may be applied directly to the pest‟s body or as a residue on plant or animal surfaces, habitations or other places frequented by the pest. In cases where residues are used, pests usually contact the pesticide through their feet. Coarse sprays or dusts are more effective means of applying contact insecticides than are mists or fogs. Most of the synthetic organic compounds act as contact insecticide, although many also confer stomach and fumigant activity (Koehler and Belmont, 1998). In the case of weeds, such herbicide kills only the soft green parts of weeds sprayed with the herbicide. A typical example of such herbicides is Paraquat (Gramoxone).

### 2.2.3.2. Systemic or Stomach Poisons

Systemic pesticides act mainly as stomach poisons. These chemicals are typically applied to one area of a plant or animal and are translocated to another area. Stomach poisons must be swallowed in order to cause death. They may be formulated as liquids, dusts, pastes, granules or baits. In the case of liquids and dusts, the pesticide is usually applied to some substance on which the animal feeds or walks through. Pastes, bait and granules may be formulated with a feeding attractant which is consumed by the pest. Inorganic and botanical (natural) pesticides in general are predominantly stomach poisons. Some synthetic organic pesticides may also act in this capacity (Koehler and Belmont, 1998). For herbicides as systemic, the weed involved absorbs the pesticide into its system after spraying where it causes death.

### 2.2.3.3. Fumigant Pesticides

Fumigants are gaseous poisons which kill pests when they are inhaled or absorbed. Their applications are usually limited to materials, structures or organisms that can be or are enclosed in a tight enclosure. There are many fumigants; some are distinctly odourless, while others are used in conjunction with odourless fumigants as a warning agent because of their odour. Fumigants leave no residue on the food after it has been used and therefore can be used safely on food products. Some combine with commodities to produce corrosive or undesirable gases. When properly used, a fumigant is non-flammable and unlike any other forms of pesticides, kills all the developmental stages of an animal. In the case of insects, this includes the eggs, larvae, pupae, and adults. When a fumigant reaches the appropriate concentration, it will kill pests quicker than any other pesticide (Koehler and Belmont, 1998).

## 2.3 Definition of Pesticide Handler

According to the US Environmental Protection Agency (EPA) a pesticide handler is anyone who:

i. is employed (including self employed) for any type of compensation by an agricultural establishment or a commercial pesticide handling establishment that uses in the production of agricultural plants on a farm, forest, nursery, or greenhouse.

ii. is performing any of the following tasks; mixing, loading, transferring or applying pesticides, handling opened containers of pesticides, acting as a flagger, cleaning, handling, adjusting or repairing the parts of mixing, loading or application equipment that may contain pesticides residues, assisting with the application of pesticides including incorporating the pesticide into the soil after the application has occurred, entering a greenhouse or other enclosed area after application and before the inhalation exposure level listed on the product labeling has been reached, entering a

treated area outdoors after application of any soil fumigant to adjust or remove soil covering such as tarpaulins, performing task as a crop advisor;

- during any pesticide application
- before any inhalation exposure level or ventilation criteria listed in the labeling has been reached
- during any restricted entry interval, disposing of pesticides or pesticide containers [source: http://www.epa.gov/agricultural.pdf ].



**2.4 Benefits of Pesticides**

Pesticides have numerous beneficial roles in human life. They include;

Cost effectiveness: pesticides are economical way of controlling pests. They require low labour input and allow large areas to be treated quickly and effectively. It has been estimated that there is a four-fold return on every dollar a farmer spends on pesticides. In developing countries, pesticides have limited the need for hand weeding, and thus the all-too-frequent total commitment of entire families to farm labour.

Protection of the environment: extensive tillage of land has been minimized in favour of application of herbicides, and soil erosion has decreased as a result. If no farm chemicals were available to control environmental pests like noxious weeds, feral animals, etc., our environment would suffer very badly. Using herbicides to control crop weeds reduces the need for cultivation, thus reducing land degradation.

Quality, quantity, and price of produce improvement: pesticides have contributed significantly in improving the quality, quantity as well as price of farm produce. Modern society demands nutritious food free from damage caused by pests and flowers which look untouched. This would be very difficult to obtain without

pesticides.

Flexibility: a suitable pesticide is available for almost all pest problems with variation in type, activity and persistence [source: http://www.regional.org.au/au/roc/1992/roc].

**2.5 Potential Health Hazards/Risks of Pesticides**

Pesticides can be hazardous if not handled with care. Undesirable side effects of pesticides use usually originate from an inadequate understanding of the impact of pesticides on the environment, compounded by indiscriminate and overuse of the product. It has been established that indiscriminate and excessive applications of pesticides has resulted in bioaccumulation, and this has adverse health implications (Rajendran, 2003).

Exposure to pesticides has been one of the most important occupational hazards among farmers in developing countries (Konradsen *et al.,* 2003 and Coronado *et al.,* 2004). Drift of sprays and vapour during application of pesticides can cause severe damage and residue problems in crops, livestock, water bodies and general environment. In US about 90 % of streams and 50 % of wells tested were positive for at least one pesticide [http://ca.water.usgs.gov/pnsp]. Ntow (2001) revealed that some levels of contamination of pesticides exist in water bodies, food and human fluids in highly intensive vegetable production areas in Ghana. Residues in food for humans and feed for livestock can be a consequence of direct application of a chemical to the food source, by the presence of pollutants in the environment or by transfer and bioaccumulation of chemical along a food chain. Ground water contamination by leach pesticides can occur in high use areas if the persistent products are used.

Many target pests may develop resistance to the pesticides used as a result of overuse and incorrect use of the pesticide. Also beneficial organisms which interact with the

targeted pests can be affected by the application of pesticides leading to a reduction in their population which can result in changes in the biodiversity of an area and affect natural biological balance.

Poisoning and other hazards to operators of pesticides can result through excessive exposure if safe handling procedures are not followed and protective clothing are not used. Poisoning risks of pesticides depend on dose, toxicity, duration of exposure and sensitivity.

### 2.6 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) is the clothing and devices that prevent the body from getting into direct contact with pesticides. PPE protects handlers from poisonings when mixing, loading and applying the pesticides. It is also important when cleaning equipment used to apply pesticides. Using PPE helps to reduce the exposure and thus reduces the risks to the pesticide applicator.

The type of PPE needed depends on the toxicity of the pesticides being used, the formulation (example liquid, wettable powder, or granules) and the activity to be carried out (example loading, mixing or spraying). It is therefore necessary for pesticides applicators to follow carefully the requirements on the product label for protective equipment to be used in order to prevent them from pesticide poisoning. Examples of PPE that are normally worn by farmers or pesticides applicators during handling of pesticides include overall, waterproof boots, long sleeves shirt, trousers, waterproof gloves, hat and face mask. Many pesticides safety experts have recommended that when wearing protective clothing rubber boots should always be worn with the trouser legs worn over the rubber boot, and not tucked in as sometimes observed.

Most farmers are aware of what equipment should be used to protect them from exposure but looking at practice realities, only few farmers use the recommended gears (Helen, 2002). In Ogbomoso (Nigeria) and Northern Cote d"Ivoire, most farmers do not use protective clothes when applying pesticides (Ajayi and Akinnifesi 2007; Adeola, 2012). The use of PPE by Ghanaian farmers during mixing, loading, and applying pesticides is said to be minimal due to primarily financial constraint (Clarke *et al*., 1997; Ntow *et al*., 2006). Other studies have revealed that most farmers in developing countries do use some forms of PPE when mixing and spraying pesticides. However, they fail to use face protective cover which protects them from serious risk of facial injury by pesticides especially for the eyes (Salameh *et al*., 2004; Ntow *et al*., 2006).

**2.7 Restricted Entry Interval (REI)**

Restricted Entry Interval is the period of time immediately after a pesticide application when agricultural employees may not enter a pesticide treated site without protective clothing. REIs are established for all pesticides used in the production of agricultural plants in greenhouses, farms, forests and nurseries. The REI is based on toxicity and pesticide residue persistence. Each pesticide REI can be found on the pesticide label under the heading „Agricultural Use Requirements" in the „Direction for Use" section of the pesticide label or next to the crop or application method to which it applies.

As an integral part of Worker Protection Standard (WPS), the rules and regulation concerning REIs were established in order to protect agricultural employees, both agricultural workers and pesticide handlers, who might normally work within the confines of pesticide treated areas [http://www.cepep.colostate.edu]. It has been published that the larger the REI period, the less risk of farmers exposing themselves to

pesticides in the environment which remain as residues on plants and/or in the soil. About 40 % of Ghanaian farmers return to work in sprayed fields within a few hours of spraying, whilst 29 % return a day after spraying (Clarke *et al*., 1997).

### 2.8 Pesticide Waste Disposal

A pesticide waste is any material which contains any concentration of pesticides that are no longer desirable. It includes such things as;

- rinse material from containers and spray equipment
- left over spray solution
- excess pesticides
- suspended pesticides

Improper disposal of pesticide wastes can result in serious harm to humans, pets, wildlife, and the environment as a whole. For instance, improperly disposed rinsed water from application equipment has great potential for causing ground water and surface water contamination. It is therefore important to spray rinsed water on the target area just treated, if application rates and amounts will not be exceeded. Excess spray solutions could be disposed by using all the mixed pesticide in accordance with label instruction.

In Ghana, the commonest way of disposing of sprayer washed water and empty pesticide containers is by throwing them on the field (Ntow *et al*., 2006). These present potential pollution problems for aquatic systems which are sources of livelihood for human communities and support varied animal and plant life since many farms are close to waterways. Some farmers in Ghana do use pesticide

containers to store food and drinking water for use (Clark *et al*., 1997).

## 2.9 Pesticide Storage

When pesticides are not stored properly, they can breakdown and their potency will be reduced. Proper storage can decrease the chance of pesticide-related accidents and make handling accidents easier should one occur. The following guidelines have been suggested by South Dakota Department of Agriculture [http://sdda.sd.gov.pdf] for farmers to help ensure safe and proper storage of pesticides;

- Avoid the problem of storing pesticides by purchasing only the amount needed for the current season.
- Store pesticides in their original container with the original label attached. Read each label to determine suitable storing conditions.
- Do not store pesticides with food, feed, and seed, planting stock, fertilizers, veterinary supplies or pesticide safety equipment. Also, avoid storing them next to a water supply.
- Date containers as they are purchased and keep an inventory list so out dated material can be disposed of.
- Designate a building, room or cabinet specifically for pesticide storage and nothing else. The optimum storage "facility" should have a concrete floor, which is impermeable and easy to wash; adequate ventilation to avoid extreme heat and reduce the concentration of toxic or flammable vapours; insulation and supplemental heating if required to meet label specifications; good lighting; and access to water to handle accidental spills.
- Always keep the building, room or cabinet where pesticides are stored locked when the area is unattended.

- Post caution signs which warn the area is used for pesticide storage at all entrances or doors.
- Routinely examine pesticide containers for leaks, corrosion, breaks and tears. Clean up spills immediately and properly dispose of containers and clean up materials. Sawdust, industrial absorbent, cat litter or dry soil may be used to soak up liquid spills. Sweeping compound can be used with dry spills. Store clean – up materials in the storage area for quick access.

# CHAPTER THREE

## 3.0. MATERIALS AND METHODS

### 3.1. Study Area

The study was conducted in four selected agro – ecological zones in Ghana and under each zone, two farming communities were considered for data collection. The selected agro – ecological zones and their communities considered include;

- Forest – Savanna Transition zone (Techiman and Agogo) – Ashanti and Brong Ahafo Regions.
- Semi – deciduous Rain forest zone (Akomadan and Mankranso) – Ashanti Region.
- Savanna zone (Tamale and Navrongo) – Northern and Upper East regions.
- Coastal Savanna zone (Amasaman and Abokobi) – Greater Accra Region.

#### 3.1.1. Techiman

Techiman, in the Brong Ahafo Region has an estimated total land area of about 669.7 square kilometers. Its geographical coordinates are 7º35´0´´ North, 1º56´0´´ West.
The town shares local boundaries with Wenchi to the West, Sunyani West and Offinso North to the South, Kintampo south to the North and Nkoransa South to the East (Ghana Districts, 2006). The major crops grown in the area include tomato, garden eggs, pepper, cowpea, plantain, cocoyam, maize, yam, cassava etc. (MOFA, Ghana).

#### 3.1.2. Agogo

Agogo is located in the Ashanti Region with an estimated total land area of about 1, 361 square kilometers. It has geographical coordinate of 6º48´0´´ North, 1º5´0´´ West.

Locally, it shares boundaries with Kwahu North in the Eastern Region to the South,

Kruofa and Adomfe in the Ashanti Akim South District to the West, Kumawu and Afram District to the East and Hwidiem to the North (Ghana District, 2006). Majority of the inhabitants earn their income through crop farming. The main crops grown in the area include maize, plantain, cocoa, yam, cassava, rice cocoyam and vegetables (MOFA, Ghana).



### 3.1.3. Akomadan

Akomadan, in the Ashanti Region, is the capital of Offinso North District. It has an estimated total land area of about 6,300 square kilometers. It lies within longitude 1º45′ 0′′ West and 1º 65′ 0′′ West. The District shares common boundary in the North and West with Techiman, Sunyani Tano and Nkranza Districts in Brong Ahafo.

It is also boarded on the East by Sekyedumase District and the South by Offinso South Municipality (Ghana Districts, 2006). The major occupation of the inhabitants of the District is crop farming. The crops grown in the District include vegetables (tomato, pepper, cabbage, garden eggs etc.), root and tuber crops (cassava, cocoyam, and yam), cash crops (cocoa, oil palm and citrus) and cereals (maize and rice). The district is well known in Ghana by their tomato production (MOFA, Ghana).

### 3.1.4: Mankranso

Mankranso is also located in the Ashanti Region of Ghana and it is the capital town of Ahafo Ano South District. It is located within 6º49′12′′ North and 1º52′12′′ West. Its estimated total surface area is about 1,241 square kilometers. It is located on the North-Western part of the region, bounded in the north by Tano District (Brong Ano North), in the South by Atwima District, in the West by Ahafo Ano North District and in the East by the Offinso District all in Ashanti Region (Ghana Districts, 2006). The District is endowed with arable land. About 80 % of the land is suitable for crop cultivation and

about 60 % of the arable land is under cultivation. Maize, rice, cassava, yam, cocoyam, plantain, okra, and tomato are the main food crops cultivated (MOFA, Ghana).

### 3.1.5. Tamale

Tamale is in the capital city of the Northern Region of Ghana and occupies an area of about 70,383 square kilometers. The city shares boundaries with Savelugu – Nanton to the West, Yendi to the East and Gonja to the South. Its geographical coordinates are 9º24′0′′ North and 0º50′0′′ West (Ghana Districts, 2006). Currently it is estimated that about 60 % of the people are engaged in agriculture in the Metropolis. The major crops cultivated include maize, rice, sorghum, millet, cowpea, groundnuts, soya bean, yam and cassava (Ghana Districts, 2006).

### 3.1.6. Navrongo

Navrongo is the capital town of the Kassena Nankana East District of the Upper East Region of Ghana. The town shares its local boundaries with Paga to the North, Bolgatanga to the East and Chuchuliga to the South. It has an estimated land cover of about 1,675 square kilometers along Ghana-Burkina Faso Border. It is located at 10º53′5′′ North and 1º5′25′′ West (Ghana Districts, 2006). Crop farming is the predominant occupation being carried out by the people in the District. The major crops grown include vegetables, cereals and legumes (MOFA, Ghana).

### 3.1.7: Amasaman

Amasaman is the capital of the Ga West Municipal which is the second largest of the six Municipalities and Districts in Greater Accra Region. It lies within latitude 5048′ North and 5029′ North and longitude 008′ West and 0030′ West. The Municipal shares common boundaries with Ga – East Municipal and Accra Metropolitan

Assembly to the East, Akuapem South, Suhum Kraboa Coalter and West Akim Municipal to the North, Awutu Efutu Senya to the West and Gulf of Guinea to the South. It occupies a land area of approximately 710.2 square kilometers (Ghana Districts, 2006). The major crops grown include local and exotic vegetables, cereals, fruits and root and tuber crops (MOFA Ghana).



### 3.1.8. Abokobi

Abokobi is the capital of the Ga East Municipal Assembly of the Greater Accra Region. Its geographical coordinates are 5º44′0′′ North and 0º12′0′′ West. It is bordered on the West by the Ga West Municipal Assembly, on the East by the Adenta Municipal Assembly, the South by Accra Metropolitan Assembly (AMA) and on the North by Akwapim South District Assembly. It covers a land area of about 166 square kilometers (Ghana Districts, 2006). The major crops grown include vegetables and cereals.

## 3.2 Data collection

The data were obtained from farmers using a combination of open-ended and closeended structured questionnaires as well as field observations in August, 2011. Pretesting of the questionnaires was carried out at Mankranso. Of the four selected agroecological zones, two farming communities were randomly selected for data collection. In all 400 farmers were interviewed, of which 50 farmers were randomly interviewed on one-on-one basis in each farming community considered for data collection. Thus 100 randomly selected farmers were interviewed in each agroecological zone. Questions were translated in the local languages of the respondent farmers to suit their understanding to provide appropriate answers. Farmers were visited at their homes and farms for the data. The following information was gathered from farmers during the interviews;

- **Socio-economic issues:** name, age, community, gender, marital status, number of children, family size and educational background.
- **Farm details:** number of years in farming, farm size, types of crops grown, farming system practiced, interaction with extension officer available and proximity of farm land to water body.
- **Pesticides handling and use:** farmers‟ perception on pesticides, crops on which pesticides are applied, frequency of application, reading of label, knowledge of expiry date, storage sites, restricted entry intervals, method of disposing empty containers, and reuse of empty containers.

### 3.2.1. Data analysis

Information gathered in the questionnaire was coded for entry into a computer. The data analysed were farmers‟ age, gender, educational status, farm size and knowledge on pesticides handling and use. Descriptive statistics (frequency tables, bar graphs and pie charts) and pictures were used to present the findings. Ideas in the responses to the questions were identified and recommendations were made based on the findings within the themes.

# CHAPTER FOUR

## 4.0. RESULTS

### 4.1. Socio-demographic Analysis of Respondent Farmers

### 4.1.1. Age Distribution

Majority (77 %) of the farmers were in the middle age group, 30 – 50 years. The younger age group (< 30) accounted for 13 % whilst the aged (51 +) accounted for only 10 % (Figure 4.1).

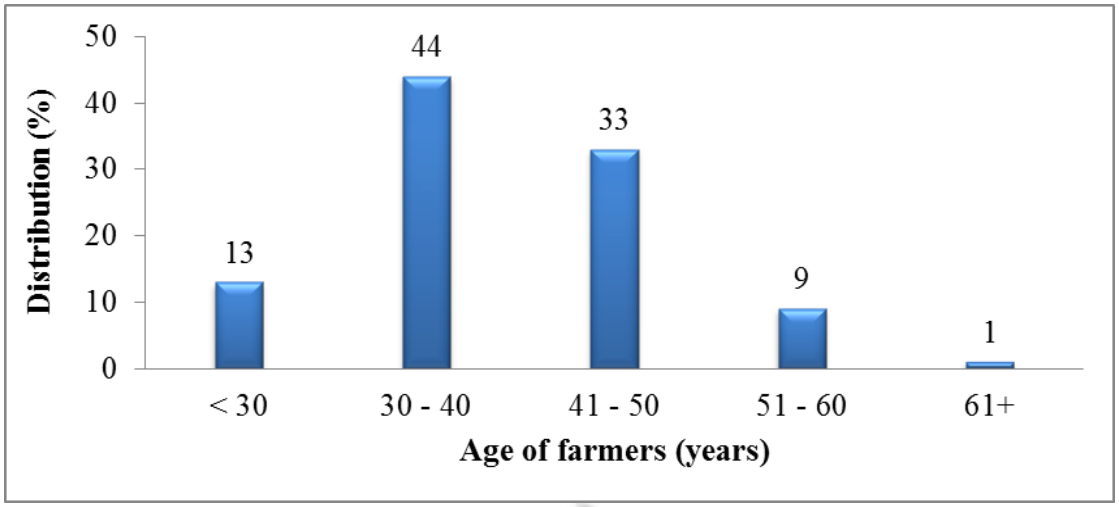


**Figure 4.1: Percentage distributions of the ages of farmers across the ecological zones in August 2011**

Comparing age groups across the four agro – ecological zones, shows that the Savannah zone had the least number of farmers aged < 30 years (7 %). The other ecological zones had between 14 and 17 % of the farmers in that age group. However, the Savannah ecological zone had the highest percentage of farmers in the middle age group of 30 – 50 years (Table 4.1). Three ecological zones (Forest, Savannah and Coastal Savannah zones) recorded no respondents above 60 years of age (Table 4.1).

**Table 4.1: Percentage distribution of ages of respondents within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Age (years)** | **Transition** | **Forest** | **Savanna** | **Coastal S.** | **Mean** |
| < 30 | 17 | 14 | 7 | 16 | **13** |
| 30 - 40 | 39 | 41 | 47 | 48 | **44** |
| 41 - 50 | 27 | 35 | 39 | 31 | **33** |
| 51 – 60 | 14 | 10 | 7 | 5 | **9** |
| 61 + | 3 | 0 | 0 | 0 | **1** |

### 4.1.2. Gender Distribution

The overwhelming majority (92 %) of the respondents are males. Generally, across the ecological zones males dominated with the Coastal Savannah zone recording 100 % (Table 4.2).

**Table 4.2: Percentage distribution of gender of respondents within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Gender** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Male | 83 | 87 | 97 | 100 | **92** |
| Female | 17 | 13 | 3 | 0 | **8** |

### 4.1.3. Educational Status of Respondents

The majority (70 %) of the respondents have had formal education up to the Basic level, with only about 1 % having Tertiary education (Figure 4.3).

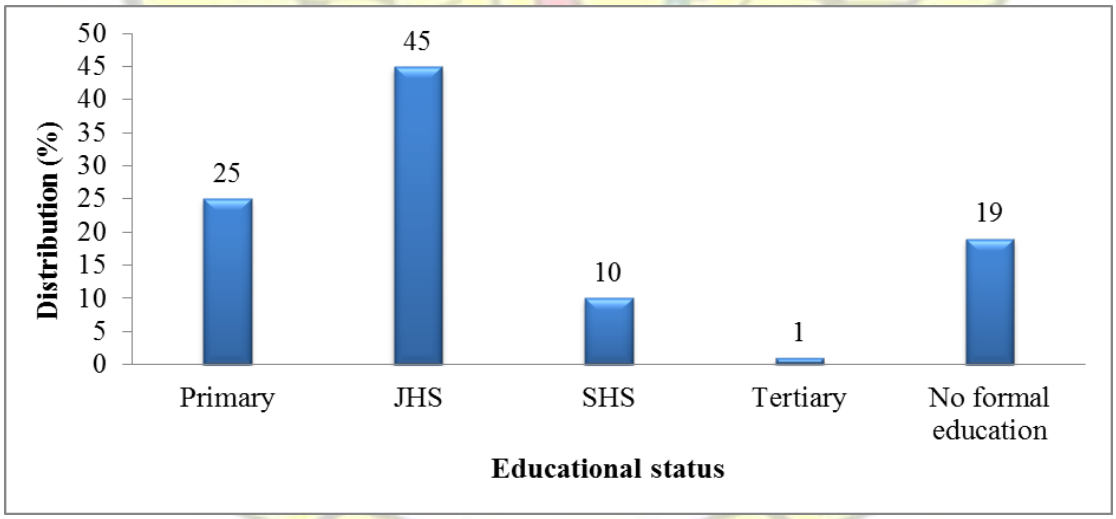


**Figure 4.2: Percentage distribution of educational status of the farmers across the ecological zones in August 2011**

A comparison of the educational level across the four zones showed that savannah zone had the highest number (45 %) of illiterate farmers whilst the forest zone had the least number (8 %) (Figure 4.3).

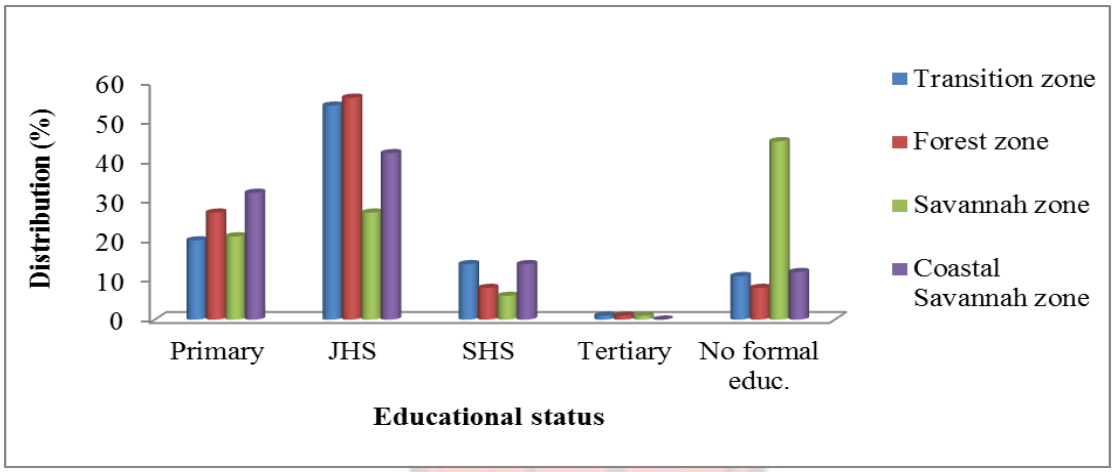


**Figure 4.3: Percentage distribution of educational status of farmers within the ecological zones in August 2011**

### 4.1.4. Farm Size of Respondents

The majority (56 %) of the farmers across the ecological zones owned between 1 – 5 acres of farm land. Comparatively, the Savannah zone recorded the highest (44 %) percentage of farmers operating between 6 – 10 acres of farm land whilst the Forest and the Transition zones recorded 70 % of farmers owing between 1 – 5 acres of farm land. The Coastal Savannah zone however, recoded 61 % of farmers owning < 1 acre farm land with no respondent owning between 6 – 10 acres and > 10 acres of farm land (Table 4.3).

**Table 4.3: Percentage distribution of farm size within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Scale** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| < 1 acre | 2 | 1 | 1 | 61 | **16** |

| | | | | | |
|---|---|---|---|---|---|
| 1 – 5 acres | 70 | 70 | 46 | 39 | **56** |
| 6 –10 acres | 15 | 19 | 44 | 0 | **20** |
| >10 acres | 13 | 10 | 9 | 0 | **8** |

Majority (67 %) of the farmers worked relatively close (2 to 5 metres apart) to a water body whereas 33 % had their farms between 10 to 20 metres away from water source (Appendix 1).

Table 4.4 illustrates that most (64 %) farmers had been using pesticides for many years whilst 25 % had been in farming for 1 – 5 years. Only 11 % of farmers have been using pesticides for less than a year.

A comparison of number of years respondents across the ecological zones had been engaging in agriculture revealed that, the Coastal Savannah zone had the highest number (74 %) of farmers who have been in farming for more than 5 years whilst the Savannah zone recorded the least number (4 %) of farmers who have < 1 year experience in agriculture (Table 4.4).

**Table 4.4: Percentage distribution of respondents over the number of years in farming within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Year(s)** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| < 1 | 21 | 8 | 4 | 11 | **11** |
| 1 – 5 | 24 | 25 | 36 | 15 | **25** |
| > 5 | 55 | 67 | 60 | 74 | **64** |

### 4.2. Farmers' Perceptions on Pesticides Handling and Use

#### 4.2.1. Education from Agricultural Extension Agents (AEAs)

All the farmers interviewed had some knowledge about pesticides and have been using them to protect their crops from insect pests and diseases. With regard to education from agricultural extension agents; in general, less than half (42 %) of the farmers indicated that they receive education concerning pesticides handling and use from agricultural extension agents in their area. More than half (58 %) however, get no access to agricultural extension education (Table 4.5). Comparatively, it is the Savannah zone which recorded the highest percentage (92 %) of famers who receive education from agricultural extension agents whilst the Transition zone recorded the least percentage (15 %) of agricultural extension education (Table 4.5).

**Table 4.5: Percentage distribution of farmers receiving agricultural extension education within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savanna** | **Coastal S.** | **Mean** |
| Yes | 15 | 20 | 92 | 40 | **42** |
| No | 85 | 80 | 8 | 60 | **58** |

#### 4.2.2. Types of Pesticides Used

The types of insecticides, herbicides and fungicides most frequently used across all the eco-zones are shown in Table 4.6.

**Table 4.6: The commonly used pesticides across the ecological zones**

| Trade name | Active ingredient | Manufacturer |
|---|---|---|
| ***Insecticides*** | | |
| Akate Master | *Emamectin benzoate* | FMC Chemical Agricultural Product Co. Ltd. |
| Sumitox | *Fenvalerafe* | Aimco Pesticides Ltd. |
| Confidor | *Imidcloprid* | Bayer Crop Sciences |
| Sunpyrifos | *Chlorpyrifos - Ethyl* | Zhyiang Xinan Chemical industry Group |
| Kombat | *Lambda - Cyhalothrin* | Saro Agrosciences Ltd |
| Lambda - M | *Lambda - Cyhalothrin* | Crop Star Chemical industry Co. Ltd. |
| Sunhalothrin | *Lambda - Cyhalothrin* | Zhyiang Xinan Chemical industry Group |
| Controller Super | *Lambda - Cyhalothrin* | Nanjing Haige Chemical Co. Ltd. |
| ***Herbicides*** | | |
| Adwumawura | *Glyphosate* | Shenzhen Baocheng Chemical Industry Co. Ltd. |
| Sunphosate | *Glyphosate* | Zhyiang Xinan Chemical industry Group |
| Sarosate | *Glyphosate* | Saro Agrosciences Ltd |
| Kondem | *Glyphosate* | High Hope International Group Jiangsu Ltd. |
| Kabaherb | *2, 4 - D Amin Salt* | High Hope International Group Jiangsu Ltd. |
| Bextra | *2, 4 - D Amin Salt* | Agricore Chemical Industry Co. Ltd. |
| Weedoff | *Paraquat dichloride* | Saro Agrosciences Ltd. |
| Paracot | *Paraquat dichloride* | Afcott Ghana Ltd. |
| Atrherb | *Atrazine* | Zhejian Changxing Zhongshan |
| Sun - Atrazine | *Atrazine* | Zhyiang Xinan Chemical industry Group |
| Atrazila | *Atrazine* | Shenzhen Baocheng Chemical Industry Co. Ltd. |
| Atraz | *Atrazine* | Saro Agrosciences Ltd. |
| ***Fungicides*** | | |
| Limaneb | *Maneb* | Limin Chemical Co. Ltd. Jiangsu China |
| Kadmaned | *Maneb* | Shandong Qiaochang Chemical Co. Ltd. |
| Kabaeb | *Mancozeb* | High Hope International Group Jiangsu Ltd. |
| Contizeb | *Mancozeb* | Wenzhon Weihe Industry Co. Ltd. |
| Green Manco | *Mancozeb* | Metchem Enterprise Group |
| Topsin - M | *Methylthiophanate* | Sino Agrochemical Co. Ltd. |
| Topsect - M | *Methylthiophanate* | Agricore Chemical Industry Co. Ltd. |
| sulfa | *Sulfur* | Westcester International |

Table 4.6 shows that some of the active ingredients in use had different trade names. A typical example is the insecticide Lambda-Cyhalothrin which comes as Kombat, Sunhalothrin, and Controller Super in the market. These pesticides, with the exception

of herbicides are used on vegetables and legumes such as tomato, pepper, eggplant, cowpea, cabbage, cash crops such as cocoa, and citrus; and cereals such as maize and rice.

Insecticides and herbicides were the types of pesticides mostly used by farmers across the eco-zones. Fungicides are the next pesticide in use after insecticides and herbicides. None of the farmers however, indicated the use of nematicides (Table 4.7).

Comparatively, three zones (Forest 98 %, Savannah 92 %, and Coastal Savannah 88 %) use more herbicides than the Transition zone. Farmers in the Transition zone (97 %), Forest zone (91 %), and the Coastal Savannah zone (88 %) use more insecticides than the Savannah zone. However, farmers in the Transition zone apply more (87 %) fungicides than all the other three zones (Table 4.7).

**Table 4.7: Percentage distribution of types of pesticides mostly used within the ecological zones August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Pesticide** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Herbicides | 78 | 98 | 92 | 88 | **89** |
| Insecticides | 97 | 91 | 78 | 88 | **89** |
| Fungicides | 87 | 64 | 50 | 44 | **61** |
| Nematicides | 0 | 0 | 0 | 0 | **0** |

With the exception of cocoa farmers who obtain some pesticides from the government through extension agents, all the farmers purchase their pesticides from available agro-chemical shops within their communities or nearby communities.

### 4.2.3. Frequency of pesticides application

A large majority of the farmers indicated that; ideally, pesticides especially insecticides and fungicides should be applied to vegetable crops more than three times per growing season, if only the farmer‟s income level is above average and the prices of the pesticides are low. Approximately 76 % of the farmers across the ecological zones applied pesticides more than three times per growing season, whilst 15 % and 9 % applied them twice and once respectively (Table 4.8).

A comparison between the frequency of pesticide application per crop season and the agro-ecological zones revealed that, most farmers (92 %) within the Transition and Forest zones (88 %) apply pesticides several times per growing season than the other two zones (Table 4.8).

**Table 4.8: Percentage distribution of frequency of pesticide application within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **No. of Times** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| **Once** | 4 | 3 | 25 | 4 | **9** |
| **Twice** | 4 | 9 | 26 | 21 | **15** |
| **Three/more** | 92 | 88 | 49 | 75 | **76** |

### 4.2.4. Stages of application

Less than half (46.25 %) of farmers treat their crops with pesticides at the early stages (1-2 weeks after planting) of crop growth whilst 45.75 % treat their crops during flowering and fruiting stage of the crops. Only 8 % of them apply pesticides based on the presence of pests on crops (Table 4.9**)**. Comparatively, it is the Savannah zone which

recorded the least percentage (25 %) of farmers who treat their crops with pesticides at the early stages of crop growth whilst the Forest zone (57 %), recorded the highest percentage of farmers who treat their crops at the early stages of crop growth (Table 4.9). However, the Savannah zone recorded the highest percentage (59 %) of farmers who apply pesticides to their crops during the flowering and fruiting stage of crop growth and also recorded the highest percentage (16 %) of farmers who apply pesticides to crops based on the presence of pests (Table 4.9).

**Table 4.9: Percentage distribution of crop growth stages for which pesticides are applied within ecological zones August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Crop stage** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Early stage (1 –2 WAP) | 48 | 57 | 25 | 55 | **46.25** |
| Flowering & Fruiting | 46 | 39 | 59 | 39 | **45.75** |
| Presence of pests | 6 | 4 | 16 | 6 | **8** |

Almost all (92 %) the farmers used Knapsack sprayers for the application of pesticides. Out of this, 48 % own the knapsack sprayers and 44 % hired or collected from friends; of which the Savannah zone recorded the highest percentage (66 %) (Table 4.10). Financial constraint is the main reason why some farmers, within the ecological zones hired or borrowed knapsack from their neighbours. However, about
8 % used motorized sprayers for both tree crops and vegetables.

**Table 4.10: Percentage distribution of how farmers within the ecological zones**

**acquire Knapsack sprayer for pesticide application in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Action** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Own | 57 | 61 | 32 | 42 | **48** |
| Hire | 27 | 19 | 50 | 45 | **35.25** |
| Borrow | 2 | 4 | 16 | 13 | **8.75** |



As regards farmers‟ protection during pesticides application, all the farmers interviewed responded that they protected themselves with protective clothing such as rubber boots (Wellington boots), long-sleeved shirt, trousers, overall, raincoat, rubber gloves and cap/hat. However, majority complained of health related effects after pesticide application and the most frequent symptoms reported were catarrh, headache, itching, body weakness and dizziness. When these symptoms appeared, the farmers indicated they sometimes took in some pain killers from drug shops or applied shea butter to the itching part or drank a tin of milk when such symptoms were accompanied with dizziness.

### 4.2.5. Knowledge on Expiry date

Majority (81 %) of the farmers are very much aware of expiry date whilst 19 % had no knowledge of expiry date. However, only 49 % check expiry dates on pesticides products (Table 4.11).

**Table 4.11: Percentage distribution of farmers who check expiry date of pesticide product within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Yes | 43 | 42 | 55 | 56 | **49** |

| | | | | | |
|---|---|---|---|---|---|
| No | 57 | 58 | 45 | 44 | **51** |

### 4.2.6. Reading of pesticide label

About 59 % of the farmers have been reading pesticide labels before applying them. However, only 20 % of those farmers who read the label actually followed what was read on the label; 40.5 % of them partially followed label (thus; do not strictly followed the instruction on the labels) whilst 39.5 % did not follow at all. Out of these the Transition zone recorded the majority (50 %) of the farmers who in a way followed some of the instructions on the labels whilst the Savannah zone recorded the highest percentage (51 %) of farmers who did not pay heed to the instructions on the labels (Table 4.12).

**Table 4.12: Percentage distribution of farmers' attitude towards following pesticide labels within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Follow | 22 | 15 | 29 | 14 | **20.0** |
| Partially follow | 50 | 48 | 20 | 44 | **40.5** |
| Don"t follow | 28 | 37 | 51 | 42 | **39.5** |

### 4.2.7. Famers' Awareness of Restricted Entry Interval (REI)

Even though 62.25 % of the farmers are not aware of Restricted Entry Interval, only 3.75 % make an entry to a sprayed site few hours after application of pesticides. A higher proportion (68.75 %) of them returned to their farms a day after application, 21.25 % enter treated field 2 – 3 days after pesticides application whilst 6.25 % a week after. The Transition zone recorded the highest proportion (79 %) of farmers who were

not aware of Restricted Entry Interval whilst the Savannah zone had the least proportion (51 %) of farmers with no knowledge in Restricted Entry Interval. Interestingly, the Savannah zone recorded 0 % of farmers who entered sprayed field few hours after pesticides application. The Coastal Savannah however, recorded the highest percentage (76 %) of farmers who entered pesticide treated field a day after treatment (Tables 4.13 and 4.14).



**Table 4.13: Percentage distribution of farmers' awareness of Restricted Entry Interval within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Yes | 21 | 44 | 49 | 37 | **37.75** |
| No | 79 | 56 | 51 | 63 | **62.25** |

**Table 4.14: Percentage distribution of the Restricted Entry Interval observed by farmers within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Few hours | 7 | 4 | 0 | 4 | **3.75** |
| 1 day | 69 | 65 | 65 | 76 | **68.75** |
| 2-3 days | 19 | 24 | 27 | 15 | **21.25** |
| 1 week | 5 | 7 | 8 | 5 | **6.25** |

### 4.2.8. Hands washing after pesticide application

In terms of washing of hands after pesticides application, a higher proportion (71 %) of the farmers across the ecological zone washed their hands with water and soap, 21 % used only water whilst 8 % used water and other substances such as leaves of plants, tomato fruits juice, sand etc. to wash their hands (Table 4.15). The overwhelming majority (80 %) of farmers from the Coastal Savannah zone used water and soap to

wash their hands and no respondent that used other means to wash hands after application (Table 4.15).

**Table 4.15: Percentage distributions of the various methods farmers within the ecological zones use to wash their hands after application in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Fore st** | **Savannah** | **Coastal S.** | **Mean** |
| Only water | 22 | 22 | 19 | 20 | **21** |
| Water & soap | 60 | 71 | 72 | 80 | **71** |
| Others | 18 | 7 | 9 | 0 | **8** |

### 4.2.9. Bathing after pesticide spraying

Although, all the farmers interviewed indicated they bathed after spraying event, the interval between spraying event and bathing varied from farmer to farmer (Table 4.16). Generally across the zones, more than half (52 %) of the farmers took their bath between 31 – 60 minutes after a spraying event, 24 % bathed between 15 – 30 minutes, 13 % in less than 15 minutes whilst 11 % bathed at least one hour after spraying. Those farmers who bathed few minutes after application bathed along the banks of water bodies whilst those who took their bath between 13 – 60 minutes after application bathed in their homes (Table 4.16).

**Table 4.16: Percentage distribution of the interval between a spraying event and bathing within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Time (min)** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| < 15 | 5 | 7 | 15 | 25 | **13** |
| 15 – 30 | 24 | 26 | 13 | 33 | **24** |

| | | | | | |
|---|---|---|---|---|---|
| 31 – 60 | 59 | 53 | 57 | 39 | **52** |
| >60 | 12 | 14 | 15 | 3 | **11** |

### 4.2.10. Disposing of pesticide waste

Table 4.17 shows how farmers across the zones disposed of their empty pesticide containers. Majority (67.5 %) of the farmers disposed of empty pesticide containers on the farm, 17 % of them puncture the containers and leave them on the field, 12 % burn them whilst 3.5 % buried the containers (Table 4.17). Pictures of some disposed empty pesticide containers are shown in appendices 9, 10, 11 and 12.

**Table 4.17: Percentage distribution of the methods by which farmers dispose of empty pesticides containers within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Action** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Burn | 8 | 6 | 15 | 19 | **12** |
| Bury | 5 | 3 | 6 | 0 | **3.5** |
| Cut & leave on farm | 3 | 10 | 28 | 27 | **17** |
| Leave on farm | 84 | 81 | 51 | 54 | **67.5** |

About 26 % of the farmers used empty pesticides containers to keep water and other food items such as salt, palm oil, etc.; of which the Transition zone recorded the highest percentage (42 %) whilst the Coastal Savannah recorded none (Table 4.18). Pictures of farmers who used empty pesticides containers to keep all sort of food items are shown in appendices 13, 14, 15, 16, 17 and 18.

**Table 4.18: Percentage distributions of farmers who use empty pesticide containers to keep food items within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Response** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Yes | 42 | 29 | 33 | 0 | **26** |
| No | 58 | 71 | 67 | 100 | **74** |



### 4.2.11. Storage of pesticides

With regard to storage of pesticides, generally less than half (43 %) of the farmers indicated that they stored them on their farms, 22 % in the bedroom, 17 % in the store room whilst 12 % stored them in other places such as on the veranda, suspended on roof or on top of ceiling and 6 % of the farmers did not store pesticides (Table 4.19). Pictures of the practice are shown in appendices 19, 20 and 21.

**Table 4.19: Percentage distribution of farmers' storage sites for pesticides within the ecological zones in August 2011**

| | Percentage distribution | | | | |
|---|---|---|---|---|---|
| **Storage site** | **Transition** | **Forest** | **Savannah** | **Coastal S.** | **Mean** |
| Store room | 14 | 13 | 27 | 14 | **17** |
| Bedroom | 31 | 29 | 14 | 14 | **22** |
| On farm | 50 | 47 | 32 | 43 | **43** |
| Others | 3 | 9 | 14 | 22 | **12** |
| No storage | 2 | 2 | 13 | 7 | **6** |

### 4.3 Relationships between educational level of farmers and restricted entry interval and interval between spraying events and bathing

Significant correlations were found between formal education and restricted entry intervals (REI), and the interval between spraying event and bathing (Figures 4.4, and 4.5).

Educational level of farmers across the ecological zones was negatively correlated (*r = 0.51*) with the restricted entry intervals (REI) observed by the farmers. (Figures 4.4)

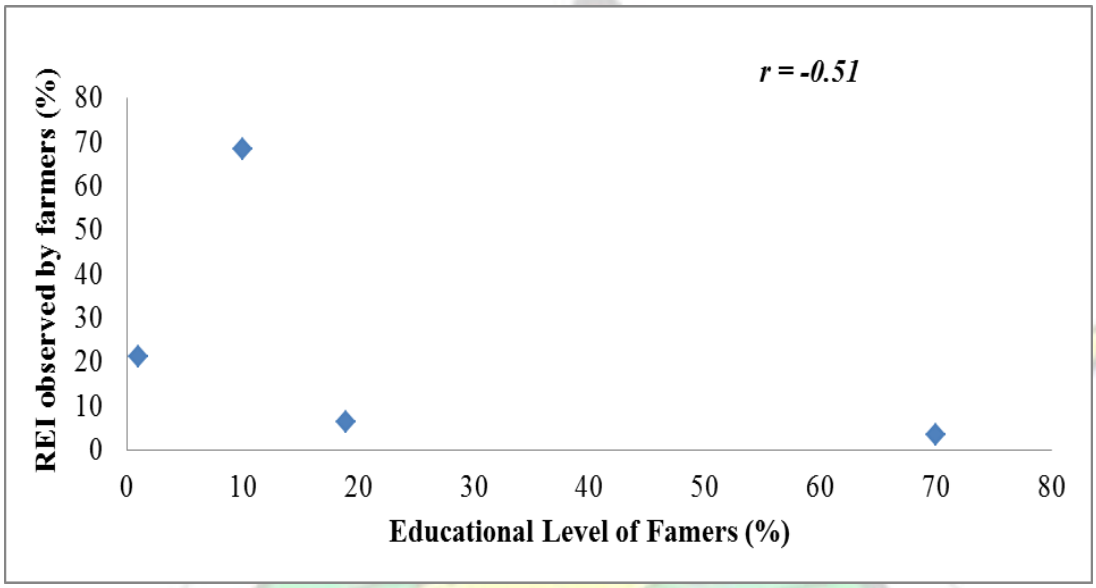


**Figure 4.4: Correlation between educational level of farmers and restricted entry intervals (REI) observed by farmers**

The educational level of farmers across the ecological zones correlated negatively (*r = -0.62*) with the interval between pesticide application and bathing. (Figures 4.5)

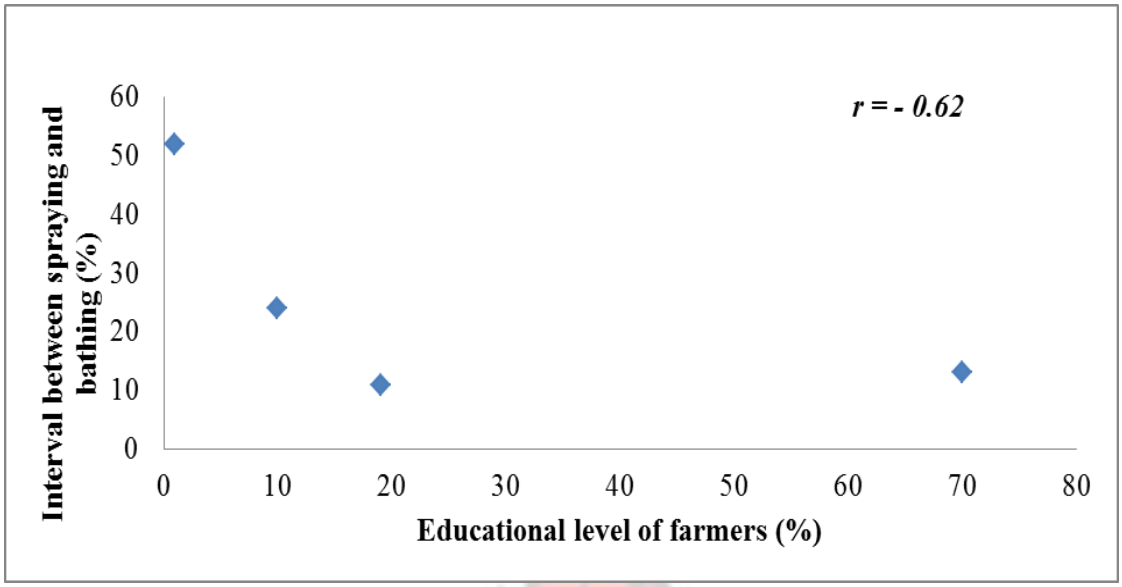


**Figure 4.5: Correlation between educational level of farmers and interval between spraying event and bathing**

## CHAPTER FIVE

## 5.0. DISCUSSION

It is apparent from the survey that older people rather than the youth (< 30 years of age) are in agriculture; supporting the assertion that farming appears not to be an attractive career option for the younger generation in most developing countries like Ghana. This can be explained from the point that the youth do not perceive agriculture as a well remunerative job and therefore move to the urban centres in search of more profitable jobs, thus leaving the aged to engage in agriculture.

Even though women play a major role in agriculture, this study shows that, very few seem to be involved in field work. It is known that agriculture employs a considerable number of women; their occupation appears to be in marketing and distribution of farm produce. Also, male farmers dominate in pesticides application, which could be

attributed to the tedious nature of application, for example carrying the spraying machine at the back to spray.

With regard to educational status of respondent farmers, majority (70 %) of the farmers terminated their formal education at the basic level (JHS). Thus people with relatively higher educational background do not often take to farming in Ghana. They negatively perceived farming to be for the uneducated, unskilled, and labourers with extremely low economic return (MOFA, 2011). This presupposes that most farmers in Ghana have low standard of education, resulting in their inability to properly read and understand labels of pesticides and to follow the right procedures in relation to pesticides handling and usage. The low standard of education may probably explain why the Savannah zone recorded the highest percentage (51 %) of farmers who do not heed to the instructions on the label of pesticide.

From the survey, 56 % of the respondents owned between 1 – 5 acres of farm land, hence engaged in small – scale farming. Ntow *et al*. (2006) reported that majority (76.6 %) of vegetable farmers at Akomadan owned between 1 – 5 acres of farm land. This is probably as a result of the land tenure system and financial constraint of farmers in Ghana.

The high proportion (67 %) of farmers had their farm lands close to water bodies because of easy accessibility to irrigate their crops and also due to the erratic rainfall pattern in Ghana of late. This practice poses serious threat to rivers and streams around the farm sites since drifts of sprays may contaminate them. It is reported that over 98 % of spray insecticides and 95 % of herbicides reach a destination other than their target species, including non-target species, air, water, bottom sediment and food [http://en.wikipedia.org/wiki/environ_impact_of_pesticide]. In the US 90 % of streams

and 50 % of wells tested proved positive for at least one pesticide [http://ca.water.usgs.gov/pnsp]. Ntow (2001) made similar report that some contamination of pesticides exists in water bodies, food and human fluids in areas of highly intensive vegetable production in Ghana.

Farmers‟ level of knowledge on proper handling and use of pesticides is contingent upon many factors, including the length of time that the farmer has been engaged in pesticides usage, the education provided by extension agents and the available extension agents in the area. The present survey revealed that a majority (64 %) of the farmers across the zones who handle and use pesticides have gained at least 5 years experience in agriculture, gives an indication that they have been using pesticides for quite a long period of time. The revelation that more than half (58 %) of the farmers get no access to agricultural extension education confirms the assertion that Ghana has limited extension services (Hogg, 2012). The current ratio of Agricultural Extension Officer to farmers stands at 1:1,500 (MOFA, 2011). This shows clearly that, extension officers are woefully inadequate to disseminate proper methods of farming to farmers. From the responses, the few extension officers available usually attend to cash crop farmers only.

Though most farmers have knowledge of expiry date, more than half (51 %) of them do not check the expiry date on pesticides products. It suggests therefore that some farmers unknowingly apply expired pesticide products to their crops. There is the need to intensify education on the significance of expiry dates on pesticide products to help discourage farmers from the use of expired pesticides. It is not surprising that the Savannah zone and the Coastal Savannah recorded high percentages of 55 % and 56 %, respectively, of farmers who checked expiry dates of pesticides in spite of recording high percentages of illiterate farmers as compared to the Transition and the Forest

zones. Besides, the refusal to check the expiry date on manufactured goods seems to be a common practice among most Ghanaians.

A high proportion (62.25 %) of the farmers are not aware of specific Restricted Entry Interval (REI) for the pesticides they use but more than half (68.25 %) do not return to a sprayed field few hours after spraying but rather a day after spraying, which is contrary to the report by Clarke *et al*. (1997) that about 40 % of Ghanaian farmers return to work in sprayed fields within a few hours of spraying, whilst 29 % return a day after spraying. Therefore, it is assumed that probably farmers are aware of the consequences of returning to a sprayed field immediately after application. Extension work by the Agricultural Extension Agents (AEAs) may partially explain why the Savannah zone recorded 0 % of farmers who return to a sprayed field in few hours after spraying, regardless of recording the highest percentage (45 %) of illiterate farmers among the ecological zones.

The situation that about 71 % of the farmers across the ecological zones washed their hands with water and soap after spraying events, may explain why most farmers are aware of the harmful effects of pesticides on humans. With regard to farmers‟ protection during spraying events, all the farmers seem to protect themselves to some extent. However, in reality the personal protective clothing of the farmers visited were woefully inadequate and not up to standard. This agrees with the statement that most farmers are aware of the kind of equipment that should be used to offer protection but in practice only a few farmers use the recommended gears (Helen, 2002). It was observed that most of these farmers are financially handicapped, therefore cannot afford all the necessary equipment and attire which include boots, hand gloves, goggles, trousers, rubber coat, nose mask and cap/hat to offer adequate protection. This observation is in agreement with Clarke *et al*. (1997) and Ntow *et al*. (2006) that the

use of personal protective equipment by Ghanaian farmers during mixing, loading, and applying pesticides is minimal due to primarily financial constraint. Consequently, most of the farmers pointed out that headache, body itching, burns, blisters and catarrh were major symptoms encountered during spraying event. The revelation that more than half (52 %) of the farmers wait for about 31 – 60 minutes. after spraying event before taking their bath is frightening as this practice may allow their bodies to absorb the chemical which comes in contact during spraying event and expose themselves to harmful effects of pesticides. Also the fact that those farmers who bath immediately after spraying bath near water bodies, presents another potential threat to aquatic life and humans as the pesticides will contaminate the water bodies (Ntow, 2001). It confirms the observations by Konradsen *et al.* (2003) and Coronado *et al.* (2004) that exposure to pesticides has been one of the most important occupational hazards among farmers in developing countries.

Observations from farmers‟ fields and responses to the question on disposal of pesticide empty containers were clear evidence to support the findings of Ntow *et al*. (2006) that the commonest way Ghanaian farmers dispose of sprayer wash water and empty pesticide containers is by throwing them on the field. It is not surprising to see several empty pesticides containers littered around farms. These present potential pollution problems for aquatic systems which are sources of livelihood for human communities and various animal and plant life since many farms are close to water bodies.

One way that may be used to reduce or decontaminate these farmlands from these pollutants is the practice of slash and burn adopted by some of the farmers, which apparently burn the littered containers. Despite the fact that most farmers are aware of the risks of pesticides exposure, a few (26 %) still use empty pesticides containers to keep water and other food items with the perception that once these containers are

thoroughly washed with soap they pose no danger to humans. Empty herbicide containers are used as funnel for communal borehole (Appendix 17), thus contaminating water supplies for the entire community. Clarke *et al.* (1997) made a similar observation that some farmers in Ghana do use pesticide containers to store food and drinking water for future use. It is common knowledge that discarded empty pesticides containers still contain some residues of pesticides even after proper rinsing of the containers [http://sdda.sd.gov.pdf]. Therefore, it is advisable to avoid the reuse of such containers. One can discourage the reuse of these empty pesticide containers by puncturing plastic or metal containers after proper rinsing.

Keeping the pesticides in homes, especially bedrooms, also poses safety challenges to farmers and their families as leakages are inhaled by them. This has direct consequence to health since pesticide can enter the lungs by means of inhaled droplets or particles especially fumigants and those with particle sizes less than 10 µm diameter. The reason behind this storage practice is the assurance against theft; besides, they do not have any choice since they live in single rooms. Only a few (17 %) farmers have special places designated for the keeping of agrochemicals. About 6 % of them however, do not store pesticides for future use since they only buy the quantity needed and apply.

Contrary to what Ntow *et al*. (2006) reported that "herbicides are the most group of pesticides used by vegetable farmers", this study revealed equal patronage of insecticides and herbicides among farmers. This revelation seems to imply that weeds and insect-pests damage are the major problems faced by crop farmers in the country. The insecticides are mostly applied to vegetables because pests and diseases pose serious problems to their production as reported by Ntow *et al*. (2006). It confirms the estimation by Dinham (2003) that 87 % of farmers in Ghana use chemical pesticides to

control pests and diseases on vegetables. Most of the farmers either applied the pesticide at the early stages (1 – 2 WAP) of crops life and flowering and fruiting stages of crops. The reasons given are that;

(i) at the early stage some insect pests destroy the leaves of crops and

(ii) the insect pests cause damage to the flowers, preventing the crops to bear fruits.



The frequency of sprays per cropping season varied among crops and the financial status of the farmer involved. Majority of the farmers who produce vegetables and fruits apply pesticides to their crops three or more times depending on the crop and the financial status of the farmer. Poverty may explain why the Savannah zone applies pesticides less frequently than the other three zones (Transition, Forest and Coastal Savannah). However, those in cereal crops production apply pesticides once or twice per growing season. This could probably be another reason why the Savannah zone applies pesticides less frequently than the other three zones since large majority of farmers within the zone are in cereal production. For vegetables, weekly application interval of pesticides is common. The interval for perennial fruits however is three months. Herbicides, on the other hand, are used equally across the ecological zones because farmers assume that herbicides suppress weeds for a longer period of time and over a wider area than manual weeding and also help to reduce weeding time and labour cost. They are either used by the farmers to prepare the land for seeds to be sown or when some crops such as maize and rice are grown as sole crops; selective herbicides are used to control weeds. The observation that many of these agro-pesticides in use come with different brand names gives an indication that different manufacturers use different brand names for the same pesticide active ingredient.

Knapsack sprayer was the most popular device used by the farmers across the zones to apply the pesticides to their crops. However, not all the farmers own knapsacks due to poverty and economic pressure. These farmers either borrow from family members and friends or hire them at a cost ranging from GH¢ 1.50 to GH¢ 2.50 per day. According to Tholang (2011), the use of knapsack sprayers poses another potential threat to farmers since they are susceptible to leaking. This may be the reason why some farmers complained of itching of the body as symptom of pesticides exposure to the human body.



# CHAPTER SIX

## 6.0. CONCLUSION AND RECOMMENDATIONS

### 6.1. Conclusion

The survey has revealed that, majority of Ghanaian farmers who handle and use pesticides are found within the middle age (30 – 50) group. They are the predominant age group exposed greatly to the hazards of pesticides as compared to the younger group. Male farmers handle and apply pesticides more than the female farmers since pesticides application is a bit tedious for women. A higher proportion (64 %) of the farmers had gained at least 5 years experience in farming and application of pesticides. The educational status of farmers is generally low; most of them have had formal education up to the Basic level. Agricultural extension education which would serve as remedy to save farmers from many exposures of pesticides is apparently inadequate as majority of the famers across the ecological zones are not receiving any form of agricultural extension education. Hence, farmers across the ecological zones lack knowledge in the handling and use of pesticides.

Insecticides and herbicides are the pesticides most frequently used by farmers across the agro-ecological zones in Ghana; thus insect pests and weeds are perceived as the major problems faced by many Ghanaian farmers. Vegetables and cash crops like cocoa and citrus are the types of crops mostly treated with pesticides.

Although most farmers are aware of the possible harmful effects of pesticides, they do not put this awareness into practice. Protective gears such as rubber gloves, face mask, overall etc. are not adequately used by the farmers as a result of poverty.

Hence, the level of farmers‟ protection during the handling and use of pesticides is mostly inadequate.

### 6.2. Recommendations

In the light of the revelations of this study, it is highly recommended that;

i. Government should employ more Agricultural Extension Agents (AEAs) to educate farmers on the safe handling and use of pesticides. The few Agricultural Extension Agents available should intensify their education and training to the farmers. ii. Government should provide subsides on protective gears so that the ordinary farmer can afford them.

iii. Various awareness programmes through the use of print media, radio, television and open forum should be employed to raise farmers‟ awareness on the potential health risks associated with the handling and use of pesticides. iv. Further studies should be carried out to investigate pesticide residues in the blood samples of the farmers within the four selected agro – ecological zones.

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APPENDICES


**Appendix 1:** A picture Showing a farmer at Twiapease (Techiman) mixing a herbicide (Sunphosate) just close to a stream in the farm.

**Appendix 2:** A picture showing a farmer at Nyamebeye (Techiman) mixing pesticides (Funguran-OH) with bare hands.

**Appendix 3:** A picture showing a farmer with a standard PPE to apply pesticide at Nyamebeye (Techiman)

**Appendix 4:** A farmer at Twiapease (Techiman) applying herbicide with Tshirt.

**Appendix 5:** Illustrates a farmer mixing an insecticide (Sumitox) with bare hands at Asempanaye (Mankranso)

**Appendix 6:** Shows a farmer applying insecticide to his citrus with T-shirt and no facial protective device at Asempanaye (Mankranso).

**Appendix 7:** Shows a pair of rubber sandals used by a farmer to apply pesticides at Dwenewoho (Mankranso)

**Appendix 8:** Shows a farmer applying insecticide to his garden-eggs crops with T-shirt at Agogo

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**Appendix 9:** Empty containers left on the farm at Nyamebeye (Techiman)

**Appendix 10:** Empty containers left

**Appendix 12:** A disposed empty container at Amasaman (GA-West Municipal)

**Appendix 13:** Illustrates an empty herbicide container used as a drinking Cup at Nyamebeye (Techiman).

on the field at Tono Irrigation

**Appendix 14:** Shows a herbicide

Field (Navrongo)


container used as salt keeping unit at Pataban (Agogo).

**Appendix 11:** A disposed empty

container at Asempanaye (Mankranso)

**Appendix15:** Shows an empty container used to keep salt at Gaani (Navrongo).

**Appendix 16:** An empty herbicide container used for keeping salt at Nyamebeye(Techiman).

**Appendix 17:** An empty container as an improvised funnel for the community borehole at Asempanaye (Mankranso).

**Appendix 18:** Shows an empty pesticide container used as water bottle at Gaani (Navrongo).

**Appendix 19:** Shows leftover herbicides stored under tree in a farm at Asempanaye (Mankranso).

**Appendix 21:** An insecticide stored under a palm tree at Nyamebeye (Techiman).

**Appendix 20:** Leftover pesticides stored in a poultry pen at Gaani (Navrongo).

Appendix 22

QUESTIONAIRE ON PESTICIDES HANDLING AND USE IN FOUR SELECTED AGRO – ECOLOGICAL ZONE OF GHANA

**A. <u>SOCIO-ECONOMIC ISSUES</u>**

1) Name of Respondent ……..

2) Town/Community ……District ……Region……..

3) Sex: **Male [ ] Female [ ]**

4) Age **: < 30 years [ ], 30 – 40 [ ], 41 – 50 [ ], 51 – 60 [ ] 60 + [ ]**

5) Marital status: Single **[ ] Married [ ] Divorced [ ] Separated [ ]**

**6)** Total number of children **[ ]**

**7)** Family size **[ ]**

**8)** Educational level: **Primary [ ] JHS/MSL [ ] SSS/'O' Level /'A' Level [ ]**

**Tertiary [ ] No formal education[ ]**

**B. FORM DETAILS AND WORK HISTORY**

1) How long have you been in farming? **< 1yr[ ], 1 – 5yrs, > 5yrs[ ]** 2)

What is the size of your farm?

**< 1 acre [ ], 1 – 5 acres [ ], 6 – 10 acres [ ], > 10 acres [ ].**

3) What types of crops do you grow?

**Vegetables [ ], Cereals [ ], Cash crops [ ].**

4) Do you obtain information from extension officers? **Yes[ ] No[ ]**

5) If yes, do you obtain information about pesticides from extension officers?

**Yes[ ] No[ ]**

6) What type of farming system do you practice? **Mixed farming [ ]**

**Monocropping [ ] Intercropping [ ] Mixed cropping [ ] Crop rotation [ ].**

7) Is your farm close to water body? **Yes[ ] No [ ]**

**C. PESTICIDE USE AND MANAGEMENT**

1) Do you have knowledge about pesticides? **Yes [ ] No [ ]**

2) If yes, what do you know about pesticides? ……

……

3) Do you apply pesticides to your crops? **Yes[ ] No[ ]**

4) On which Crops do you apply pesticide? **Vegetables [ ] Legumes [ ] Cash crops[ ] Arable crops [ ]**

5) How many times do you apply pesticides per growing season? **Once [ ] Twice [ ] Three times or more [ ]**

6) When do you apply the pesticides to your crops? **Early in the growing season [ ] During flowering and fruiting stages of crops [ ] Any time pests are seen on crops [ ].**

7) Why do you apply pesticides at a particular time?

……

8) What types of pesticides do you normally use?

**Weedicides [ ], Insecticide [ ], Fungicides [ ], Nematicides [ ].**

9) Name some of the pesticides you normally use.

……

10) How do you obtain your pesticides?

……

11) Do you have any knowledge about expiry date? **Yes [ ] No [ ].**

12) If yes, what does expiry date mean to you?

……

13) Do you check expiry date on pesticide products? **Yes [ ] No [ ].**

14) Do you use expired pesticides? **Yes[ ] No [ ]**

15) If yes, why do you use? ……

16) Do you know pesticide label? **Yes [ ] No [ ].**

17) If yes, do you read the label? **Yes [ ] No [ ].**

18) If yes, what does the label tell you? …….

19) Do you follow the label? Yes **[ ] No [ ].**

20) Do you have knowledge about application rate? **Yes [ ] No [ ].**

21) Do you have knowledge about direction of spraying? **Yes [ ] No [ ].**

22) If yes, do you follow wind direction during spraying? **Yes [ ] No [ ].**

23) If yes, explain how you follow direction during spraying?

24) Do you have knowledge about re-entry period? **Yes [ ] No [ ].**

25) When do you make an entry to the farm after spraying event?

**Few hours [ ], 1 day [ ], 2 – 3 days [ ], 1week [ ].**

26) Do you know the harmful effects of pesticides? **Yes [ ] No [ ].**

27) What symptoms or poisoning cases have you experienced after a spray event? …….

28) How often do you experience such symptoms? ……..

29) Do you seek medical attention? **Yes [ ] No [ ].**

30) Do you protect yourself when applying pesticides? **Yes [ ] No [ ].**

31) If yes, what type of protective clothing do you use? ……

……

32) Do you wash your hands after pesticides application? **Yes [ ] No [ ].**

33) If yes, what do you wash your hands with?

**Only water [ ], Water and soap [ ], Others [ ].**

34) Do you take your both after pesticides application? **Yes [ ] No [ ].**

35) If yes, after what period do you take your bath?

**< 15mins [ ], 15 – 30mins [ ], 31 – 60mins [ ], > 60mins [ ].**

36) How do you dispose of empty pesticides containers?

**Burn [ ], Bury [ ], Cut & leave on farm [ ], Leave on farm [ ].**

37) Do you use pesticides container to keep food item or water?

**Yes [ ] (indicate :……) No [ ]**

38) Do you own a sprayer? **Yes [ ] / Motorized [ ] or Knapsack [ ] No [ ].**

39) If no, how do you obtain a sprayer for your work? **Hire [ ], Borrow [ ].**

40) If you have any spray liquid left, how do you dispose of the left-over?

……

41) Do you wash or clean sprayer before spraying? **Yes [ ] No [ ].**

42) Do you wash or clean sprayer after spraying? **Yes [ ] No [ ].**

43) How do you dispose of the water used to wash the sprayer?

……

44) Where do you store your pesticides? **Store room [ ], Bedroom [ ], On farm [], No storage [], Others [ ]** (specify)……

45) What is the time interval between pesticide application and harvesting of your produce? **1 day [ ], 2 – 3 days [ ], 4 – 5 days [ ], 1 week [ ].**

46) Why that time interval? .....

47) Do you store your produce after harvest? **Yes [ ] No [ ].**

48) If yes, do you use pesticides to treat your produce before storage? **Yes[] No[]**

49) If yes, mention some of the pesticides you use to treat produce for storage.

……