

**PESTICIDE USAGE AND PERCEIVED HEALTH
STATUS OF VEGETABLE FARMERS IN KWARA
STATE, NIGERIA**

**ADEWOLE, ADEFUNKE MOJIRADE
(93/036618)**

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CERTIFICATION

This is to certify that this thesis has been read and approved as meeting the requirements of the Department of Agricultural Extension and Rural Development, University of Ilorin, Nigeria, for the Award of Doctor of Philosophy (Ph.D.) degree in Agricultural Extension.

Prof G.B.Adesiji
(Supervisor)

Date

Dr. S.A. Aderinoye-Abdulwahab
(Postgraduate Coordinator)

Date

Dr. R. S. Adisa
(Head of Department)

Date

Prof. (Mrs) O.B. Fawole
(Internal/External Examiner)

Date

(External Examiner)

Date

DEDICATION

This work is dedicated to women all around the world struggling against all odds to achieve their dreams. “By strength shall no man prevail”

DECLARATION

I, Adefunke Mojirade ADEWOLE, a Ph.D. student in the Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, hereby declare that this thesis entitled “Effects of Pesticide Use on Health Status of Vegetable Farmers in Kwara State, Nigeria”, submitted by me is based on my actual and original work. Any materials obtained from other sources or work done by any other person or institutions have been duly acknowledged. In addition, the research has been approved by the University of Ilorin Ethical Review Committee.

Adefunke Mojirade ADEWOLE
(93/036618)

Date

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ABSTRACT

Pesticides are widely used for the control of pests and diseases of vegetables in Nigeria but majority of the farmers are not adequately informed on the hazards associated with these chemicals. This study therefore examined pesticide usage and perceived health status of vegetable farmers in Kwara State, Nigeria. The specific objectives were to: (i) describe the socio-economic characteristics of vegetable farmers; (ii) identify the types of pesticides used by vegetable farmers; (iii) investigate the use of safety practices during the application of pesticides among vegetable farmers; (iv) examine the perceived health status of vegetable farmers; (v) identify capacity building needs of vegetable farmers on safety practices for pesticide use; and (vi) examine the constraints to safety practices employed by vegetable farmers in the study area.

A three-stage sampling technique was used to select 532 registered members of Vegetable Farmers' Group of the Kwara State Agricultural Development Project (KWADP). The first stage involved purposive selection of 11 major vegetable producing Local Government Areas in three zones of KWADP. The second stage involved a selection of 27 communities across the 11 LGAs. The third stage was a random selection of 50% members of the group in the communities. Interview schedule was used to elicit information. However, response rate was 85% (455). Data collected were analysed using descriptive and inferential statistics such as Multiple and Multinomial Regression analyses at 5% level of significance.

The findings of the study were that:

- (i) majority of the farmers (95.6%) grow vegetable on a small scale ($\bar{X}=0.4$ ha) with mean annual income of ₦101,648.90 per hectare;
- (ii) types of pesticides commonly used by respondents were Cypermethrin (90.5%), Atrazin (87.5%) and Paraquat Dichloride (63.1%);
- (iii) knowledge level ($\bar{X}=2.43$) and usage of safety practices ($\bar{X}=1.7$) for pesticide handling and application were low;
- (iv) main ill health symptoms experienced during pesticide use were conjunctivitis (red eye) (65.3%) cough (61.1%) and running nose (34.4%); majority (84%) of the farmers perceived their health status as good;
- (v) capacity building on safety practices was needed for reading instructional manual ($\bar{X}=8.68$) and compliance with recommended dosage ($\bar{X}=9.01$);
- (vi) constraints to usage of safety practices during pesticide application include poor finance ($\bar{X}=3.77$), illiteracy ($\bar{X}=3.63$) and inadequate information on pesticide dosage ($\bar{X}=3.60$); and
- (vii) perceived health status measured was significantly influenced by the usage of safety practices such as compliance with dosage recommendation ($p=0.001$), reading instruction manual ($p=0.093$) and avoiding re-use of pesticide container ($p=0.001$). The type of pesticide used was significantly related to the occurrence of running nose ($t=3.157$; $p=0.002$), conjunctivitis ($t=5.66$; $p=0.001$) and cough ($t=2.224$; $p=0.027$).

In conclusion, contrary to the perceived good health status among vegetable farmers using pesticides, majority experienced conjunctivitis (red eye) and cough as a form of ill health that were significantly associated with the use of pesticides in Kwara State, Nigeria. It is therefore, recommended that vegetable farmers should be well informed and trained on the importance of safety practices of pesticide use.

CHAPTER ONE

1.0

INTRODUCTION

1.1 Background to the Study

Agriculture is the main occupation of most Nigerians from ancient times. Agriculture contribute about 40% Gross Domestic product to the economy and provide source of livelihood for not less than 70% of the Nigerian population. (Federal Ministry of Agriculture and Rural Development [FMARD], 2000). It is mostly practiced on small scale in the rural areas and is characterised by the use of crude and traditional methods making it laborious. (Rahji, 2005). In developing countries, agricultural work is hazardous resulting in chronic illness to farmers which may result in death. According to the International Labour Organization [ILO], 2000), agricultural sector is one of the most hazardous to health worldwide. This is because farmers are usually exposed to hazards on the farm especially with certain modern practices like the use of pesticide which exposes farmers to hazards especially when they are not properly handled (Ajayi and Akinnifesi, 2007).

Vegetables are widely cultivated in many parts of Africa for food and income generation. In Nigeria, it is produced on subsistence level with crude implements and the main source of hydration is rainfall which is usually unreliable and unpredictable (Department for International Development [DFID], 2002). As in many States in Nigeria, vegetable is one of the widely grown crops in Kwara State (Ajadi, 2017). It is mostly grown in the rural areas although there are strips of fadama sites known for vegetable production in the urban centers too. It can be produced all year round with supplemental hydration in form of irrigation during the dry season when the prices of vegetable reach its peak market value. According to Mohammed (2002), its yield per unit land area is high

compared to other arable crops, making it a good source of income generation for farmers especially women who may be limited to crop large farm lands. Vegetables are generally cheaper sources of essential nutrients compared to other food stuff which makes it possible for poor households to afford its consumption (Iheke, 2009). Its production is increasingly gaining recognition in Africa as a source of income both for rural households and also for generating foreign exchange. (Asian Vegetable Research Development Centre for Africa [AVRDCA], 2004).

Pest and disease infestation is a major constraint militating against the production of vegetable on an increased scale as it may cause severe loss if there is no adequate and timely intervention (DFID, 2002; Ugwu, Omoloye, Asogwa and Aduloju, 2015). The leaves and fruits of vegetable crops are highly vulnerable to attack by pest this will depreciate its market value as well as reduce its yield consequently leading to reduction in quality and quantity of the crop. Pests and diseases attack on vegetable may cause severe crop damage resulting in about 20 to 60% pre-harvest losses of vegetable crop (Sithanntham *et al.*, 2003). Consequently, farmers resolve to the use of pesticides in order to curb wastages and loss, thereby leading to increased productivity (Okrikata and Anaso, 2008). According to Tijani (2006), the use of pesticide in cocoa and rice plantation can prevent loss due to pests and diseases attack by 45 percent which implies better yield.

Pesticides are chemicals used to kill, control, repel, or mitigate any number of pests which, if left uncontrolled, deplete crop yield. Pesticides can fall into one of several categories: insecticides, fungicides, rodenticides, herbicides, and germicides. The Food and Agriculture Organization of the United Nations [FAO] defines pesticide 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 or interfering with the production, processing, storage or marketing of food, agricultural commodities, wood and wood products or animal food stuffs or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies (FAO, 1986).

Due to the ability of pesticides to improve productivity by reducing damages and loss of vegetable crops, farmers tend to overvalue this property without adequately putting into consideration the hazardous effects of pesticides on health (Konya, 2005; Adeniran *et al.*, 2006). However, it is worthy of note that despite the productivity-enhancing attribute of pesticides, evidences from studies in recent times have proven that pesticides use can be dangerous to health especially if it is not properly handled (Tadesse and Asferachew, 2008). There are standard measures that have been recommended to be followed when handling pesticides. Failure to comply with these measures due to misuse, overuse and even in some cases, lawful use of these toxic chemicals will expose both the users and his environment to the hazardous effect of pesticides (Kishi, 2005).

Previous studies revealed that when pesticides get into the body either through dermal route or inhaled into the lungs and in some cases through drinking water, this results in adverse health conditions like headaches, heart attacks, respiratory disorders, stomach and intestinal upset, dizziness, liver tumours, convulsions, leukaemia, spasm, epilepsy, stroke, cancer, brain tumours and even death (Yousaf *et al.* 2004; Tijani, 2006). These adverse health effects of pesticides have raised public concern and as a result, strict regulations and guidelines have been put in place to monitor and regulate the use of these harmful chemicals in developed countries where some pesticides which were considered as highly toxic to health have been banned. In the same vein, in Nigeria, 30 chemicals were banned by the National Agency for Food and Drug Administration and Control [NAFDAC] in line with the new European Union legislation on pesticide use (Auwal-

Ahmad and Awoyale, 2008). Nevertheless, highly toxic pesticides are still used by farmers in developing countries especially in Nigeria and this constitutes a very significant occupational risk to farmers' health (Coronado *et al.* 2004). Accumulation of pesticide residue in human body may result in serious health consequences, which can be avoided with adequate and timely intervention (Konradsen *et al.* 2003).

Health is defined as the state of complete physical, mental, and social well-being (including quality of life, positive mental health, and the consideration of culturally sensitive approaches to healthcare) and not merely the absence of disease or infirmity (World Health Organisation [WHO], 2000).

1.2 Statement of the Problem

In recent times, there is a growing concern for increase in the quantity of pesticides consumed for the control of pests and diseases of vegetable crops among farmers in Nigeria. In fact, pesticides use among farmers in the country has proven to be indispensable tool in combating damage from pests. The reason for this has been the improvement in yield which is attributed to the ability of pesticides to eliminate pests of vegetables crops.

Nevertheless, the continuous indiscriminate application of pesticides has stepped-up hazards to farmer's health due to non-compliance with recommended practices while handling or applying pesticides. All over the world, it has been established that there is a link between pesticide misuse and occurrence of illnesses among farmers and his environment (Soares *et al.* 2003). The state of health problems has led to heavy agricultural losses among rural farmers in Nigeria (Killen, 2005). Goudge and Govender, (2000) also reported that the significant consequences associated with ill health status are poorer physical and mental health, and reduced productivity.

Pesticide exposure is a major risk which agricultural workers encounter and this has led to several cases of poisonings and in extreme cases, deaths have been recorded especially in developing countries (McCauley *et al.* 2006). According to the World Health Organization, about 20,000 deaths are recorded annually as a result of pesticide exposure among farm workers, majority of this occur in developing countries (Kishi, 2005). About 3000,000 cases of organophosphate intoxications and not less than 300,000 deaths and casualties occur annually (Larson, 2003) as a result of pesticide poisoning with adverse effects ranging from headaches, skin irritation, vomiting, respiratory distress and forms of neurological disorders. The occurrence of these ailments depends on toxicity of the chemical compound, dosage and length of exposure (Jors *et al.* 2006).

Various types of pesticides are used by farmers on their vegetable crops all over the world as well as in Nigeria for the control of pests and diseases in a bid to reduce loss and improve yield but studies have established that farmers do not have adequate and sufficient knowledge and information about the adverse health consequences associated with misusing pesticides (Ngowi, 2003). Farmers do not have deep and full understanding of the effect of pesticides on the health status of man and the adverse effects on the environment (Mathews, 2008). They are also a knowledge gap on the appropriate recommended safe practices for pesticide handling and application (Ngowi *et al.* 2007) which could be attributed to lack of adequate, up to date, timely information and training on pesticide safety, low education levels among rural population, the use of poor spraying technology and non-compliance with adequate personal protection during pesticide use (Hurtig *et al.* 2003; Atreya, 2008).

In addition, many farmers are not sensitive to the effect of pesticides on their health due to the fact that many pesticide induced diseases and disorders are chronic rather than acute which makes it difficult to relate ailments to their causes. This condition is further

worsened in the rural areas where many ailments are not reported to the health care facilities making it difficult to track the effect of pesticides on farmer's health.

Numerous studies had been carried out in Kwara State to determine the health of farmers and the economic importance of pesticide use among farmers. (Adesiji *et al.* 2013; Adesiji and Komolafe, 2013; Akangbe *et al.* 2012; Komolafe *et al.* 2015, Oloyede *et al.* 2016; Adewumi *et al.* 2007). However, none of these had established the empirical findings of the relationship between farmers health and pesticide use in Kwara State.

Despite the importance of pesticides and good health status required for increased agricultural productivity which is necessary to address the growing demand for food by the teaming population in Nigeria, there is still paucity of literature that revealed the extent of the adverse effects of pesticide on the health status of farmers. This necessitates empirical findings from this study upon which agricultural policy can address to ensure the use of pesticides with minimal effect on health of vegetable crop farmers in Kwara State and Nigeria as a whole.

To bridge the aforementioned research gap, this study proposed to provide answers to the following research questions:

- i. What are the socio-economic characteristics of vegetable farmers in the study area?
- ii. What are the prevalent types of pesticides used among vegetable farmers?
- iii. What is the level of use of safe practices during handling and application of pesticides among respondents?
- iv. What is the perceived health status of vegetable farmers?
- v. What are the capacity building needs of vegetable farmers on safe practices during handling and application of pesticides? and

- vi. What are the constraints to the use of safe practices during handling and application of pesticides among vegetable farmers?

1.3 Objectives of the Study

The main objective of the study is to examine pesticide usage and perceived health status of vegetable farmers in Kwara State, Nigeria.

The specific objectives are to:

- i. describe the socio-economic characteristics of respondents;
- ii. identify the prevalent types of pesticides used among respondents;
- iii. investigate the usage level of safe practices during handling and application of pesticides among respondents;
- iv. determine the health status of respondents;
- v. identify capacity building needs on safe practices during handling and application of pesticides among respondents; and
- vi. examine the constraints to the use of safe practices during handling and application of pesticides among respondents.

1.4 Hypotheses of the Study

- i. There is no significant relationship between level of use of safe practices and perceived ill-health symptoms experienced by respondents.
- ii. There is no significant relationship between selected socio-economic characteristics and the use of safe practices during handling and application of pesticides among respondents.

- iii. There is no significant relationship between the usage level of safe practices during handling and application of pesticides and the perceived health status of respondents.
- iv. There is no significant relationship between selected socio-economic characteristics and knowledge level of respondents on safe practices during handling and application of pesticides.
- v. There is no significant relationship between the constraints faced and usage level of safe practices during handling and application of pesticides among respondents.
- vi. There is no significant relationship between the types of pesticides used and perceived ill-health symptoms experienced by respondents.

1.5 Justification for the Study

Farmers' health status is greatly affected by indiscriminate use of pesticides on their vegetable crops which definitely weakens the health condition of the farmers causing a great reduction in the number of man-hour put as labour. Some farmers reduce their farm sizes because of the incapacitation and some others die from diseases resulting from pesticide usage. Eventually, there is great reduction in farm output and income resulting in poor living condition of the people. (Kesavachandran et al. 2009).

It is evident that farmers are concerned with obtaining maximum yield with minimum input. This is why over the years; the use of pesticide by vegetable farmers has increased with its attendant adverse effect on human health. In a bid to reduce the undesired effect of pesticides, there is need to identify the pesticide use practices among vegetable farmers in compliance with healthy / safe practices during handling and application of pesticides. It is necessary to identify knowledge gaps and determine capacity building

needs of vegetable farmers in order to design intervention programmes for improving pesticide use practices among vegetable farmers.

Findings from this study will be a useful guide for extension workers and other relevant training agencies to facilitate trainings and capacity building of vegetable farmers on Best Management Practices for pesticide use.

The study will show relevant organizations the challenges faced by vegetable farmers in following recommended safe practices while handling pesticides. This will help in designing appropriate interventions to meet the farmers' needs.

In general, the study aims to promote safe practices in handling and application of pesticide in order to foster good health condition of farmers so that they can perform their activities to the fullest and achieve better productivity.

1.6 Definition of Terms as Used in this Study

The following terms are defined as used in this study

Perceived health status: A self-report of present (period of survey) opinion of the absence or presence of any form of ailment, diseases or illness that hindered effective functioning of farmers in vegetable farming activities.

Vegetable farmers: This refers to an individual who owns or operates farm to grow okro, spinach, ewedu, pepper, tomatoes, cabbage, garden egg or onion e.t.c

Ill-health conditions: Diseases or illnesses opined to have occurred (now or before) to vegetable farmers as a result of the use of pesticide.

Safe practices during handling and application of pesticides: A set of guiding principles of recommended healthy practices for handling and application of pesticides

which are set to reduce harmful or detrimental effects and consequences of pesticides on man's health and his environment.

Restricted entry interval: This is the recommended precaution time frame which must lapse after pesticide application during which an unprotected person must not enter the treated area in order to prevent contact with pesticides. This time frame is required to ensure significant reduction in the concentration of the pesticide in the treated area thereby reducing the exposure risks like contact with vapour of the pesticides or wet surfaces.

Pre-harvest intervals: This is the recommended period of time representing the time required to allow for eliminating pesticide residue in crops. This time span vary depending on the type of pesticide used but it ranges between 10-21 days. This is important to ensure that the risk of pesticide residue in harvested vegetable crops is eliminated.

1.7 Scope and Limitations of the Study

This study was confined to the use of pesticides and health status of vegetable farmers in Kwara State, Nigeria.

- i. This study relied only on retrospective self-reports of the effects of pesticide.
- ii. The study investigated only the perceived effect of the use of pesticides on the farm site.
- iii. The study population was based on the list of registered vegetable farmers with Kwara State Agricultural Development Project (ADP) and as such, the list excludes some other vegetable farmers that are not registered with ADP.

- iv. Reluctance of some of the vegetable farmers in expressing their views about ill health experienced relating to pesticide use was also a challenge.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Chapter two covers the presented related literature to this study. The review starts with concept of pesticide usage, pesticide use practices in Nigerian agriculture, economic importance of pesticide, pesticide residue in food, indigenous knowledge system in pest control, vegetable production in Nigeria, effect of pesticides on health, perceived health status, health and safety with agricultural pesticides, health and safety tips on best management practices (BMP) of agricultural pesticides, capacity building needs analysis, the theoretical frame work and conceptual framework for the study.

2.1 Concept of Pesticide usage

Chemical substance called pesticide was derived from French word called “peste”. The word *Peste* in French means “pest or plague”. The meaning in Latin language is “caedere” which could be translated as “to kill” (Akunyili and Ivbijaro, 2006). Pesticide can be defined as chemical substance purposely for preventing, terminating pest, organism carrying human and animal disease, undesirable types of plants and animals instigating damage and or meddling with field crops, food storage, food processing, and marketing of agricultural food products, animal feeds and wood products. It may also be used for the purpose of controlling pest infestation in animals (FAO, 1986).

In Nigeria, different kinds of pesticides are useful in many different places in the society, but agriculture accounts for majority of pesticide demand. Study has established that pesticides worth of about one hundred and twenty five thousand to one hundred and thirty thousand metric-

tonnes are used yearly. Over the years, pesticides remain the major control against pests of agricultural crops such as vegetables, cash crops (cocoa) and cereals (Ikemefuna, 1998).

According to WHO (2009) pesticides are grouped in categories according to their mode of attack, chemical composition, the kinds of pest they can kill, and toxicity of formulated chemical product of the pesticide. WHO further grouped pesticides by hazardous potential as shown in Table 1.

Table 2.1: Grouping of pesticides based on hazard as recommended by WHO

WHO group	LD50 for the rat	[body weight mg/kg]
	Oral	Dermal
Ia. Exceedingly hazardous	< 5	< 50
Ib. Greatly hazardous	5–50	50–200
II. Moderately hazardous	50–2000	200–2000
III. Slightly hazardous	Over 2000	Over 2000

Source: WHO, 2009.

As shown in Table 1, pesticide grouped as 1a are exceedingly hazardous, pesticide grouped as 1b are greatly hazardous, pesticide grouped as II are of moderate hazard, group III are pesticides that poses slight hazard and group 1V are pesticides that are not likely to pose acute severe hazards when used normally (WHO, 2004). Almost ninety percent of the forbidden/banned pesticides belong to group category of 1a, 1b, and II of the WHO hazard guidelines.

Indigenous use of pesticides can be traced back as far as 400 years ago when poisonous plants, smoky fire, and mud were used to protect crops from pest attack (Rao *et. al.*, 2007). The first kinds of contemporary pesticides possess highly toxic substance like hydrogen cyanide and arsenic. It was after, that the application of pesticides expanded worldwide and increased with the invention of synthetic pesticides in the 1940s with the discovery and inclusion of Adrin, DDT, BHC, Parathion and Chlorodane. In 1939, first pesticide was made and was called

dichlorodiphenyltrichloroethane (DDT). In 1945 just after the 2nd World War, the dimension of pesticide production and other by-products changed as a result of increase in their demand (Banjo et al. 2010).

The application of pesticides in contemporary modern agricultural practice has brought to light the green revolution and food security in several countries. As pesticide application in agriculture had increased food supply worldwide, findings continues to accrue that human exposure to pesticide can be a determinant factor for bad health. Although getting data on incidence of hazards and injuries resulting from pesticide use in developing countries is very hard, exposure in various occupation where pesticide is used has been proven to lead to yearly occurrence of up to 18 cases related to illnesses associated with pesticides out of every one hundred thousand factory/farm workers in U.S (Calvert et al., 2004).

2.2 Pesticide Use Practices in Nigerian Agriculture

Nigeria is known as one of the largest pesticides consumers in Africa most especially in sub-Sahara with an annual fifteen thousand metric tons of pesticides imported into the country by two hundred produce brands and varieties of formulation (Osibanjo, 2002). Over the years, agricultural sector has the major demand for pesticide. This is because pesticide has become an essential tool in fighting the threat of pests attack on agricultural products. The long history of use and application of pesticides in Nigeria can be precisely noted to be the introduction and prevalence of pest and diseases in cocoa farms. However, several health hazards have been recorded with the use of pesticides.

According to Ogunjimi and Farinde (2012) increased use of pesticide in Nigeria happens after it was presented in the 1957 precisely. Pesticide introduced then was Lindane and was specially

recommended for use in agricultural sector. In the expression of rising human population, and growing urbanization in the country, consumption of pesticide grew in 1960s after Nigeria Independence but the risk involved in pesticide use, be it perceived or real has forced modifications in the techniques by which pesticides are being used and applied. Banjo et al. (2010) supports Ogunjimi and Farinde (2012) who reported that the development of synthetic pesticides stands its foot in 1940s with the discovery and presentation of Aldrin, DDT, BHC, Parathion and Chlorodane. Kemabonta and Odebiyi (2005) also supported the report when they found that from 1940s, the control of insect pest had been done with the use of synthetic insecticides. In the 21st era, serious campaign for more production of pesticides in a form by which it persists for smaller periods in the environment and with minimal danger when compared with the ones manufactured earlier with DDT and arsenic.

Despite growing concern about the hazardous properties of pesticides, reports of excessive use of pesticides in developing countries have been documented. Tijani, (2006) reported that farm workers are not following safety precautions when handling pesticides. Due to unfavourable attitude towards pesticide handling, several farmers dumped their used pesticide containers in farm field and sometimes in irrigating water. This has been associated with rise in health hazards and environmental pollution in the society. Several studies have reported unsafe use of pesticide among farmers. Evidence from several studies have reported elements of dangerous use of pesticides among farmers as failure to pay attention to first aid information and environmental hazards warnings, poor maintenance of spraying equipment, refusal to use protective gear, use of damaged sprayer, inappropriate clothing, and non-compliance with safety precautions written on pesticide labels (Damalas *et al.*, 2006; Ajayi and Akinnifesi, 2007; Sosan and Akingbohunbe, 2009). Study by Oluwole and Cheke *et al.* (2009) assessing the pesticide use and handling

practices revealed that 86.7 per cent of the pesticides used by farmers in Ekiti State, Nigeria belong to the group of pesticides classified by WHO as greatly hazardous which have been banned and restricted for use in most developed countries. The study further revealed that ninety seven percent of the farmers did not obtain formal training on safe use of pesticide. According to findings from the study, about sixty percent of the applicators of pesticides sprayed close to the river. This further confirmed the findings of Udoh (1998), in a study to investigate conditions of use and impact of pesticides in Nigeria. The study revealed harmful storage and application practices among farmers using pesticides. It observed that most of the highly hazardous pesticides that have been labelled as harmful to the environment and hence were banned for usage in developed countries were still found to be in use. The study also pointed out that safe interval between pesticides applications were not observed by farmers. For most of the common recommended pesticides, 5-21 days is the safe period before farmer could harvest such crops. Furthermore, the study showed that twenty-two per cent of the farmers harvested their crops 3 days after the previous spray. None of the farmers in the study observed the 21 day of peak safety period. The harm of harvesting vegetables, fruits, and seeds before the 21st day of safe period cannot be overstressed. This mishandling also causes increased residues of pesticide in food crops consumed by humans (Ansari *et al.*, 1997; Ahad *et al.*, 2006).

2.3 Economic Importance of Pesticide

Pesticides are known as one of the important inputs in agriculture with the aim to prevent loss in crop production. If the application is not appropriately managed, they could result to severe health problems and environmental disaster (Vergucht *et al.*, 2006). Pesticides application are vital management tool for agricultural growth; the use could increase crop yields and assure control of insects after harvest of crops and storage and it has constantly been the backbone of

agriculture in recent times. This high level of importance is associated with the tremendous benefits of pesticide. Some of the benefits are elongation of agricultural products shelf life for storage (Olabode *et al.*, 2011). Cooper and Dobson (2007) upheld that four times return is realized on every 1 dollar spent on pesticide on field and storage crops yearly.

Pesticides are valid and useful gears that can give significant gain among farming community. To make the most of these gains, it is needed to apply pesticides in an efficient and safe manner; improper use of pesticides can result to harmful consequences both on the environment and people in the environment. A broad range of importance of pesticides include the use of herbicides for the control of weeds, insecticides for controlling insects pests which is capable of increasing crop yield and even the quality of fibre and food crops, the application of pesticides for protecting livestock against parasites while poison baits can also be helpful in reducing predators and rodents.

Pesticides can be regarded as vital instrument in the control of termite invasion in houses. The prevention of biting insects like mosquitoes causing nuisance and also serves as vectors of diseases, it contributes to health gains and advances the quality of lives in the society. The application of pesticides in entertaining areas such as golf courses, parks and sporting ovals has positive contribution to recreational aesthetic and social benefits in the society. Pesticides are used for the control of several exotic organisms like feral or weeds and animals species which may be harmful to our natural environment. The application of pesticide in the control of harmful organisms in the environment will ensure the conservation of biodiversity and reservation of local habitats. Pesticide products used in homes can also provide great comfort and improve the quality of lives.

2.4 Pesticide Residue in Food

Pesticides comprises of greatly important class of chemical substance required to be controlled as a result of their great toxicity and their worldwide use for agricultural purpose in field and storage prevention of pests. The availability of pesticide remains in food is as a result of pesticide use on field crops. The pesticide remains and residuals resulting to food contamination are now progressively frequent in recent years causing questions about economic consequences and human health. Widespread pollution of pesticide in the soil, water and air implies that the very crops grown, animals reared and food we eat contained some toxic substances.

The degree of pesticide remains/residues in food crops is normally enacted in order to protect consumers from harmful and or preventable intakes of some quantity of pesticides. It is also ensured that the correct use of pesticides regarding registration and authorization is monitored to regulate intervals between application and harvest, application rates and to allow the free passage of treated pesticide products, with the understanding that applicators abide by the recommended maximum residue limit (MRL). MRL implies the highest concentration of the pesticide residue (unit in mg/kg) that is formally allowed in particular food items. MRL is not the same as toxicological limit; however they must fall within the acceptable toxicological limit to be accepted as safe for consumption. Surpassed MRLs are solid indicators of abuses of standard agricultural practices. Continuous uncontrolled application of pesticides will continue accumulating in soil and invariably find its route into water bodies, leaving the environment loaded with remains of these pesticide chemicals. Thus pesticide residue finds its means into every crop planted in the environment even those that are organically grown.

Organic agricultural practices prohibit the application of pesticides for pest control. Instead, substances like slurry, urine and manure can be used to augment nutrients in the soil, while

copper oxychloride, rotenone, neem, sulphur, copper hydroxide and tobacco are applied to control plant disease and pest. Studies suggest that regardless of the ban placed on the use of industrial pesticides in organic farming, food produced by organic farms may still have pesticide residues. Ground water, rain and soil can all convey pesticide substances to crops grown in organic farms. This is confirmed by Gonzalez *et al.* (2003) who reported detectable pesticide residues in organically grown vegetable crops although the organic food samples contain lower level of residue compared to the conventional food samples.

In Nigeria, several studies have analyzed the presence of pesticides in food. A study was conducted by Etonihu *et al.* (2011) on randomly purchased sorghum, maize grains and white beans in the open markets in north central Nigeria. The study revealed the presence of 28 pesticides. Consumption of polluted foods is the main route of human contact with pesticides. Also, a study conducted by Osibanjo (2002) showed that two hundred and seventeen vegetable and fruits samples, four cereal crops (sorghum, maize, rice and soybeans), along with food stuffs of animal source from several location within Nigeria analyzed for the presence of organochlorine contained DDT, Aldrin and Dieldrin, some above maximum residue limit (MRL) (Osibanjo and Adeyeye, 1997; Adeyeye and Osibanjo, 1999).

Numerous studies have emphasized the need to equip farmers with necessary knowledge on pesticide handling and safety practices (Alimi, 1999; Bayard *et al.*, 2007). Nevertheless, the influence of synthetic pesticides on the environment and health of human is of great concern. There is also a need to improve the patency of botanical formulations since it has been established that they have potent pest control abilities with little or no consequence on the environment and human health.

2.5 Indigenous Knowledge System in Pest control

In Nigeria, modern agriculture have promoted the application of industrial pesticides in the past decade, however, some vegetable farmers in rural areas are yet to key into the practice of chemical pest control, due to the sustenance nature of production, low of knowledge of handling it and high rate of poverty (Okunlola, 2007). They hinge majorly on local knowledge for mitigating the impact of pest damage on the field crop by the use of plant based or botanical formulations (Perrin and Phillips, 2006). The native knowledge system is very vital to the rural vulnerable, poor and marginalized people because it attracts little or no cost. More importantly, is the fact that it poses no threat to human health and it is eco-friendly. Despite the huge potential characteristic in plant based locally made pest control, the practices have been largely under examined with restricted intervention and assets devoted.

Literatures have acknowledged several local plant-based materials for pest management alternatives used for the prevention of storage and field pest in Nigeria. Adedire and Lajide (1999) examined the influence of the extract of plant on the oviposition and toxicity prevention of storage pest of cowpea called *Corymbia maculate*. Onifade (2000) also studied the antifungal impact of *Azadirachta indica*. In another study, Aduloju (2000) investigated the use of aqueous extracts of plant in the prevention of field insect pest. Ofuya *et al.* (2005) further stated that powders of *Eugenia aromatic* repelled pests of cowpea seeds put in storage. In another study, Ofuya and Olowo (2006) examined the fumigant toxicity of 4 botanical oils on *Callosobrunchus maculatus* and attested to its ability to successfully control the pest. Their findings were confirmed by Ofuya and Longes/ (2009) report that the botanical composition efficiently controlled both field and stored insect pests. Results have also revealed that botanical composition reduced infestations of pest by more than 50%. It also increased the yield of crop

by more than 60% when compared to conventional control methods (Aduloju, 2000; Okuku, 2002; Folorunso, 2004).

Nevertheless, farmers are constrained in the use of botanical formulation due to some challenges associated with the formulation. The most critical being the problem of farmers' incapability to approximate in what ratio the ingredients contained in plant-based composition should be constituted. This was ascribed to the point that (a) the amount of parts of plant used in composing them varies (b) No regular standardized approach of preparation, (b) no standard preparation time prior to application, (c) No precise time of treatment and application of the botanical formulation, (d) use of same kind of prepared plant-based methods to be applied for the control of different kinds of pests, and (e) No standardised quantity or filed application rates for pest control in crops.

Opinions from field also showed that farmers rely mainly on guess work and sight-seeing to approximate the aggregate of material chosen and concentration level for a particular plant based pesticide composition. In several cases, accomplishment of a specific color has been regarded as indicator for attaining desired concentration (Ofuya and Longe, 2009). Unfortunately, the formulation of some plant-based materials will produce diverse effects on same crop at different times for the same farmer. This makes it difficult to rank the efficiency and effectiveness of a particular botanical composition. Consequently, boosting improved production of vegetable by enhancing production of safe food for consumption and sustaining the already fragile ecosystem require that, botanical formulations along with other non-chemical methods in management of pest need to be accurately documented, standardized and scientifically rationalized. This may encourage farmers to use it thereby reducing their dependence on chemical control methods.

2.6 Vegetable Production in Nigeria

Vegetables are crop belonging to the class of horticultural crops. Vegetables are vital crops capable of contributing to household income of many households in the rural areas. However, helping vegetable farmers to actively participate in the marketing and producing for markets is an important challenge affecting the production of vegetable in several African countries Nigeria inclusive (Heinemann, 2002; Bongiwe and Masklu, 2012).

Vegetables play important roles in eradicating hunger and ensuring food security. This is why they are very crucial part of the diet of several people. It adds to the quality and variety of menu, as well as add appreciably to the daily nutrient requirement of every household (Solanke and Awonorin, 2002).

Vegetables are rich sources of micronutrients, and they also supply little amount energy in diets. This makes it a valuable source of diets providing limited energy. The fibre contained in vegetable has been described to possess beneficial influence on the cholesterol level of human blood and supports in the prevention of large bowel diseases. Specifically in diabetic patients, vegetables can increase glucose tolerance. Vegetable can also be used for improving food variety, colour, flavour, aesthetic appeal and taste.

Vegetables are crucial dietary components. Both fruit and leafy vegetables have several years of recognition to be an important ingredient in the traditional pastes that go together with carbohydrate food (Francisca and Eyzaguirre, 2007). When compared with other food, prices of vegetables are fairly affordable (Schippers, 2000). The nutritional composition of vegetables may differ considerably, but altogether they contain few proportion of fat and protein, varying ration of vitamins like Vitamin B6, Vitamin A, Vitamin K and provitamins, carbohydrates,

dietary minerals. Vegetable are also rich in certain phytochemicals which have been reported to contain antiviral, antibacterial, antioxidant, anticarcinogenic and antifungal properties. Several vegetables have high fiber content necessary for excellent functioning of gastrointestinal organs. Vegetables can supply important micro-nutrient in diet of human which is needed for growing healthy skin and hair and serves as defensive agents against many ailments.

Vegetable farming is a source of employment and income generation. Production of vegetable can make tremendous impact in improvement to smallholder farmers' wellbeing and income as well as compensate for deficiencies in animal protein by combination of several vegetables in the diet. It improves livelihood and aids employment and diversification for small-holders farmers most especially in the dry season (Obuobie *et al.*, 2006). Considering the rapid population growth due to urbanization in Nigeria which has been reported to increase at five per cent yearly (NPC, 2006), there is therefore an increasing opportunities for expanding the market potentials of crop like vegetables thereby leading to an increase in the production of vegetables in large quantities, although the production is yet to received institutional support and proper attention when compared with cash crops and other food.

In Kwara state, there production of vegetables has increased. This is because the state is located in suitable zone favouring the cultivation of leafy vegetables such as water leaf (*Talinum triangulae*), Amaranthus (*Amaranthus* spp., Ugwu (*Telefaina occidentalis*), bitter leaf (*Veronia colorata*), Celosia (*Celosia argentea* L.) and lettuce (*Lactucasativa*). Also, fruit vegetables like okra (*corchorus* spp.) and tomato (*Lycopersicon esculentum*) are commonly cultivated.

The art of vegetable production: Growing vegetables is an old art. Joy (1980) pointed out that different kinds of vegetables are grown depending on the taste of the people and how well these vegetables are suited to the climatic and soil condition.

Production of vegetable in Nigeria is known to be cultivated with the use of crude implements, costly and complex technologies which farmers cannot afford, illiteracy, and non-availability of inputs (Mofeke *et al.*, 2003). Vegetables are a major part of the main daily diet taken in many homes which is either eaten boiled or some could be eaten fresh. They are essential constituent of several local delicacies and cuisines enjoyed in Nigeria. Vegetables include melon, African spinach, lettuce, cabbage, okra, water leaf, *Cocorus olitorus* (Ewedu), *Telfera* (Ugu), *Amarantus* spp (Tete and Shoko), fluted pumpkin, and host of others. Vegetable grown by farmers in Nigeria are of different species and are often intercropped with other staple food crops, employing indigenous farming approaches (Denton *et al.*, 2000).

Vegetables can be eaten alone or as part of food. The cultivation is majorly for production of leaves. Vegetable leaves can add to a balanced diet most especially among the rural dwellers where they have limited access to animal protein. Nigeria alone produces over 3.8million tones of different types of vegetables annually, which is short of the requirement compared to other developed countries. Hence, the need for increase and improve production of vegetable.

The addition of vegetable in ever day diet is reported to have strong association with reduced risk of many forms of illnesses such as stroke, heart diseases, and cancer. Some constituents of vegetables are strong antioxidants which function in modifying the metabolic disposition and activation of carcinogens and also affect processes that influence the danger of tumor cells. Taking into consideration benefits of vegetables, the Nigerian government at all levels are making effort to increase its production.

Cultivation of vegetable in commercial scale can be a means to improve the nutritional value of food consumed by households. Vegetable production is the solution to reduce malnutrition and hunger in Nigeria. In the country, several children have suffered deficiency in vitamin A and other nutritional problem that can be checked by frequently eating leafy vegetables and fruits Georges (2011). A very important opinion is that vegetable production in large quantity should be encouraged and intensified ultimately in the dry season most especially in the months of November to March. Within this period, the market prices of vegetable produce increase considerably, yielding maximum returns on investment.

Classification of Vegetables in Nigeria: In Nigeria vegetables can be classified depending on part of vegetable consumed, botanical/taxonomy, growth habit, area of production, and maturity time, frequency of cultivation, and harvesting pattern.

Category by part consumed: Most part consumed may include the succulent young shoots and leaves of leafy vegetables. Examples include lettuce, jews mallow, amaranthus, pumpkin, water leaf, cabbage, fluted pumpkin, celosia, and bitter leaf. Fruit vegetables consist of immature young and unripe fruits and mature ripped fruits of plants cultivated as vegetables. Examples include eggplant, cucumber, pumpkin, water melon, okra, tomato, chilli pepper, garden egg and sweet pepper.

Furthermore, seed vegetables are vital for production of seed. A good example is melon. While root vegetables include irish potato, radish, sweet potato and carrot. Spices are good for their colour and flavor in foods such as basil, onion, garlic and chilli pepper. Depending on the situation weather variation in the area where cultivation is taking place, wet season vegetables include radish, cabbage, garlic, lettuce, onion, carrot, spinach and potato. Warm weather season

vegetables include eggplant, pepper, tomato, garden egg, pumpkin, melon, okra, sweet potato and cucumber.

Botanical and Taxonomic Classification: A well accepted ways of classifying vegetables are based on genera, species and family.

Table 2.3: Botanical or Taxonomic Classification of vegetables

Family	Botanical Name	Common Names
Amaranthaceae	<i>Celosia argentea</i> , <i>Amaranthus dubius</i> ,	Amarath Celosia
Cucurbitaceae	<i>Cucumis sativus</i> , <i>Cucurbita maxima</i> ,	Pumpkin, Cucumber
Malvaceae	<i>Abelmoschus esculentus</i> (L.) Moench	Okra
Solanaceae	<i>Solanum melongera</i> L., <i>Solanum tuberosum</i> ,	Irish potato, Eggplant
Tiliaceae	<i>Corchorus olitorius</i>	Jews mallow (ewedu)
Compositae	<i>Lactuca sativa</i> , <i>Vernonia calorata</i> ,	Bitter leaf, Lettuce
Cruciferae	<i>Raphanus sativus</i> , <i>Brassica oleraceae</i>	Cabbage, Radish
Portulacaceae	<i>Talinum triangulare</i>	Water leaf
Basellaceae	<i>Basella rubra</i>	Indian spinach

Source: Major, 2017

As for regularity of cultivation, frequently cultivated vegetable include pepper, amaranthus, egg-plant, melon, Okra, Tomato, onion, and celosia. Occasional and wild vegetables also include *Celosia triguna* (Ajefawo), *Crassocephallum biafrae* - Bologi, *Basella Rubra* (White) – Indian spinach, *Basella alba* (Red), mushroom (*Agaricus* spp) and *C. crepidoidis* – (Ebolo).

Classification by growth habit, harvesting pattern and maturity time: Vegetables have few days of growing period. Harvesting could be done 2-3 times by removing top or young leaf. This group comprise of leafy vegetables like *Celosia argentea* and *Amaranthus* spp. Some vegetables can be harvested few weeks or months. Example includes *Solanum* spp, Okra, Cucurbits, *Capsicum* spp, *Corchorus* spp and Tomato. Class of vegetables with climbing growth habits are vegetables capable of climbing a stake or house walls. Examples are basella spp, melon, fluted pumpkin, and snake gourd. Examples of vegetables having creeping stems are cucumber, water melon and melon.

Types of vegetable in Nigeria: Both indigenous and exotic-type vegetables are found in Nigeria. Indigenous African vegetables include vegetables that can tolerate hot and humid of the tropics. They are used to the hot weather and lot of rainfalls in the tropics. In some tropical Africa where root crops producing starch are their main staple food, vegetables are commonly consumed as additions to the carbohydrates producing foods. Vegetable is a cheap source of minerals, protein and vitamin. The wild and local vegetables are normally cultivated and intercropped as minor crops. Indigenous vegetables are more noticeable in backyard small farms. They are normally grown with the use of domestic organic waste and manure and they hardly use inorganic fertilizers on them. Women are the major grower, processing and marketing of the indigenous vegetables. Production/cultivation requires little capital/cash and relatively small plot of land area. Furthermore, a noticeable return can be gained over time.

Exotic-types of vegetable on the other hand can grow in an area with cool weather climate region. These vegetable in Nigeria are cultivated in high altitude region such as tropical uplands and Sahel of Adamawa and Plateau states. They are commonly consumed in the urban areas.

Examples of the exotic vegetables are cabbage, beet, carrot, lettuce, irish potato, radish, etc.

Intercropping the exotic vegetables with other crop is not common for the reasons below:

- (a) There is poor consumer demand for exotic vegetables.
- (b) Production of exotic vegetables demands special ways which are hard and costly.
- (c) The exotic vegetables are poor storage under and seed formation in warm weather tropical conditions.
- (d) They have unfamiliar cooking texture, taste and particular cooking procedures which are strange and therefore not acceptable in most households in tropical Africa.

There are severe principles essential in the cultivation of vegetable crops which are very vital and well-known to vegetable growers. Vegetables production does not require a long time span as compared to mango, orchard of citrus and cashew. Also, vegetable farmers are not usually compelled to produce the same vegetable crop each year like his counterparts, who grow fruit crops. Vegetable farming lacks the steadiness which is systematically developed over some period of time as compared to orchards. Thus, attaining production of vegetable is a quick process.

Vegetables can be cultivated by farmers with few years of experience. Only trained farmers can sustain vegetable production in abundance, the land for cultivation of vegetable production can be adjustable and flexible. It is also very easy for vegetable farmers to change vegetable production from one vegetable to another than for fruit growers. Cooperative organizations and strength are to some extent harder with farmers growing vegetable when compare to fruit growers. Farmer growing vegetable have short period for creating plans because vegetable

cultivation is seasonal with the exception of dry season vegetable farming. This is normally supported with irrigation and it needs more concentrated management of production per time of unit area.

Vegetable production practices: There are several practices in the cultivation of vegetable most of which were influenced by fast political institution, socioeconomic, and urbanization situations.

These practices are emphasized below:

- i. Gardening at home: The primary sources of fresh indigenous vegetable supplies for majority of homes. It supplies a vital part of the family basic food needs and extra income.
- ii. Gardening market: This can be used to supply the market and family needs. This kind of production goes further than family taste and needs. It hinge on demand of market in urban area.
- iii. Producing commercially: The source is the primary production for plenty vegetables for market purpose. This production is greatly for specialized and extensive market. Edaphic and climatic factors are the main factors of production.
- iv. Production purposely for Processing: Here is the main source of production of fresh vegetable for the service of processing industries. The extent of production could be as large as commercial production.
- v. Vegetable forcing of production: This kind of practices of production of vegetables is normally out of regular vegetable production season. This kind of production could be

done by adjusting the production environment like protection from cold and provision of heat.

vi. Environmentally controlled agriculture: This practice of adjusting the natural environment for maximum plant development and production of growth factors such as temperature, light, water, relative humidity and air.

vii. Production of vegetable seed: This agricultural practice that is particular production for the supply of industry. The seed production practice is solely for seed production and never for fresh vegetables.

2.7 Effect of Pesticides on Health

Incidence of pesticide poisoning is the leading problems of health among several developing countries. Pesticide poisoning had resulted to additional deaths far beyond infectious diseases (Xue *et al.*, 1987; Jeyaratnam, 1990). Poisoning as a result of pesticide in specialized occupational workers and even farmers in growing countries is shocking (McCauley *et al.*, 2006). WHO projected that about 20,000 workers were poisoned of exposure to pesticide yearly in most of the developing nations (Pimentel 2005; Kishi 2005). The estimated figure of intoxications with pesticide containing organophosphates is approximately 3000,000 yearly. The number of casualties and deaths is about 300,000 yearly (WHO, 1992; Larson, 2003). Subject to the kind of toxicity of the pesticide, length of exposure to the pesticide and dosage, the negative effects of poisoning from pesticides include skin irritation, neurological disorders, respiratory problems, vomiting, and headaches (Jors *et al.*, 2006).

Studies have reported the occurrence of biological markers of pesticide in children and adults in farming communities (Perera *et al.*, 2006; USEPA, 2006; Rauh *et al.*, 2006; Arcury *et al.*, 2007;

Lu *et al.*, 2008). Similarly, Fabre *et al.* (2005) reported that isomers HCH were gotten from animal and human tissues indicating the perseverance of such compounds. Another study reported that clinical features such as depression, irritability, erectile disorders, anxiety and psychotic symptoms were significant among applicators of pesticides (Amir *et al.*, 1997). Severe low-dose contact to pesticides is known to be associated with neuropsychiatric manifestations among workers of tobacco agricultural (Salvi *et al.*, 2003).

Also, an assessment of Hexachlorocyclohexane isomers of the blood collected from retailers of agrochemicals in Taraba state, Nigeria revealed that 90% of the study population had residues of HCH – isomers lindane, grouped in WHO Class II as moderately hazardous in their blood (Hotton *et al.*, 2010). The study further revealed that the blood of the female retailers who constituted 36% of the respondents were analysed and found to have residues of HCH–isomers in their system. Storage of toxins in fat is known to be a problem of bigger concern in females. This is because percentage of body fat in female is high and changes of hormone occurs during lactation, menopause and pregnancy which could result in activating internal deposit of pollutants several years even after exposure (Falcon *et al.*, 2013). Furthermore, Torres *et al.*, (2007) called that new-borns can be exposed to pesticide via breast feeding or placenta transmission.

Epidemiological findings have connected pesticides as causal agent of human cancer (Zahm and Blair 1992). This is buttressed by Gertrudis *et al.* (2001) who opined that even death and cancer have increased frequency among farmers when compare to the general public. Cytogenetic studies have showed an escalation in DNA impairment and developed chromosomal aberrations (CAs) of unprotected farmers when compared to protected farmers (Naravaneni, 2007). The growing risk of lung cancer has been found among workers in agriculture in Germany, the risk is

observed to increase in magnitude as exposure time increases. (Barthel, 1981). A summary of reported effect of pesticides on health is shown in the Table 2.3

Table 2.3: Health effect of commonly used pesticides in Nigerian Agriculture

Pesticides	Application	Health effects
1. Aldicarb	Systemic insecticide. It is active for the control of nematodes, aphids, flea white flies, thrips, etc	Inhibitor of cholinesterase
2. Aldrin	This is effective to control termites and wire worm.	Amplified the metabolism of D-glutaric acid.
3. Paraquat	Plant desiccant that is effective for the control of grasses	Cellular proliferation and, chronic fibrotic changes, Fetal intoxication, dermatitis contact of the lung
4. Captafol	It can serves as an extensive spectrum foliage on soil fungicide and protective	Contact dermatitis
Pesticides	Application	Health effects
5. 2-4-D	This is selective method after the emergence of herbicide used in the control of several yearly wideleaf weeds	Contact dermatitis
6. Mancozeb	This is protective fungicide. It is an effective control of broad range of disease of the foliage	Contact dermatitis
7. Benomyl	Fungicides used as an eradicator	Act as skin sensitization, rash contact dermatitis and allergic reaction
8. Pentachloronitro benzene	Molluscicides	Teratogenicity or fetal toxicity
9. Lindane	This is used to control biting and sucking insects	Rash, allergic reaction and Skin sensitization, Enzyme induction and contact dermatitis
10. Malathion	Wide range insecticides used against aphids, red spider, thrips and leafhoppers.	Skin sensitization, allergic reaction and rash
11. Ethylene dibromide	Fumigant nematocide	Mutagenic
12. Dieldrin	Used against ectoparasite, moths, beetle.	Increase D-glutaric acid metabolism
13. Folpet	Protective fungicide	Teratogenicity or fetal toxicity
15. Captan	It is foliage fungicide with protective action	Teratogenicity or fetal toxicity

16. Carbaryl	This is a fruit thinner and contact insecticide having a wide spectrum of activity active against several pests affecting fruit.	Teratogenicity or fetal toxicity
17. Pyrethroids	Insecticide	Peripheral neuritis
18. Metachlor	Selective pre-emergence herbicide	Decrease in kidney weight
19. Carbofuran	Broad insecticide	Cholinesterase inhibitor
20. Heptachlor and heptachlor epoxide	Broad-spectrum insecticide	Kidney tumour
21. Methyl-parathion	Acaricide and non-systemic insecticide	Reduces cholinesterase actions, , anemia, sciatic nerve dymyelination
22. Methoxychlor	Broad-insectide	Carcinogenic promising in testes and liver
23. Molinate	Herbicide	Damage of reproductive performance

Source: Adapted from Erhunmwunse *et al.*, (2012)

Numerous findings have thoroughly examined the existence of pesticide residue in the blood of users and their health implications. Despite these findings, farmers still engage in unsafe pesticide use and practices. Farmers will continue unsafe use of pesticide if their perceptions about the threats of pesticide on their health are not corrected. Their incorrect perception about pesticide hazards may be due to the difficulty in linking many pesticide induced ailments to their sources. In many cases, pesticide induced ailments and or injuries never manifest immediately within 24 hours after contact with a pesticide. Negative effects may be late for several weeks, months or years after the first contact with a pesticide. The scenario is further worsened by the poor health care delivery in many rural areas. This may explain why farmers do not pay attention to safe pesticide handling and use.

Though in the recent years, farmers are now becoming highly aware of its damage effect on natural resources in the environment and other consequences. This has increased the awareness though not leading to a reasonable change in the handling the fragile ecosystem. Factors such as economic, psychological, social are influential in making decisions and improve the ability to

transform behaviour. Now that agricultural structures are fundamentally human-based systems, issues pertaining farmers' attitudes, behaviours and perceptions can do much to affect farmers' decisions and ability to modify their behaviour.

Agricultural workers are constantly at risk on the farm. These farming risks could be great principally for exposure in occupation (McCauley, 2006). Occupational exposure of pesticide can happen directly while mixing and application of pesticide and indirectly when doing the task of re-entry in farms treated with pesticide or by taking contaminated materials home. Exposure of pesticide can happen via the skin also known as dermal uptake, through the respiratory system or inhalation, or through the mouth or by ingestion and may lead to health defect such as skin damage, cardiovascular, gastro intestinal, ocular, endocrine disruption, respiratory defect, carcinogenic, developmental and neurological effects (Damalas and Eleftherohorinos, 2011; Ntzani *et al.*, 2013).

Among the distinctive symptoms of pesticide poisoning in humans which are relatively easily recognised or diagnose as severe poisoning of pesticide are body aches, fatigue, headaches, skin discomfort, skin rashes, poor concentration, feelings of weakness, circulatory problems, dizziness, nausea, impaired vision, tremors, vomiting, excessive sweating, panic attacks, coma, cramps, and even death (Alavanja, 2004).

Beside pesticides causing severe poisoning, it can further results to severe illnesses if it is assimilated for longer period of time even when the amount inhaled are fairly small. Symptoms are always not specific or may not manifest in a long time, which then results to chronic fatal effects. Workers in the farm are specifically at risk, although the general public can also be

affected, for instance due to consumer goods, contamination of food or pesticide pollution from sprayed fields.

Several pesticides that are normally used in the recent time have been grouped based on testing on animal as possibly or perhaps possible to induce cancers in humans. (PAN Germany (2011). Though, the results of numerous epidemiological finding are not consistent, research studies has ascertained that workers in the agricultural sectors are exposed to pesticides and have a substantial risk of being brought down with numerous chronic diseases. Current studies have showed a relationship between the use of pesticide and prostate cancer, sarcomas, pancreas, multiple myelomas, lungs, liver, the breasts, testicles, intestines, kidneys, brain tumors and ovaries (Alavanja, 2004; Chem Trust 2010; WHO, IARC, 2008).

Additionally, pesticides can harm the nervous system of humans. There are suggestions that there is an association between exposure of pesticide and decrease sensitive faculties, depression, disruptions in psychomotoric and cognitive functions. Several studies had shown that the risk of coming down with Parkinson's disease can advance by as great as factor seven in a condition there has been interaction with particular pesticides (Alavanja 2004; Hancock et al., 2008). Nowadays several organisations and experts like Berufsgenossenschaften (employee of occupational health payment boards) in Germany have confirmed that farmers that used certain pesticides consequently suffered from the deteriorating illness of nervous system later in life. (Smolka (2011). The interruption of neurological growth in children due to contact with several pesticides have not been given much attention though, laboratory studies showed that there can be relationship (Bjorling-Poulsen *et al.*, 2008). Amongst the highly occurring neurological disorders that can result from exposure of pesticide include attention deficits, learning deficits of children, retarded development or sensory deficits.

It has been known for many years that specific pesticides can disrupt the hormone system, but so far authorities have not determined exactly which pesticides have such effects. To date no agreement has been reached in the EU on how hormone disrupting pesticides should be identified and evaluated. Hormonal influence can be apparent at exceedingly low dosages that occasionally cannot be noticed at greater dose points. In a study, 37 pesticides selected from a group of 134 pesticides found as residue in food were tested for their effect on hormones. Out of the 37 pesticides, 23 were found to be anti-androgenic while seven others were grouped as androgenic. It was pre-empted that exposure of foetuses to these substances can result in malformations and growth disorders of the sexual organs (McKinley, 2008; Orton, 2011). Several later effects owing to pesticide use or even exposure to low doses of these these chemical have been linked with adverse influence on reproductive system and weakening of the immune system that can result to still birth, miscarriage, low birth weight and premature birth (PAN Germany (2011).

2.8 Perceived Health Status

Health status is a personal relative stage of illness and wellness which takes into account the existence of physiological and biological dysfunction, functional impairment and symptoms. Perceived health status is a personal rating of the affected person of his/her health status. It could be known as “Patient Reported Outcome” (PRO). This is a health outcome reported directly by the patient who suffered the illness. It represent in contrary to someone giving a report about another persons’ state of health such as nurse report or physicians’ report.

The perception of some people is that they have good health notwithstanding their suffering from one or more severe diseases. Other people sometimes perceived themselves as suffering from ill-health when there is no significant confirmation of disease seen. Assessment of self health status

gives a measure of the total level of a public health based on personal perceptions of his/her own health. Agreeing to the WHO, health is a condition of total mental, social and physical well-being, and merely not the non-presence of disease. Health is recognized as pertaining to social, spiritual, mental and physical components. Consequently, the dimension of health needs to go far from quantifying stages of mortality and morbidity. A wider approach to evaluating health is to inquire of people to judge the condition of their personal health. Assessment of self-health status is reliant on personal expectations and awareness pertaining to their health. Self-rated health status is determined by numerous factors which include access to health information and health services, the degree to which health status have been detected along with educational status (Delpierre *et al.*, 2009).

There are various tools used for measuring perceived health status or Patient Reported Outcome (PRO). Several of the public generic PRO apparatuses calculate health-linked value of life and patient appraisals of health-care. Example of the PRO survey tools are the Sickness Impact Profile (SIP), the Health Utilities Index, [SF-36 Health Survey](#), SF-12 Health Survey, the [Nottingham Health Profile](#), [Consumer Assessment of Healthcare Providers and Systems](#) (CAHPS), the EuroQol (EQ-5D) and the Quality of Well-Being Scale.

SF Health Surveys tools are the main extensively used instrument worldwide for calculating patient reported outcomes, over 32,000 authorized cases till date and over 41,000,000 surveys have been done. The SF-12Health Survey has several functions. The short form survey containing 12 questions were collected from the SF-36Health Survey (Ware et al. 1996). The queries are pooled, counted, and weighted to provide 2 scales which offer glimpses into physical and mental functioning and the general health-associated with excellence of life also known as the health related quality of life.

There are 8 constructs in the SF-12 tool includes Vitality (V), Physical Functioning (PF), Role Physical (RP), Mental Health (MH), Social Functioning (SF), General Health (GH), Role Emotional (RE), and Bodily Pain (BP). There are likert- type questions under each of the construct to be answered by an individual on his state of health based on his perception. Response to each questions are scored and recorded and aggregate score are recorded for individual scale. The raw score represent the simple algebraic aggregate of responses for all items in the scale as revealed in Table 2.4. For instant, the score of the raw scale of PF scale is the summation of the scores for items on (i) a and (i) b. For single-item scales, the raw score is simply the final item response value.

This modest scoring technique is possible simply because the items in same scale could have approximately equal relation to the fundamental health idea that is measured. Also, none of the item can be used in extra scale than one. Consequently, it is unnecessary to weigh or standardize items. These expectations have been widely verified and tested (McHorney, Kosinski and Ware, 1994). The aggregate scores are then transformed to a 0 to 100 scale employing the formula display in Table 2.4. The table gives the information needed to use this formula in each scale. This change converts the highest and lowest possible scores to 100 and 0 respectively. Scores amid these values denote the percentage of the aggregate possible score realized.

$$\text{Transformed scale} = \frac{(\text{Actual raw score} - \text{lowest possible raw score})}{\text{Possible raw score range}} \times 100$$

Table 2.4: Aggregated Scale Items and Range of Possible Scores

SF -12v2 Scale	Sum of Final Item Values (after recording items) A (actual raw score)	Lowest and highest possible raw scores B and C	Possible raw score range D= (C-B)
Physical Functioning (PF)	Items 1a+1b	2, 6	4
Role Physical (RP)	Items 2a+2b	2, 10	8
Bodily Pain (BP)	Item 3	1, 5	4
General Health (GH)	Item 4	1, 5	4
Vitality (VT)	Item 5	1, 5	4
Social Functioning (SF)	Item 6	1, 5	4
Role Emotional (RE)	Item 7a+7b	2, 10	8
Mental Health (ME)	Item 8a+8b	2, 10	8
		ΣB=12	ΣD=44

Source: Wares, (2002)

Health status is then calculated for each respondent as the summation of actual raw score minus summation of the lowest possible score divided by summation of the possible raw score multiplied by 100. i.e.: $\sum A - \sum B \div \sum D \times 100$

Result obtained is further grouped on the scale of 1 to 5. 5 = excellent, 4= very good, 3= good, 2= fair and 1= poor. Summary is shown in table 4.

Table 2.5: Final scoring for Health Status

Response	1-5 Scale	0-100 Scale
Excellent	5	81-100
Very good	4	61-80
Good	3	41-60
Fair	2	21-40
Poor	1	0-20

Source: Wares, (2002)

2.10 Empirical studies on healthy/safe practices during handling and application of agricultural pesticides

Body contact with agro-chemicals such as pesticides results to major farming occupation damages in the agricultural area (Regoeng, 2012). Hence, there is well-known recognition that

farm workers misuse pesticides and other agrochemicals in the cause of protecting their crops from invasion of pests, weeds and diseases. High occurrence of misuse of pesticide and extraordinary level of pesticides associated accidents and their linked consequences on the public's health is reasonably alarming (Abdullahi, 2008). This explains why the following authors recommended the appropriate use of pesticides.

- a. Idowu, (1996) recommended precautionary and safe use measures while using agro-chemical such as putting on protective clothing such as not eating, rubbers and boots gloves, wearing of apron, drinking and smoking while using agro-chemicals.
- b. Banjo et al., (2010) noted that appropriated pesticide handling practices and use of nose guards, overall and hand glove.
- c. Ogunjimi and Farinde (2012) study discouraged eating, drinking, and smoking during spraying agro-chemicals, spraying directed towards directions of air, entering farm site twenty-four hours after spraying agro-chemical to control unavoidable contamination. The study further encouraged washing and cleaning spraying equipment after spraying chemicals, wearing of protective clothes during application to prevent body exposure to chemical, washing of contaminated clothes immediately after spraying, bath immediately after spraying of chemical, Burying or burning of empty chemical containers after spraying and contaminated food during spraying should be buried.
- d. Tijani and Nurudeen (2012) further ascertained that training for farmers, proper use of personal protective device, shower after pesticide exposure, avoid drinking of water near pesticide treated areas, avoid application in windy and sunny weather, change clothing before and after pesticide exposure are appropriate and safe practices.

- e. Olowogbon, Fakayode, Jolaiya and Oke (2013) recommends Integrated pest management practices, Farmers are recommended to be trained on the use of material safety data sheet, there should be massive awareness on the health and safety implications of agrochemicals, massive sensitisation on the use of personal protective equipment should be encouraged, national agricultural policies should be designed in line with global best practices, farmers should be trained on proper mixing, sprayer calibration and application of agrochemicals, and sustainable agricultural practices such as conservation agriculture should be encouraged
- f. Issa, Atala, Akpoko and Sanni (2015) also found the following practices safe for health while applying pesticides. They include purchasing from reputable source, avoid using expired/banned chemicals, using the appropriate agrochemicals, original labels and checking that seals have not been broken, correct calibration of sprayer, using the right dosage, avoid purchase of chemicals too early in the farming season, regular repair and maintenance of spraying equipment, using the right equipment, following labeling instructions, avoid spraying against wind direction, wearing protective clothing, keeping herbicides separate from other types of pesticides, observation of the ahead of the period, avoid entering sprayed farm until 24 hours subsequent to spraying, avoid combination herbicide with fungicide, checking stored pesticides regularly for sign of damage or leakages, applying the agrochemical at the right time, do not store pesticides in homes, animal house, kitchen or toilets, avoid leaving pesticides in equipment overnight, avoid eating, drinking and smoking during spraying, proper handling and storage of agrochemical, proper disposal of empty container, do not use agro-chemical for various purpose e.g. keep away pesticides from place of drinking water, wells, & streams,

handling animal wound. The study further revealed that endorsed agrochemical practices like the use of proper calibration of tools, unaffected product, correct application method, safeguarding personal health and safety and safeguarding environmental have been badly used thus leading to agrochemical disappointment and hazards in the environment and health.

- g. Okafoagu, Oche and Lawal (2017) found that adoption of healthy/safe practices during handling and application of pesticides can be achieved by educating farmers on safe pesticide use and how to prevent such risks. .

2.11 Efforts to protect pesticide Users and the environment by Nigeria government (the Federal and State).

Availability of information at the Environment Protection Agency of the Federal government showed that the Federal Government of Nigeria (FGN) knows the harms in the use of pesticides. FGN has then put in place administrative and legal procedures purposed at monitoring and regulating pesticide use, manufacture, distribution, disposal and importation. The aim is to safeguard all users and environment from the negative effects of pesticides.

The Management guidelines of Pesticide: These guidelines were established to help general public, users, importers, formulators, transporters, marketers, and distributors to implement the philosophies of environmental sustainability approaches to the use of pesticides. Standards are provided under this guideline to guarantee that pesticide uses are well-suited with the general goals of bestowing a safe and clean environment among Nigerians.

The National Programme for Tracking Chemical: The main objective of this programme is to control and monitor chemicals that are hazardous which include pesticides. The programme is

aimed at serving as a check for controlling the importation, transport, sale, storage, and use/handling, distribution and disposal of hazardous chemicals with the aim of minimizing harms to the environment and human health. Together with this programme is the statement that all chemicals imported into Nigeria should go through laboratory analysis, sampling and other physical examinations to ensure its authenticity before it can be release for public use.

Standing Committee Controlling the Actions for Managing the National Chemicals: This committee was organised to provide guidance to government of the federation on pesticide importation issues. Before and after decisions are taken, the committee often take to consideration the worries of different stakeholders and the safety level of such chemicals in Nigeria. The committee is saddled with the duty of recommending appropriate importation of pesticides and other chemicals for the national control actions.

Obsolete Pesticide Stocks of the National Inventory: Ministry of Environment of the federation in conjunction with relevant agencies just completed a survey in the nation as regards outdated pesticide in stocks as the foremost step to control future store up of out-dated pesticides.

Reduction of Pollution in Industries and Regulations for Facilities Generation of Wastes in 1991: This regulation enforces limitations on the proclamation of toxic chemicals and specifies requirements to monitor pollution in order to ensure that allowable limits are not surpassed or exceeded.

The Programme Chemical Registration: This programme involves that entails that chemicals importers bringing in chemicals containing toxic substance in it, ozone depleting chemicals and agricultural chemicals must apply for import permit on yearly basis. The hazardous chemicals controlled by this programme are majorly for chemical used in large volumes in industries, farms, spill cleaning-up and other commercial purposes which normally results to wastes

discharged into the environment. Such discharge and application of this type of chemical often affects the quality of land, air and water thereby exposing animals, humans, microbes and plants to risk.

Training Programmes and Public Enlightenment: The Ministry of Environment and other regulatory bodies of the federation organize intermittent workshops training to coordinate activities and speed-up issues related to management of pesticide. The body also educate relevant bodies on the use of pesticide and handling practices for the purpose of protecting the health of general public and the environment via increased awareness of pesticide related risks and approaches for managing such chemical.

2.12 Capacity Building Needs Analysis

According to FAO Journal (1992), Training need happen in a situation where difference occur in “what is” and “what should be”. The variance can be terms as skill, knowledge or attitude gap that a trainee needs for effective performance in their job. These aspects of individual’s performance give the basis and reasons for some of the training associated problems faced by that individual.

Analysing needs helps to carefully determine the gap which can assists to plan training. Assessing needs gap will also lead in the formulating training objectives. It will further assists to identify relevant content needed for training. The word needs is associated with the process of simplifying some difficulties into its component sections. This idea is not new to the training environment. Need identification can be useful for the simplification and understanding of such component parts. Need can be identify for policy, a job, a development programme, a farming problem, manpower events, a fishing procedure or even activities can be identified.

Needs assessment is a process involving the breaking down of training challenges or a particular need into its basic sections such that training can be understood and identified. The process of need analysis can be grouped into four different phases. The phases are:

Job analysis (task identification)

Task analysis

Trainee skill estimation

Gap analysis

To determine frequency of performance of each task, the following indicators are needed; i. Seldom, ii. Occasionally, iii. Weekly or Monthly, iv. Daily or Weekly, v. Daily

To determine importance of each component, the following indicators are needed;

- i. Marginally important,
- ii. Moderately important, and
- iii. iii. Extremely Important

To estimate the training difficulty:

- i. Easy,
- ii. Moderately Difficult,
- iii. Very Difficult,
- iv. Extremely Difficult,

To rate each component with a scale

- i. Cannot complete any task,
- ii. can complete less than half the task,
- iii. can complete more than half but less than the total,
- iv. can complete the entire task but takes too long, and
- v. complete the task within time standard.

Job Analysis entails the division of a main work activity into its section parts.

Task Analysis entails the segmentation of a particular job task into their section part. Each of the elements (in this case vegetable cultivation) is further analyzed to identify its criticality and importance in terms of performance such job task.

The training needs of the vegetable farmers were determined through the gap analysis which involved listing the task in descending order according to their score (E) rating each component with a scale (F) and reviewing the proficiency rating; where low proficiency means the gap between what is desired and actual performance, hence training need. While high proficiency means training is not required for the task. A good training programme will provide skill, knowledge and expertise which are required for effective and outstanding performance leading to better quantity and quality of the output.

2.13 Theoretical Framework of the Study

2.13.1 Behavioural change theories

In recent years farmers are becoming highly knowledgeable about the harmful effects of pesticide misuse on resources in their environment and health. This situation has increased awareness but has not led to any significant change in their attitude and practices while handling pesticides. Several other factors (social, economic and psychological) seem to influence their decisions and their capacity to change their behaviour. Generally speaking, agricultural operations are essentially people driven hence issues related to the perception and behaviour of farmers can do much to influence their practices and attitude towards pesticide use.

Theory of Behavioural Change: This theory attempts to describe reasons behind changes in behaviours. The theories assume that behavioural, environmental and personal characteristics are

the main factors influencing people's behaviour. There are several behavioural change theories or models, each emphasis on several factors in making an attempt to explain the change behaviour of people. Some of the most prevalent theories of the behavioural theories are: Theory of Reasoned Action, Learning theories, Theory of Planned Behaviour, the Health Action Process Approach, Trans-theoretical Model and Social Cognitive Theory. These theories have a common element called self-effectiveness.

Self-efficacy or effectiveness is a person's idea of his/her own capability to do a task of demanded. This could be challenges like problem of adopting new method and rejecting the old methods, undergoing surgery or facing an exam. This impression of idea is centred upon factors such as success of the individual's prior task or in similar tasks, the personal physiological status, and external means of persuasion. Self-efficacy/effectiveness is assumed can be predicted of the extent of the effort an individual can expend in starting and maintaining a constant change in behaviour. Even though self-efficacy/effectiveness is not really a behavioural change theory, it is seen as a vital element of several of the behavioural theories which include the theory of Planned Behaviour, the Health Action Process Approach and Health Belief Model.

2.13.2 Learning theories / behaviour analytic theories of change

This theory was developed by a behaviourist called B. F. Skinner. It state that difficult behaviour is learned progressively through the adjustment of modest behaviours. Reinforcement and imitation play vital functions in learning theories. The theory states that individuals can learn by repeating behaviour they notice in their fellow. The rewards are important to ensure the repetition of the needed behaviour. Simple behaviour is recognised by subsequent reinforcement, imitation and complex behaviour development. When a behaviour is communicated, the entity can further learn by rule-governing behaviour.

Going by the learning theory, farmers will change from their present attitude and practices of pesticide misuse and comply with Best Management Practices (BMP) of healthy/safe handling of pesticide if there are models they can imitate. This may be in the form of practical oriented trainings and demonstrations with observable positive outcomes. Such positive outcomes will encourage farmers to initially make an attempt to imitate the BMP process and subsequently, observe healthy/safe practices during pesticide use. This decision will be reinforced and maintained when farmers starts to see positive desirable outcomes. This model is limited because it sees learning as purely behavioural but in the real sense, learning process is a bringing together of factors as opined by the social cognitive theory.

2.13.3 Social learning / social cognitive theory

Social learning theory holds that learning is a process of cognition that takes place in a social context and can occur purely via direct instruction or observation, even without reproduction or direct reinforcement. Furthermore to the opinion of behaviour, learning also occurs via the observation of punishments and rewards. This process is known as second-hand reinforcement. The theory expands on local behavioural theories (in which behaviour is governed only via reinforcements), by putting emphasis on the essence functions of various inner processes in the learning of individual.

Theory of social learning combined cognitive and behavioural theories of learning so as to give a robust model that can provide for the broad range of experiences in learning that happens in the original world. As previously listed by Bandura and Walters (1963) and was additionally explained in 1977, the main tenets of the theory of social learning are that: Learning is not only behavioural; but it is a process of cognitive which can take place in a social environment.

The theory Social Learning dwells strongly on the idea of modelling and learning behaviour through observation. Therefore, Bandura listed three kinds of stimuli of model:

1. Live model as a situation where the real person is performing the wanted behaviour
2. Verbal instruction as a condition where the individual narrates detail of the desired behaviour and also teach other members the way to employ the behaviour
3. Symbolic is a modelling that occur via media such as radio, movies, literature, Internet and television. Stimuli can be fictional or real characters. Precisely the type of information which is passed from thought is often influenced by the kind of model and sequences of behavioural and cognitive processes. This include:
 - a. Attention: Here, for learning process to take place, participants must observe the modelled behaviour. Attention is influenced by characteristics of the participants. Examples include cognitive abilities, past performance, perceptual abilities and arousal. Characteristics/features of the behaviour (e.g., functional value, affective valence, relevance and novelty).
 - b. Retention: For reproduction of an observed behaviour to take place, such observers need to be able to recollect features of the behaviour. Also, this process is affected by participant characteristics (cognitive rehearsal, cognitive capabilities) and event characteristics (complication).
 - c. Reproduction: in order to reproduce behaviour, observer needs to bring together responses in agreement with the model. Observer features influencing reproduction are cognitive and physical capabilities and experience in performing similar task.

- d. Motivation: The choice to reproduce or to desist from reproducing an observed behaviour is reliant on the expectations and motivations of the observers which include internal standards and anticipated consequences.

A significant factor in the theory of social learning is the idea of reciprocal determinism. This concept posits that as environment becomes main factor influencing an individual, so also the environment can be affected by behaviour of the individual. In other words, an individual's behaviour, personal qualities and the environment all reciprocally affect each other. According to the social learning theory, behavioural change is influenced by personal, environmental, and behavioural elements. Each factor influences one another. For instance, in congruence with the principles of self-efficacy/effectiveness, an individual's opinions affect his/her behaviour and a person's character produces certain effects on his/her social environment. So also, an individual's environment can influence the growth of personal behaviour and features. Individual's behaviour may change their environment and the manner that individual feels or thinks. Social learning theory dwells on the reciprocal relationship between these factors, which are assumed to affect behavioural change.

2.13.4 Theory of Reasoned Action

Theory of Reasoned Action undertakes that individuals give importance to the consequence of a particular behaviour prior to the performance of that particular behaviour. Consequently, intention is a vital factor in assessing behavioural change and behaviour. Icek Ajzen aims started from the perception of individual behaviour as negative or positive altogether with the each person's impression of the approach the society accepted that same behaviour. Thus, social

pressure shape of intention and personal attitude are the essential for effective performance of a behavioural change and subsequently behaviour in general.

According to this theory, the intention of vegetable farmers is to control pests on their vegetable farms using the most effective control methods known to them. However, their choice of control methods sometimes has detrimental effects on man and the environment, but because farmers do not perceive their actions as detrimental to their health and environment, they tend to continue these harmful practices.

Unless farmers are fully aware of the consequences of non-observance of BMP during pesticide use, it may be difficult for them to stop their negative practices. Farmers perceive chemical control as the most effective method of pest control; hence they will continue to use it unless they are enlightened about the adverse consequences of agro-chemical control on the environment and health of users and approaches to reduce such negative effects.

As their perception changes due to enlightenment and practical demonstration of the consequences of their harmful practices, there will be a corresponding change in their attitude and practices as regards pest control.

However, it is vital to observe that even though the theory of reasoned action predicts that behaviours are affected by intentions only, several other literatures had suggested that attitude and actions taken in the past could have direct effect on behaviour in the future (Bargh, 1997; Bentler and Speckart, 1979; Fazio, 1986). Following this opinion, one's present behaviour may be usual which is capable to trigger automatic stimuli of the environment. Such influences are assumed to be the leading factor for correlation between future actions and past behaviour, then

that is when the contexts are steady enough to performance as conditional stimuli (Ouellette and Wood, 1998). In another perspective, as argued by Bargh (1997), the main problems of the reasoned action theory are the points that behaviour may not be intentional in which instance attitudes could prompt behavioural change even in the absence of rational consideration of intention.

2.13.5 Theory of Planned Behaviour

The theory of reasoned action was long-drawn-out by Ajzen in 1985, Ajzen formulated the Theory of Planned Behaviour which further emphasizes the function of intention in the performance of behaviour but it goes beyond to cover situation in which an individual has no power to regulate all the factors influencing the real performance of behaviour. Thus, the current theory states that the occurrence of real behaviour performance is relative to the amount of control a person has over the behaviour and the determination that persons plan to execute the behaviour. He also hypothesized that self- effectiveness and efficacy is critical to determine the ability of the person to execute the behaviour. That is, Actual behaviour = Control over behaviour + Intention.

This implies that farmers' decision to practice safe pest control methods is not only governed by their intention but may also be influenced by certain factors beyond their control. Examples are literacy and numeracy limitation, lack of access to protective gears, etc. Farmer's perception of the level of control they have over a particular behaviour is an important factor worthy of consideration. Hence, Fishbein and Ajzen (2010) presented the Reasoned Action Strategy and Theory of Planned Behaviour's successor was further included. Although the theory of reasoned action normally provides an outstanding account of preference behaviours, (Ajzen and Driver,

1991; Ajzen and Madden, 1986) Ajzen further stated that the variable of perception for behavioural control is an effort to assume behaviours and intentions that are incompletely under optional control. Perception on behavioural control implies ones' perceived way of controlling his/her behaviour and is predicted to affect the problems encountered in the past performances of such behaviour.

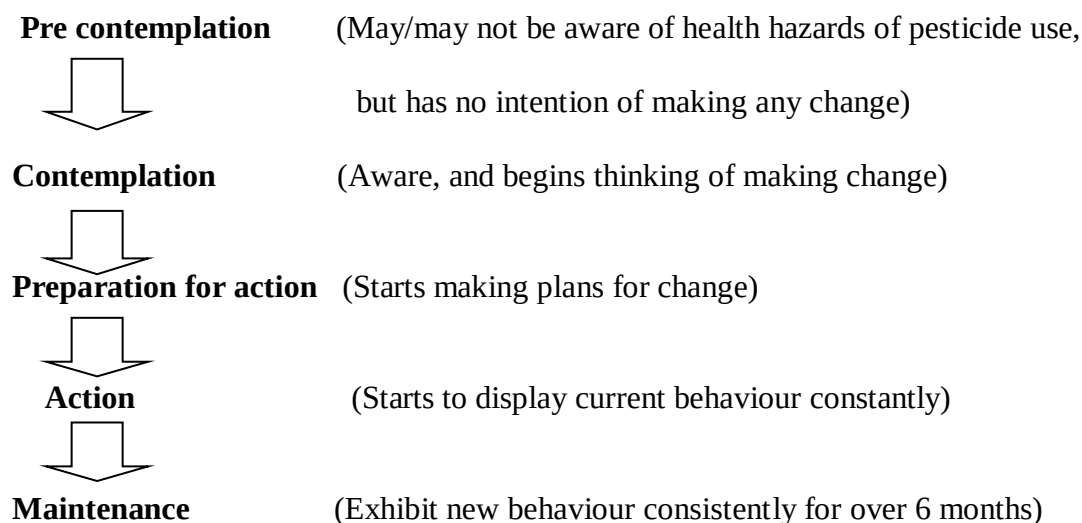
With the addition of this fresh factor, Ajzen's theory of planned behaviour suggests that perceived behavioural control can directly affects behaviour. Hence, $B = I + PBC$, (1) where B represent the behaviour, I represent intention, and PBC could be known as perceived behavioural control. To add more impacting factors to behavioural assumption, control of perceived behavioural is predicted to affect a person's ideas to follow healthy and safe practices during pesticide use. This implies that people with greater perception on control are far likely to create intentions to do a specific action than others who perceived to have little or no control. Generally, perceived behavioural control is taken as a combination of perceptions that (1) a person can/cannot do the behaviour if the person desire to perform, (2) executing the behaviour is not determined by the person's capability, and (3) acting the behaviour is not difficult (Ajzen and Madden, 1986).

Though scholars have hypothesized the essence of behavioural control based on perception in this environment. Chan (1994) the relationship between this variables and real behaviour has occasionally been unsatisfactory. For instance, Eagly and Chaiken (1993) asked whether simply having control over behaviour can determine behaviour. According to their outcome, control should solely be applicable when people desired to execute the behaviour that was asked. Another query raised was about the behavioural control based on perception for construct is relative to previous behaviour. Given that previous behaviours are resulting for future behaviours

(Ouellette and Wood, 1998). It has also been proposed that perception of behavioural control always impacts behaviours and intentions because perceived control are often based on one's experience of behaviour and or because people endeavour to give the impression of consistent in their findings. To this magnitude, proof of backing for the addition of perceived control needs to be presented in relation to previous behavioural performances.

2.13.6 Trans-theoretical / Stages of Change Model

Going by the Trans-theoretical Model, the theory can also be called Stages of Change Model, behavioural change is a 5-step process. Within the 5-stages, each person may hesitate before accomplishing a total change, maintenance, preparation for action, contemplation, pre contemplation and action. At the pre-contemplation stage, an individual may or may not be aware of a problem but has no thought of moving their behaviour. From pre-contemplation to contemplation, the person starts thinking about varying a particular behaviour. While preparing, the individual starts his/her planning for change, and during the action stage the individual begins to exhibit new behaviour steadily. A person is believed to attain the final point which is the maintenance stage when they display the current behaviour steadily for over 6 months



2.13.7 Health Action Process Approach

The design of strategy for “The Health Action Process” is in order of 2 nonstop phases of personal regulatory processes, goal-pursuit or volition and goal-setting or motivation. The next phase is sub-grouped into an action phase and pre-action phase. Risk perceptions, outcome-expectancies and motivational self-efficacy are predicted to be determinants of intentions. This can be called motivational phase in the model. The assumption is that the motivational self-efficacy can predict to certain extent the behaviour which is expected to be influenced by retrieval self-efficacy, and the outcomes of intentions are expected to be influenced by planning. Volitional phase is known to be the latter processes of the model.

Theories of behavioural change are not generally recognised. Criticisms to this model include the theories' details on personal behaviour and a general neglect for the effect of environmental factors on behaviour. Furthermore, as some theories were designed as directing the understanding of behaviour while others were formulated as concept for behavioural interferences, the theories' objectives are not dependable. Such critics displayed the weaknesses and strengths of the theories, indicating that there need for further research in the area of behavioural change.

2.13.8 The Health Belief Model (HBM)

The HBM is known as psychological model that tries to describe and envisage health behaviours by concentrating on the beliefs and attitudes of an individual. The HBM was formulated in the 1950s by four social psychologists named Rosenstock, Hochbaum, Kegeles, and Leventhal. The theory is related to behaviours that are subjected to each persons' control. The model was first conceived to forecast health behaviours that are preventive but with future adaptations (Becker,

1974; Becker and Maiman, 1975) it has also been used to determine the behaviour of an individuals with severe illnesses.

The Health Belief Model is broadly based on the psychological parts of peoples' behaviours when faced with several behavioural conditions based on perceptions and attitudes towards these situations. The probability of someone implementing a particular health action is known to be influenced by his/her perceptions about his/her vulnerability to an illness and the perceived intensity of its penalties. Taken all together these are stated to contained the perceived harm or threat and risk of the illness which gives the energy and force to perform the required action. The behavioural consequences, on the other hand, is affected by an assessment of the needed action as regarding its effectiveness in minimizing the threat (perceived benefits) considered against the perceived expenditures or cost and/or hindrance or barrier to executing the behaviour. The model undertakes that of highly value and concern is health. Also, the model proposes that behaviour is activated by 'cues to action' which enables each person to be aware of things that constitutes danger to health. Such inducements may be from a persons' internal signs or could be prompted from external entities such as providers of health care, family members, media or extension agents. Antonovsky and Kats (1970) had noted that the addition of the concept of cues or warning signals in the theoretical model is not necessary because each person's effectively makes his/her own cues. In other term, the appearance of symptoms, the rapid awareness of facts and health threats reminders will influence beliefs of severity and susceptibility. Hence, it is not the sign that directly stimulates one to take action on health but the belief. Likewise, various demographic (race, sex, age, etc.), socio-psychological (reference group, social class, peer personality, etc.) and organizational factors (knowledge of previous experience and disorder) are expected to be important to shape health behaviour, although, such factors could influence

behaviour indirectly by altering another component of the model. The main sections of the model are perceived barriers, perceived benefits, perceived susceptibility, and perceived severity. The other "modifying factors", "health value" and "cues to action" are factors that explained antecedents to the main components.

Agreeing to this model, people act based on their perceptions, and on the evidence that they are possibly susceptible to many new circumstances which could have severe penalties as well. Based on this concept, the use of preventive scale can function as active protections contrary to such challenges. It is under a condition that the perceived benefits is connected with protection against current harms and is considered to be of greater benefit than the costs connected with succeeding measures to alleviate the already prevailing problems and encounters, there will be an equivalent change in behaviour. The 4 main sections of the health belief model in a straight line affects the probability of using preventive practices by creating a sufficient understanding of the hazards associated with numerous types of harmful practices and their consequences.

Although HBM has proven to be a very useful tool in predicting health behaviours and outcomes, it has not provided a societal view of health behaviour. The concept of *self-efficacy* is the current addition to the HBM and another is self-confidence in the capability to successfully carry out an action. This concept was included by Rosenstock (1988) to assist the HBM to better enhance fit the obstruction to changing usual behaviours unhealthy behaviours.

Core Assumptions of the Health Belief Model as it relates to pesticide use/misuse.

The HBM is founded on the knowledge that a vegetable farmer will make a health-linked action (i.e., comply with BMP in order to avoid misuse/over use of pesticide) if he/she:

- i. assumed that an adverse health situation (i.e., pesticide –induced illness) can be escaped,

- ii. have a favourable expectation that by following a suggested action, he/she will escape the unfavourable health condition (i.e., compliance with BMP will be efficient for preventing and reducing pesticide-induced illnesses), and
- iii. assumes that he/she can productively follow a suggested health action. This implies that the individual can comply with BMP when using pesticide or otherwise use eco-friendly alternatives with confidence).

Scope and Application of theoretical model

The Health Belief Model has been useful in a wide-range of health behaviours. Three comprehensive areas can be listed (Conner and Norman, 1996) namely (i) health behaviours for prevention. This include health-supporting and health-risk behaviours, (ii) Sick function behaviours, which implies a compliance with endorsed medical procedures, normally following expert diagnosis of illness, (iii) Clinical use to includes doctor visits for a range of reasons. Hence, this study will focus on the Preventive health behaviours, which include health-promoting and health-risk behaviours.

2.14 Conceptual framework of the study (Perceived effect of the use of pesticide on health status of vegetable farmers)

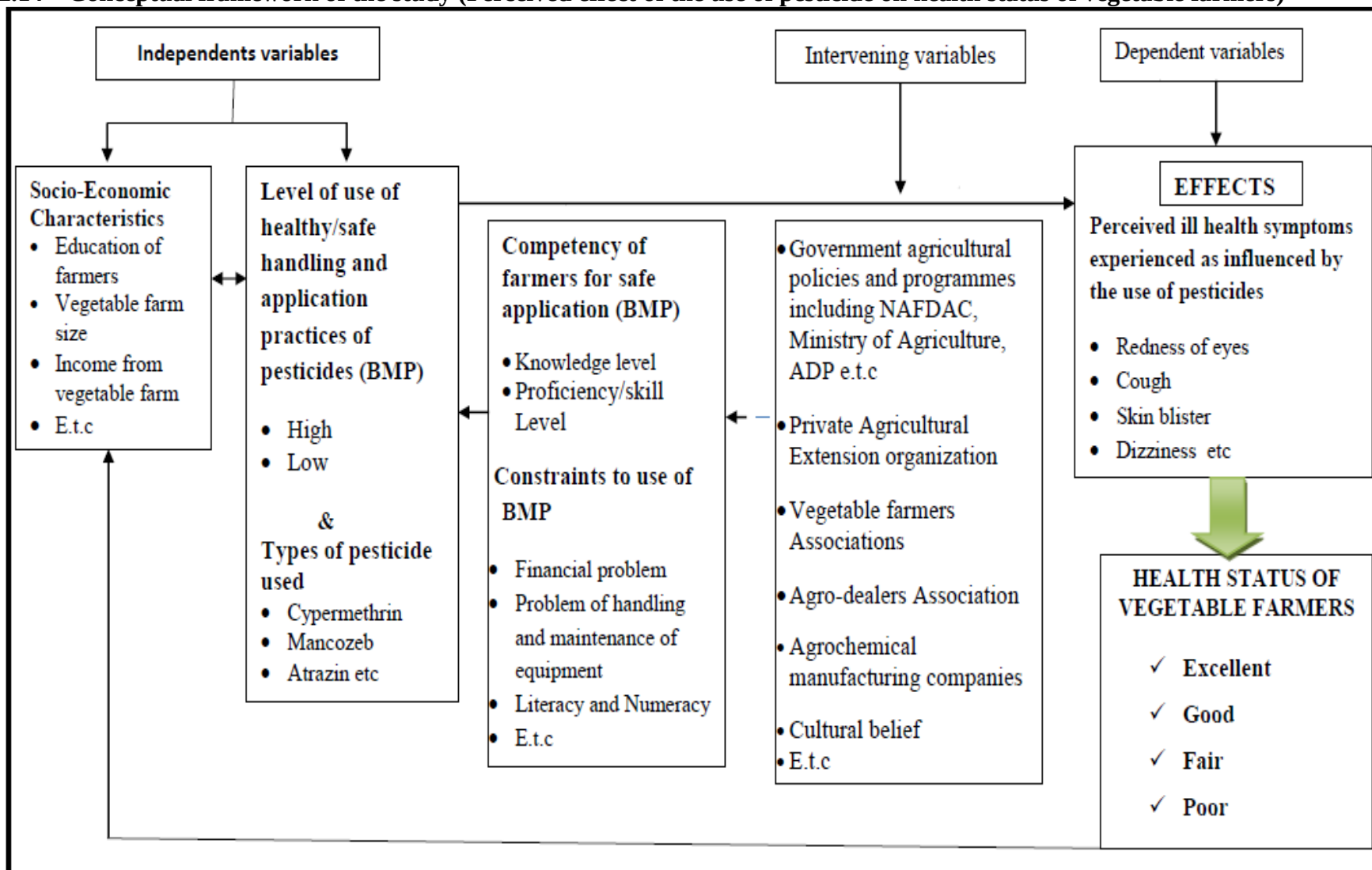


Fig 2: Conceptual framework showing relationship between Pesticide Use Practices and Health Status of vegetable farmers
Source: Authors' Conceptual Framework

Explanation of the Conceptual Framework

This conceptual framework is the figurative explanation of the dimension of analysis in the study. It describes how the use of pesticides can predict health condition of vegetable farmers in Kwara State. This study is premixed on the model of health belief. The model is based on the concept of attitudinal and behavioural change as a result of perceived threat to health.

The framework of this study is founded on the concept that vegetable farmers are being affected directly or indirectly by certain factors which have been classified as independent, intervening and dependents variables.

Independent Variables: The socio-economic feature of the vegetable farmers, usage level of safe practices for pesticide handling and application, the types of pesticides used, the capacity building identification of farmers on pesticide safe practices for handling and application and the constraints to use of safe practices for pesticide handling and application are grouped as independents variables because they are factors to predict health status of vegetable farmers.

Intervening variables: These variables were classified as intervening because they are conceived to have direct impact on capacity building of vegetable farmers and such impacts are expected to improve vegetable farmers' knowledge, proficiency, and minimize the constraints to usage of safe practices for pesticide handling and application among vegetable farmers. This explains the arrow pointing from intervening variables to capacity building and constraints in Figure 2.

Another arrow pointed from competence and knowledge level of farmers to the types of pesticide used. The assumption here was that trained and informed vegetable farmers

will purchase the recommended less toxic pesticides, handle it and apply it following the recommended safe practices that will have little or no negative effect on his/her health.

Dependents variable: This is conceived as the outcome or effect of the kinds of pesticides used and the level of use of recommended safe practices by vegetable farmers. It explains how the usage level of safe practices for pesticides handling and application affects the perceived ill-health experienced by farmers. This implies that safe or unsafe use of pesticide can predict the extent of ill-health that can be experienced by vegetable farmers. The big arrow pointing down to health status means that the extent of ill health experienced can be a direct determinant of the health status of vegetable farmers.

The health status of vegetable farmers finally pointed back to socio-economic characteristics, this was premixed on the assumption that the state of health will have influence on the education, farm size, and income of vegetable farmers.

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

The study was carried out in Kwara State, Nigeria otherwise known as the State of Harmony, created 51 years ago on 27th May, 1967 when the country was divided into twelve States. The State is the midpoint between the Northern and Southern parts of Nigeria. There are sixteen (16) Local Government Areas in Kwara State and the State shares boundaries with Kogi, Osun, Oyo, Niger and Republic of Benin.

Kwara State lies between latitude 8° 5' - 10° 4'N and longitude 4° 55'N and 6° 5'E which falls within the Southern Guinea Savannah zone of Nigeria with average annual rainfall of 800 mm to 1500 mm, usually between April and October with two peaks in July and September (Ibiremo *et al.*, 2010). The average annual temperature vary between 31.5°C and 35°C with the peak hottest months from February to April while the coolest months are between June and September which coincides with the peak of the wet seasons. There are two seasons in the State namely; the wet season (May-September) and the dry season (October to April).

Kwara State lies in two geo-ecological zones; the derived savannah which is characterized by woodland and the Guinea savannah which is characterized by tall grasses growing intermixed with deciduous trees (Ajao, 2012). The vegetation consists largely of a great expanse of arable land and rich fertile loamy soil.

The state has a population of 2,371,089 and an estimated figure of 260,528 farm families who largely reside in the rural areas, with a total landmass of 32,500 Square Kilometres, out of which 75.3% is cultivable (Farmer Census 2009, KWADP, 2012). Majority of the farmers practice mixed cropping. Crops grown include Root/Tuber, Cereal, Legumes,

Tree crop, Oil crop, Fibre crop, Fruits and Vegetables and they constitute the main staple food (Ajadi, 2011). Edu and Asa LGAs have the highest number of farmers planting Root/Tuber, Isin LGA has the highest number of tree crop farmers while Asa LGA has the highest number of vegetable farmers.

The State is grouped into four zones namely A to D by the Kwara State Agricultural Development Project [KWADP] for effective project administration and based on the peculiar ecological characteristics of the various parts of the state. The Zonal headquarter of Zone A is Kaiama, Zone B has it's headquarter in Patigi, while Malete and Igbaja are the Zonal headquarter of Zone C and Zone D respectively. This study covered the major vegetable farming communities in Zones B, C and D in Kwara State.

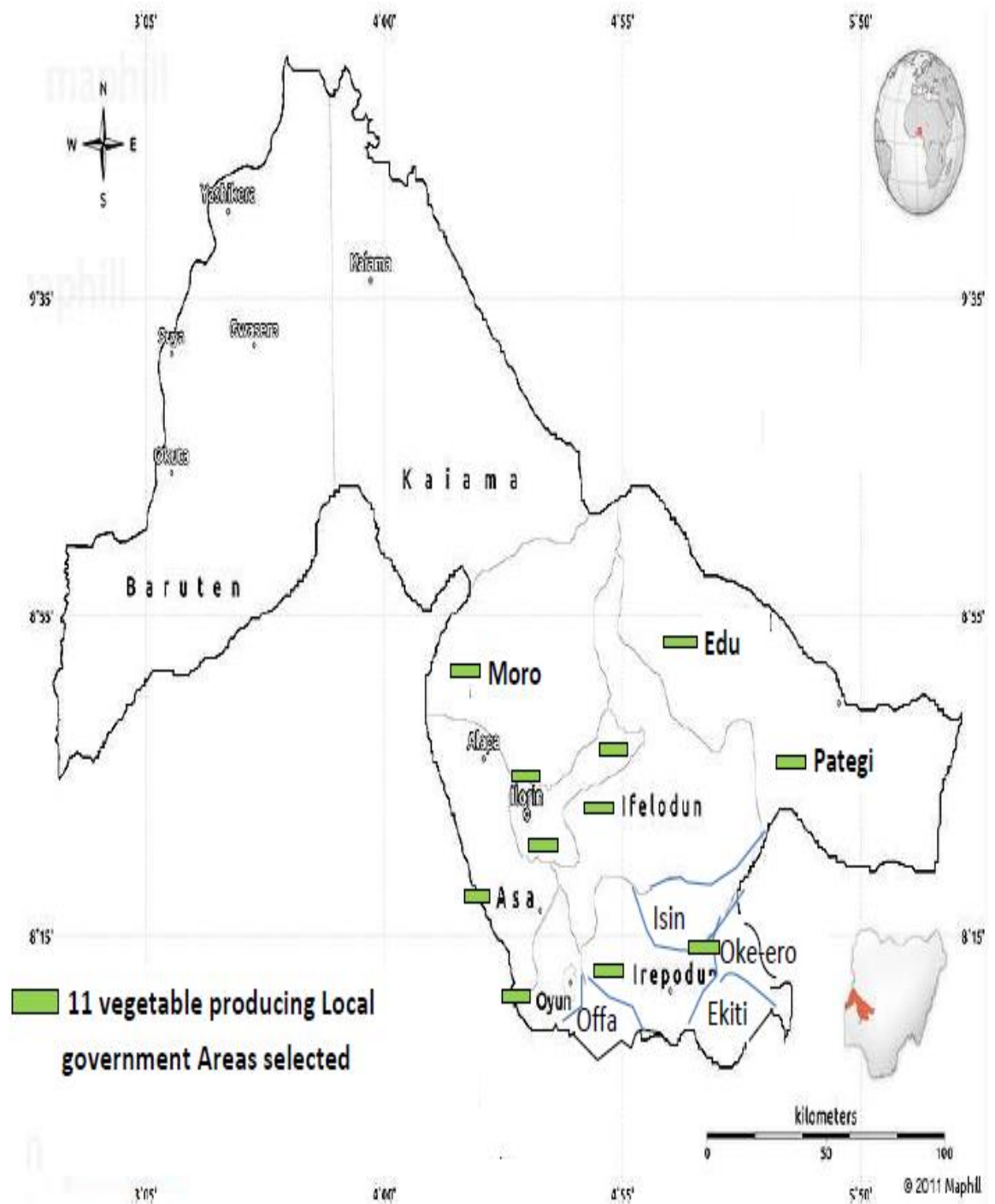


Figure 3.1: Map of Kwara State showing the major vegetable producing areas selected

Source: Kwara State ADP (2012)

3.2 Population of the Study

The population for the study comprised 1,059 vegetable farmers all belonging to vegetable farmers' groups that registered with KWADP in zones B, C, and D.

3.3 Sampling Procedure and Sample Size

Selection of respondents was done using a three-stage sampling technique. The first stage involved purposive selection of eleven vegetable producing Local Government Areas spread across KWADP zones B, C and D ([KWADP], 2012). In the second stage, a purposive selection of twenty seven (27) major vegetable producing communities from the eleven LGAs was done. The purposive selection of LGAs and communities was determined by the list obtained from Kwara State ADP. The third stage involved simple random selection of 50% of the population of vegetable farmers from the selected communities on the sampling frame to give a total of 532 respondents. A total of 540 questionnaire were administered out of which only 450 satisfactorily filled questionnaire were retrieved.

Table: 3.1: Summary of sampling procedure for selection of respondents

Stage 1: Purposive selection of LGAs across 3 ADP zones	Stage 2: Purposive selection of 27 communities	All available vegetable farmers groups	Total Number of farmers in the available vegetable farmers groups per LGA	Stage 3: Random selection of 50% respondents	Retrieved and completely- responded questionnaire
Zone B					
Edu	Lafiagi Tsaragi	2 1	103	52	42
Patigi	Kpada, Lade Tsuba	1 1 1	27	14	14
Zone C					
Ilorin-West	Oko-erin Osere Oloje	1 1 1	55	28	22
Ilorin-East	Oke-oyi Oke ose Alalubosa Isale koko Sobi	1 1 1 1 1	60	30	24
Asa	Balla Otte Owode-oja Lasoju Ganmo Amoyo Temidire	3 3 1 4 1 1 1	475	238	208
Moro	Shao Oloru Bode Saadu	1 1 1	55	28	19
Ilorin South	Maraba Oyun	1 1	40	20	20
Zone D					
Ifelodun	Omupo Oke ode	2 2	60	30	23
Irepodun	Ajase Omu-aran	1 2	123	61	52
Oyun	Erin-ile Ipee	1 1	32	16	14
Oke-Ero	Odo-owa Ilofffa Erinmope	1 1 1	29	15	12
11	34	45	1,059	532	450

3.4 Instrument for Data Collection

Data used for this study was obtained from both primary and secondary sources. The primary data was collected using structured questionnaire. Focus Group Discussions (FGD) and Key Informant Interviews (KII) were also conducted as part of the data gathering process with the use of interview schedule.

Eleven (11) Research assistants were recruited and trained for four (4) days in the month of March, 2016 for the purpose of data collection. After the training, they proceeded to the selected community to collect data for instrument validation in Kankan, a community in Asa LGA was used for the pilot study. The research instrument was restructured after the pilot test prior to a three day refresher training which was conducted in the third week of May 2016 before data collection. The period of data collection lapsed between 28th May and 30th June 2016.

3.5 Validity of the Instrument

In order to establish content validity, the questionnaire designed was modified by experts in the Department of Agricultural Extension and Agronomy to ensure its validity. This was done alongside the objectives of the study and the hypotheses. The comments and suggestions made by experts were thoroughly used in restructuring the instrument before being used for data collection. The purpose of this was to ensure that each of the items measured what it was designed to measure.

3.6 Reliability of the instrument

To determine the reliability of the questionnaire, the study instrument was subjected to test and re-test method in which the questionnaire was pre-tested during a pilot study in one of the vegetable producing communities in Asa LGA, Kwara State. This involved

using the intended data collection instrument (questionnaire) to obtain information from 65 respondents selected from Kankan, a community in Asa LGA which was not included in the final study population. After two weeks, the second test was carried out with the same respondents. The first and second tests were subjected to the Cronbach's Alpha Reliability test for Likert-type Scales. The SPSS was used to calculate the Cronbach's Alpha Reliability Coefficient. To interpret the output, the rule of George and Mallery (2003) was followed thus: > 0.9 (Excellent), > 0.8 (Good), > 0.7 (Acceptable), > 0.6 (Questionable), > 0.5 (Poor), and < 0.5 (Unacceptable).

i.e. the r-value was computed using the following formula:

$$r_{xx} = \frac{2r_{oe}}{1 + 2r_{oe}}$$

Where r_{xx} = product moment correction coefficient of the whole instrument.

r_{oe} = product moment correlation coefficient between the odd and even items

The correlation co-efficient (r) of 0.82 which was obtained ascertained the reliability of the instrument.

3.7 Measurement of Variables

(A) 1. Independent variables: These are the socio-economic characteristics of vegetable farmers, which include the following: age, household size, sex, marital status, farming experience, educational level, farm size, pesticide usage experience, types of vegetable grown, labour type, and average annual income. These variables were measured as follows:

- i. Age: Respondents actual age in years as at last birthday was obtained
- ii. Sex: respondents were required to indicate whether they were male = 1 or female = 2

- iii. Marital status: Single 1, Married 2, Divorced 3, Widow 4, Separated 5
- iv. Education status: respondents indicated their highest educational attainment as tertiary education (5), secondary (4), primary (3), Islamic/Arabic (2) and no formal education (1).
- v. Extension contact: Yes = 1, No = 0
- vi. Types of vegetable crop grown: respondent were asked to list the types of vegetable crop they grow as follows: okro, spinach, ewedu, pepper, tomatoes, cabbage, garden egg, onion e.t.c
- vii. Farming experience: respondent were requested to state the number of years they have been planting vegetable.
- viii. Pesticides usage experience: respondent were asked to indicate the number of years they have been using pesticide,
- ix. Farm size: respondent indicated the total area of land used for planting vegetable; measured in hectares. This was later grouped as follows: below 2 hectares = small scale, 2 to 3 hectares = medium scale and 4 hectares and above = large scale
- x. Average annual income: respondent indicated in naira the income generated through vegetable farming on the basis of income from each type of vegetable crop they cultivated in the last cropping season.
- xi. Labour type: respondents' source of labour on their vegetable farm was categorized and measured as either family labour = 1, communal = 2 or hired labour = 3.

2. Types of Pesticides Used:

Focus Group Discussion and open ended questions were used to obtain information using the indicators listed below:

- i. Common pests identified: respondents stated the different types of pests they have identified on their vegetable farms
- ii. Time the infestations commonly occur: respondent stated the time of the year when each of the pest identified usually occur. This was expressed with respect to weeks after planting.
- iii. Types of pesticides commonly used: respondent listed the common name of pesticides they use at various stages of growth of their vegetable crop. This was later categorized using the WHO recommended classification of pesticides by hazard as follows: Ia- extremely hazardous, Ib- highly hazardous, II- moderately hazardous and III as slightly hazardous.
- iv. Source of pesticide: respondents stated where they obtained pesticides used on their vegetable farms and they were categorized as: agrochemical shop, local peddler, community market, friend/neighbor, extension officer .e.t.c
- v. Quantity of pesticide used per hectare: Quantity of each type of pesticide used were calculated and expressed in liter per hectare
- vi. Frequency of pesticide application was measured in weeks after planting
- vii. Equipment used during pesticide application were stated as follows: sprayer, bucket and broom, leaves e.t.c
- viii. Precautions taken when applying pesticides: respondent stated the steps they follow to ensure safety when applying pesticides

- ix. How pesticide spillage is handled: respondent stated the steps they take in case there is accidental pesticide spillage.
- x. Where pesticides are stored or kept: respondents stated where they usually keep their pesticides.
- xi. How pesticide containers are disposed: respondents stated their methods of disposing empty pesticide containers
- xii. How excess mixed pesticide solutions are disposed: respondents were requested to state what they usually do in case they have remnant mixed pesticide after spraying their crops.

Responses were categorized and analysed using descriptive statistics. Results were expressed as frequencies, percentages and means with standard deviation.

3. Awareness of respondents on safe practices during pesticide handling and application:

The respondents were provided with the list of seventeen recommended safe practices for pesticide handling and application and these were measured on the basis of Aware = 1 and Not Aware = 0.

(B.) Dependent Variables:

4. Level of use of safe practices during pesticide handling and application among the vegetable farmers: A series of recommended safe practices for pesticide handling and application were presented to the respondents and they were asked to rate these practices on a scale of Used (1), Not used (0).

On the level of use of safe practices, respondents were asked to rate the seventeen recommended Practices on a 3-point likert scale ranging from Highly used (3), Moderately used (2) and Less used (1).

In calculating the level of use or extent of use of recommended safe practices for pesticide handling and application by respondents the mid-point values of the scale (3+2+1) was added up to get 6. The total was later divided by 3 to obtain 2.0 which is the mean value. Any level of use of recommended safe practices for pesticide handling and application with a mean score above the cut-off mean of 2.0 is considered as highly used, any mean score equal to the cut-off mean is considered as moderately used while any mean score lower than 2.0 was considered as less used.

Analysis of the 3-point Likert scale rating was computed using the following formula:

$$\begin{aligned} \text{i.} \quad X_{lsp} &= \frac{\sum(LSP)}{Nlsp} \\ \text{ii.} \quad X_{ws} &= \frac{\sum(F_x LSP)}{n} \end{aligned}$$

Where: X_{lsp} = Mean of likert scale points

X_{ws} = Mean of weighted score

LSP = Likert scale points (1, 2 and 3)

$Nlsp$ = Number of likert scale points (3)

Therefore, the following benchmark was set

If $X_{ws} < X_{lsp}$: Less used

If $X_{ws} = X_{lsp}$: Moderately used

If $X_{ws} > X_{lsp}$: Highly used

5. Perceived knowledge level of vegetable farmers on safe practices for pesticide handling and application

To determine the knowledge level of the respondents in the study area, the respondents were provided with the list of seventeen (17) knowledge areas on recommended safe practices for pesticide handling and application and were asked to indicate their level of knowledge on a scale of: No knowledge (1), Little knowledge (2), Average Knowledge (3) and High knowledge (4). Responses were further categorized as high knowledge and low knowledge based on the mean value. Bench mark of mean score = 2.5 was set as mid-point. Decision rule: mean score = 2.5 and above (High knowledge), mean score = 2.49 and below (Low knowledge).

In order to address the knowledge gap identified, the study further investigated the areas of recommended safe practices for pesticide handling and application where capacity building is needed among the respondents in the study area. To investigate the capacity building needs of vegetable farmers on recommended safe practices for pesticide handling and application, the FAO (1992) model of conducting capacity building analysis was adopted. In this model the needs analysis was divided into job analysis, task analysis and knowledge/skill-gap analysis.

Procedure for conducting job and task analysis:

The following steps were used for job and task analysis.

Step 1: Several “Task Analysis Work sheets” were duplicated and the name of the job was written at the top of each.

Step 2: One task each on the “Task Analysis Worksheets” was written.

Step 3: All component parts of each task on the respective Task Analysis worksheet were listed.

Step 4: How frequent each part of the component is performed was determined using a five point likert type scale of Seldom = 1, Occasionally = 2, Weekly to monthly = 3, Daily to weekly = 4 and Daily = 5.

Step 5: To determine the relative importance of each step or component, components that are performed seldom may be very critical to one job. Therefore, it is important to gain both an importance rating as well as a frequency rating by using a 3 point likert type scale of Marginally important = 1, Moderately important = 2 and Extremely important = 3.

Step 6: Difficulty of learning the task component or step were estimated. An estimate of learning difficulty is one other dimension of the analysis. Therefore, the Task Analysis Worksheet was used with the following scale: Easy = 1, Moderate difficulty = 2, Very difficult = 3, Extremely difficult = 4.

Step 7: Total score for each task component or step were tallied by simply adding the scores for frequency, importance and learning difficulty for each component.

Procedures for estimating Skill and Gap Analysis:

The following steps were used to estimate the skill levels of the respondents.

Step 1: The “steps or components” that were identified on the task analysis worksheet were listed on the Gap Analysis Worksheet.

Step 2: Each “step or component” in terms of the respondents’ current proficiency were rated on a scale of 1 to 5, with the following descriptors.

1= cannot complete any part

2= can complete less than half the task

3= can complete more than half but less than the total

4= can complete the entire task but takes too long

5= complete the task within time standard.

Step 3: The proficiency ratings were done and those tasks that appear to have low proficiency were reviewed. Low proficiency means that there is a gap between what is desired and what the situation is currently.

Decision rule:

- i. Is proficiency a problem? Total number of numeral assigned to scales divided by number of scales (i.e $1+2+3+4+5=15/5 = 3$). Therefore, the mean score of 3 is the benchmark. Any mean scores below 3 were considered “YES” as area where proficiency is a problem. Any mean score of 3 and above were considered “NO” as area where proficiency is not a problem.
- ii. Can it be solved by training? Average of the number of scales (i.e $5/2 = 2.5$) was used to decide if skill gap can be solved through training. A scale of 2.5 was therefore considered as threshold. Scale below 2.5 could be regarded as “YES” for skill gaps that can be solved by capacity building.

6. Perceived ill-health conditions experienced as influenced by the type of pesticides used by vegetable farmers.

The respondents were requested to list the various signs and symptoms of ill-health they experience as a result of handling pesticides based on their perception. The responses were measured on the basis of Yes (1) or No (0).

7. Perceived Health Status of vegetable farmers

Perceived Health Status of vegetable farmers was measured using the SF12v2 procedure documented by Ware *et al.*, (2002). Higher score indicates good health status while low score indicates poor health status. Items were coded under the following; Physical Functioning (PF), Role Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (V), Social Functioning (SF), Role Emotional (RE), and Mental Health (MH). The steps are shown below:

i. **Physical Functioning (PF):** there are two items in this section.

a. Moderate activities, such as trekking to farm, fetching water,

b. Weeding plot, thinning, applying pesticides

Respondents were requested to rate the extent to which they are limited in performing their activities as follows: Yes, limited a lot coded as 1, Yes, limited a little as 2, Not limited at all as 3.

ii. **Role Physical (RP):** There are two items listed in this section.

a. Accomplished less than you would like

b. Limited in your work or other activities

How much respondents were prevented from accomplishing their work or other activities was rated on a 5 point scale as shown: All of the time coded as 1, Most of the time as 2, Some of the time as 3, A little of the time as 4 and None of the time as 5.

iii. **Bodily Pain (BP):** How pain interfered with respondent's normal work (including farm work and house work) was measured on a 5 point scale thus: Not at all coded as 5, A little bit as 4, Moderately as 3, Quite a bit as 2 and Extremely as 1.

iv. **General Health (GH):** Based on respondents' perspective in general, they were asked to rate their general health on a 5 point likert scale thus: excellent coded as 5, very good as 4, good as 3, fair as 2 and poor as 1.

v. **Vitality (VT):** respondents were requested to rate how energetic they feel on a 5 point scale thus: All of the time coded as 5, Most of the time as 4, Some of the time as 3, A little of the time as 2, None of the time as 1.

- vi. **Social Functioning (SF):** The extent to which physical health or emotional problems interfered with respondent's social activities was rated on a 5 point scale as shown: All of the time coded as 1, Most of the time as 2, Some of the time as 3, A little of the time as 4, None of the time as 5.
- vii. **Role Emotional (RE):** There are two items listed in this section. Respondents were requested to state the extent to which they were unable to accomplish their daily tasks on farm and other activities as shown below:
- a. Accomplished less than you would like
 - b. Did work or other activities less carefully than usual

Response Choices: All of the time coded as 1, Most of the time as 2, Some of the time as 3, A little of the time as 4, None of the time as 5.

- viii. **Mental Health (MH):** The two items in this section are:
- a. Have you felt calm and peaceful
 - b. Have you felt downhearted and depressed

Response Choices: All of the time coded as 1, Most of the time as 2, Some of the time as 3, A little of the time as 4, None of the time as 5.

Responses were scored, recorded and raw scores were computed for each scale. This score is the simple algebraic sum of responses for all items in that scale, as shown in Table 6. For example, the raw scale score for the PF Scale is the sum of the scores for Items (i)a and (i)b. For single-item scales, the raw score is simply the final item response value. This simple scoring method is possible because items in the same scale have roughly equivalent relationships to the underlying health concept being measured and no item is used in more than one scale. Thus, it is not necessary to standardize or weight

items. These assumptions have been extensively tested and verified (McHorney, Kosinski, and Ware, 1994).

The raw scores were then transformed to a 0 to 100 scale using the formula shown below. The information necessary for applying this formula to each scale is provided in Table 3. This transformation converts the lowest and highest possible scores to 0 and 100, respectively. Scores between these values represent the percentage of the total possible score achieved.

$$\text{Transformed scale} = \frac{(\text{Actual raw score} - \text{lowest possible raw score})}{\text{Possible raw score range}} \times 100$$

Health status was then calculated for each respondent as the summation of actual raw score minus summation of the lowest possible score divided by summation of the possible raw score multiplied by 100. i.e.: $\sum A - \sum B \div \sum D \times 100$

Result obtained represents the health status of vegetable farmers which was further grouped on a scale of 1 to 5 as excellent, very good, good, fair or poor as shown in table 4. Scores between 0 to 20 = 1 (poor), 21 to 40 = 2 (fair), 41 to 60 = 3 (good), 61 to 80 = 4 (very good) and 81 to 100 = 5 (excellent).

Other factors which affect vegetable farmers' health status that were considered in the study include the following: Age, BMI, History of chronic illness, Availability of basic health facility and service provider.

- Age was measured in years
- Body Mass Index (BMI) was calculated using the formula; $\text{BMI} = \text{Weight (kg)} / \text{Height}^2 (\text{m}^2)$. The value obtained from the calculation of BMI is widely used to categorize whether a person is underweight, normal weight, overweight or obese. A BMI of 25.0 or more is overweight, while the healthy range is 18.5 to 24.9.

Respondents' BMI was categorized according to the WHO standard as shown in Table 6.

Table 3.2: The International Classification of adult underweight, overweight and obesity according to Body Mass Index (BMI)

Classification	BMI(kg/m ²)
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00 – 16.99
Mild thinness	17.00 – 18.49
Normal range	18.50 – 24.99
Overweight	≥25.00
Pre-obese	25.00 – 29.99
Obese	≥30.00
Obese class I	30.00 – 34.99
Obese class II	35.00 – 39.99
Obese class III	≥40.00

Source: Adapted from WHO (1995), WHO (2000) & WHO (2004).

- History of chronic illness: respondents were requested to answer yes or no if they have any history of illnesses such as hypertension, diabetes, cancer etc.
- Availability of basic health facility and service provider: respondents were requested to answer yes or no if there is any functioning health care facility within a reasonable distance to them.

8. Constraints to the use of safe practices during pesticide application among vegetable farmers

Several constraint items were presented to the respondents and they were asked to rate these items as constraints on a 4-point likert type scale of Very Severe (4), Severe (3), Less Severe (2), Not Severe (1).

In the case of constraints, the mid-point values of the scale (1+2+3+4) were summed up to get 10. The sum was further divided by 4 to obtain 2.5 which is the mean value. The mean for each constraints faced were obtained by multiplying the point scale by the number of respondents in each scale. In this respect, any constraint with a mean score

above the cut-off mean of 2.5 was regarded as Severe, any mean score equal the cut-off mean (2.5) was considered as Moderately severe and any mean score lower than 2.5 was regarded as Not severe. Analysis of the 4-point likert type scale rating was computed using the following formula:

$$\text{i. } X_{lsp} = \frac{\Sigma(LSP)}{Nlsp}$$

$$\text{ii. } X_{ws} = \frac{\Sigma(F_x LSP)}{n}$$

Where: X_{lsp} = Mean of likert scale points

X_{ws} = Mean of weighted score

LSP = Likert scale points (1,2,3 and 4)

$Nlsp$ = Number of likert scale points (4)

For this study the following benchmark was adopted

If $X_{ws} < X_{lsp}$: Not severe

If $X_{ws} = X_{lsp}$: Moderately severe

If $X_{ws} > X_{lsp}$: Severe

3.8 Data Analysis

Descriptive statistics involving the use of frequency counts, percentages, mean scores, standard deviations, and charts were employed in analyzing objectives 1 to 8 while inferential statistics such as Multinomial and Multiple Regression Analysis were carried out to test the hypotheses.

3.9 Analytical tools

1. Multinomial Logistic Regression:

The Multinomial Logistic Regression Function was used to determine if there is any relationship between the level of use of recommended safe practices for pesticide handling and application and the health status of vegetable farmers.

To establish the effect of pesticide use on health status of vegetable farmer, bearing in mind that, the health status of a particular farmer is not a sole function of pesticide usage, a Multinomial Logistic Regression Function of health status, Y is fitted thus,

$$\ln Y_i = \alpha + \beta_i(X_i) + U_i \dots\dots\dots \text{equation (1)}$$

$$\ln(Y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + U \dots\dots\dots \text{equation (2)}$$

Where Y= 5 if health status is Excellent,

Y=4 if health status is very good,

Y=3 if health status is good,

Y=2 if health status is fair and

Y=1 if poor.

X₁ = Usage of safe practices (measured qualitatively as 1 if farmer used safe practices during the farming season under consideration and 0 if otherwise)

X₂ = Age of farmer (measured qualitatively as 1 if farmers' age lie within 0 to 17 years; 2 if farmers' age lie within 18 to 45 years and 3 if famers' age is above 45 years).

X₃ = BMI (measured qualitatively as 1 if farmers' BMI is within the normal range and 0 if otherwise)

X₄ = Family history of chronic diseases (measured qualitatively as 1 if farmer or family has a history of chronic diseases and 0 if otherwise).

X_5 = Availability of basic health facility and service provider (measured qualitatively as =1 if available, 0, otherwise)

2. Multiple Regression Model

The Multiple Regression Analysis was used to test the hypotheses 1, 2, 4 5 and 6 of the study respectively. The choice of this model was based on its proven adequacy in situations when there is the need to predict the value of a variable (the dependent variable) based on the value of two or more other variables called the independent, regressor or predictor variables [Berger, 2003]. The Multiple Regression Analysis is represented by the following equation:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_p X_{pi} + e_i \dots\dots\dots \text{equation (3)}$$

Where:

Y_i is the dependent variable

β_0 is the constant term

β_1 to β_p are coefficients relating to p explanatory variables of interest

e_i is the error term

All variables are spelt out under the measurement of variables.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Vegetable Farmers

The socio-economic characteristics of the respondents that are of interest to the study are presented in the following order: age, sex, marital status, educational status, vegetable farm size, vegetable farming experience, membership of associations, Types of farm labour for vegetable farming, Agricultural Extension visit, Numbers of vegetable crops grown, Years of using pesticides, and Average annual income from vegetable farming.

4.1.1 Age of the Respondents

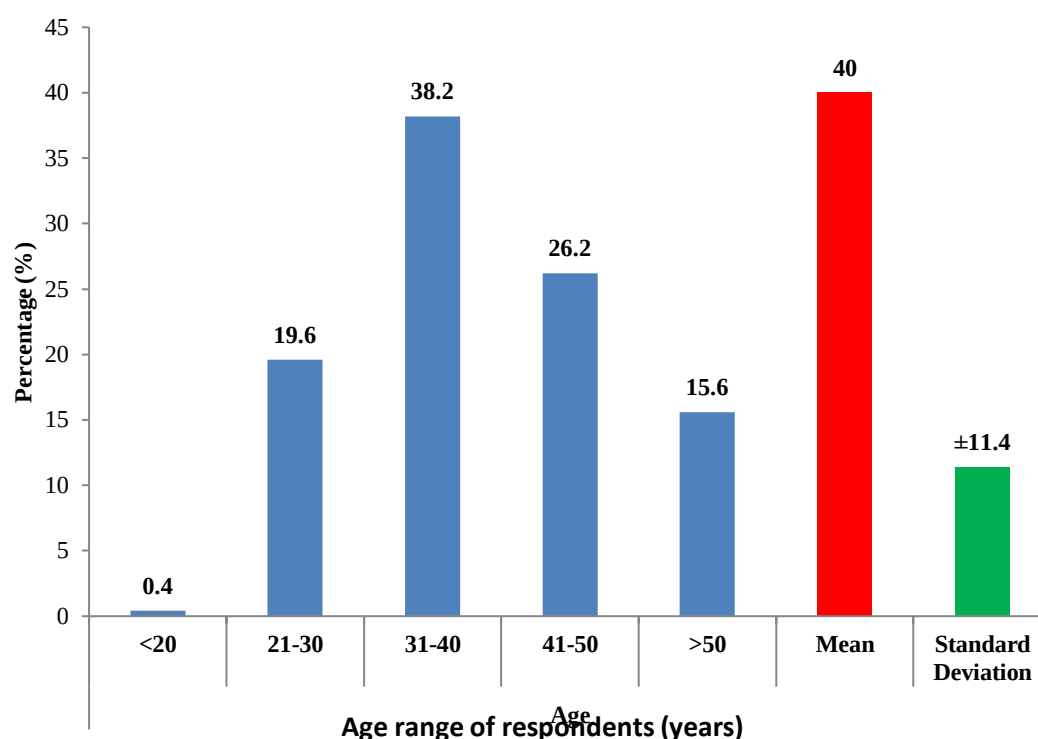


Figure 4.1: Distribution of respondents according to their age

Source: Field Survey (2016)

Data illustrated in Figure 4.1 shows that the average age of respondents was 40 years with majority within the age bracket of 31 to 40 years. This implies that respondents are

young and falls within the active age bracket which is between 25-59 years. According to the submission of FAO (1997), this age bracket is very important player in the economic sector of any nation because of their strength and productive ability. In the same vein, Ibitoye (2012) posits that this age bracket is observed to be more productive and is likely to possess the required strength for farming operations. This makes the prospects of improved vegetable production in Kwara State very positive. This finding agrees with the report by Adenuga *et al.* (2013) that majority of the vegetable farmers and marketers in Kwara State fall within the age bracket of 31-40 years which implies that they are relatively young. However, it is in contrast with that of Matanmi *et al.* (2017), who reported that majority of the vegetable farmers in Fadama III programme in Kwara State are aged and consequently, less likely to be responsive to vegetable production improvement innovations.

4.1.2 Sex of the Respondents

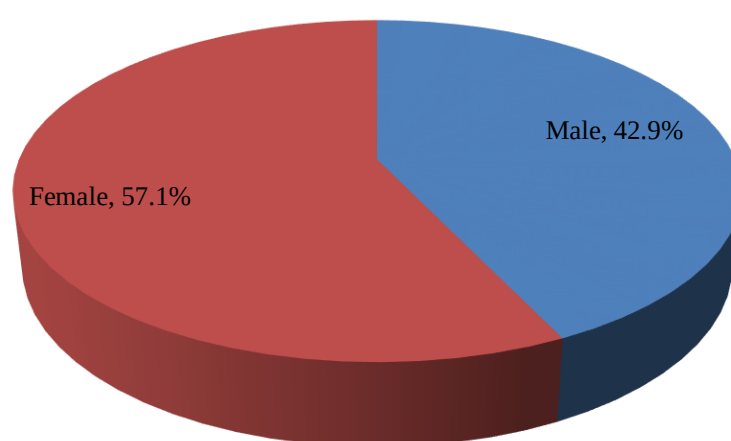


Figure 4.2: Distribution of respondents according to their sex

Source: Field survey (2016)

The results in Figure 4.2 showed that most (57.1%) of the respondents are female while only 42.9% of the respondents are male. This suggests that more women or females are

involved in the production of vegetable crops than men in Kwara State. This finding is in line with that of Adenuga *et al.* (2013) who supported the submission of Adeyemi (1992) that women contribute significantly and have favourable attitude towards vegetable production in Nigeria. High involvement of females in vegetable farming may be because of the fact that the venture is commonly not capital intensive, less strenuous and yields little but consistent earnings/income hence making it convenient. This finding is however in contrast with the report by Abubakar *et al.* (2015) and Fakayode *et al.* (2012) that vegetable production in Borno and Osun states respectively is dominated by men.

4.1.3 Marital Status of the Respondents

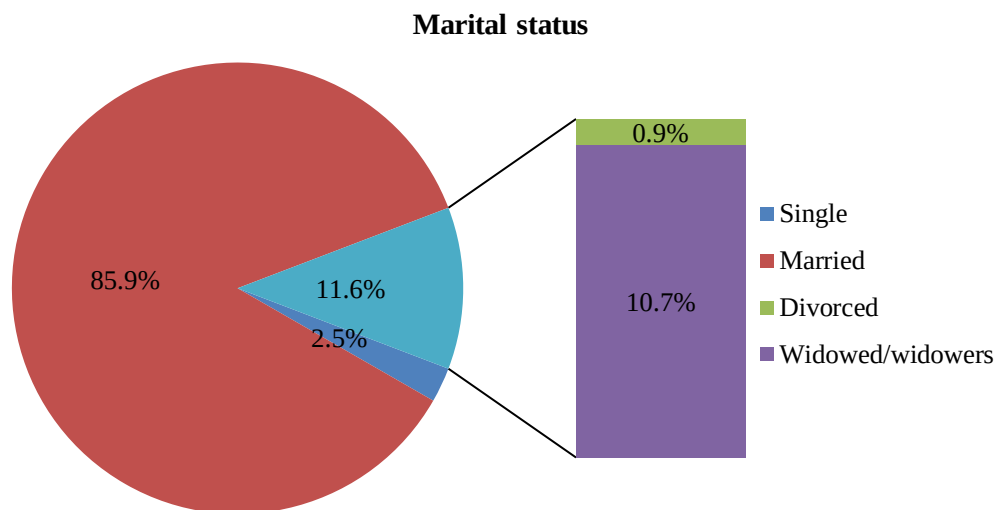


Figure 4.3: Distribution of the respondents according to their marital status

Source: Field survey (2016)

Figure 4.3 showed the large portion (85.9%) of the surveyed vegetable farmers are married. This suggests that an over whelming majority of the respondents in the study area engaged in vegetable farming are married. This finding corroborate the earlier finding by Daudu (2016) that rural communities in Kwara State are dominated by

married people and that married household heads tend to be more involved in agricultural activities.

4.1.4 Level of Education of the Respondents

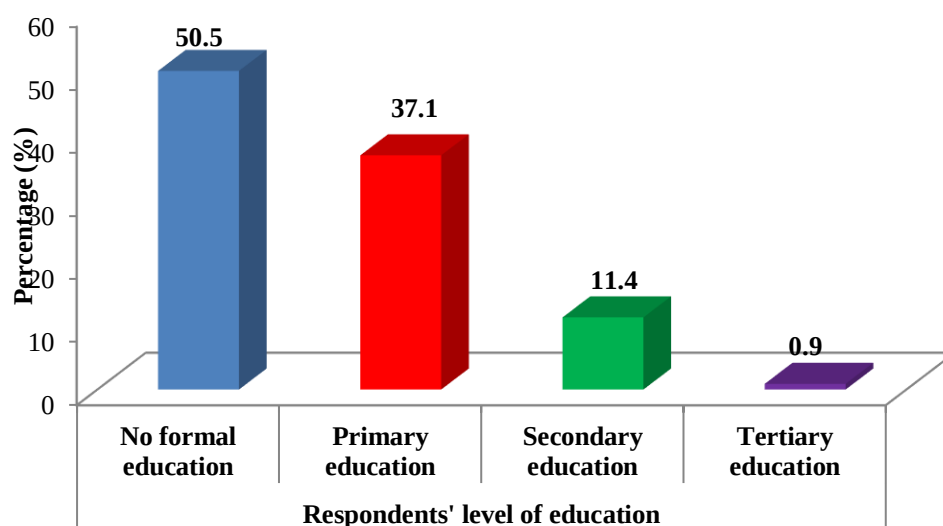


Figure 4.4: Distribution of respondents according to their level of education

Source: Field survey (2016)

Results presented in Figure 4.4 on educational level of the respondents showed that about half (50.5%) of the population surveyed had non-formal education, 37.1% have completed primary education, while only 11.4% and 0.9% have completed secondary and tertiary education respectively. This finding is similar to that of Matanmi *et al.* (2017) who noted that most vegetable farmers in Kwara State had no formal education. The low level of formal education among half (50.5%) of the respondents in the study area must have contributed greatly to unsafe practices observed among the farmers during handling and application of pesticides. This opinion is supported by Ajala *et al.* (2013), who pointed out that education empowers individuals with knowledge and skills, thereby increasing their level of reasoning and understanding. Furthermore, education is a major factor that influences adoption of new technology by farmers (Agwu, 2004;

Omotesho, Falola, Muhammad-Lawal and Oyeyemi, 2012). With the other half of the respondents (40.5%) having one form of formal education or the other, the possibility of compliance with safe practices for pesticide usage is expected to increase because education increases the tendency or rate of participation of rural farmers in improved agricultural activities. Also, education plays a significant role in increasing the level of awareness of farmers regarding adverse effects and negative consequences of pesticide misuse on farmers' health and the environment. According to Muhammad *et al.* (2013), there is a significantly increase in risk perception as the educational level of farmers increases.

4.1.5 Farm size of the respondents

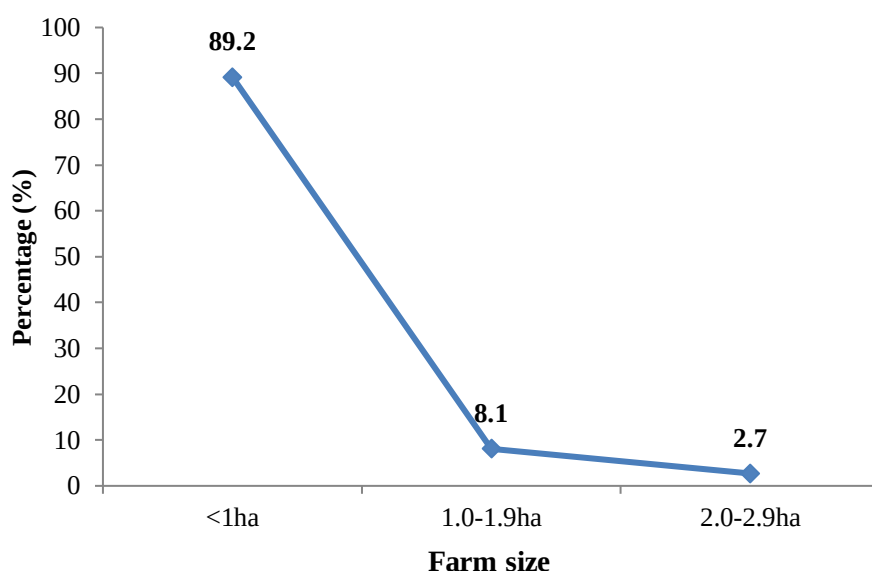


Figure 4.5: Distribution of respondents according to farm size

Source: Field survey (2016)

Results in Figure 4.5 showed that the mean vegetable farm size of respondents was 0.36 hectares with majority (89.2%) of the respondents cultivating less than 1hectare.This finding corroborates Ajibola *et al.* (2015) who had earlier reported 0.4ha as mean value of vegetable farm size in Kwara State. World Bank's Rural Strategy (UNECA, 2009) had

defined small-scale farmers as those with low capital base, operating less than 2 hectares of cropland. Following this definition, this study opined that vegetable farmers in Kwara State are small-scale vegetable farmers.

4.1.6 Vegetable Farming Experience (Years)

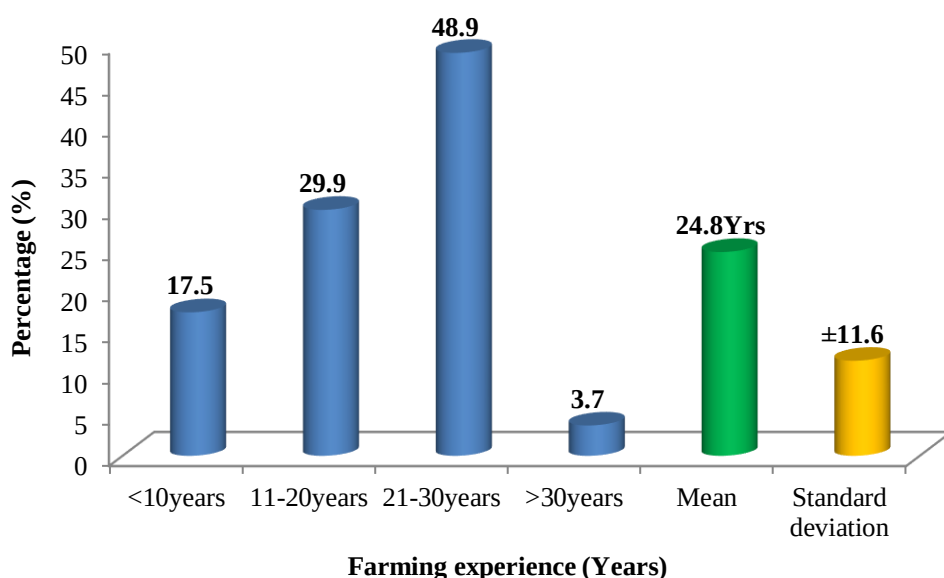


Figure 4.6: Distribution of respondents according to farming experience

Source: Field survey (2016)

Figure 4.6 shows that the mean farming experience of respondents was 24.8 years as most (48.9%) of the respondents had 21-30 years farming experience. This suggests that most of the respondents have been in vegetable farming for quite a long period of time. This finding conforms to report by Ajibola *et al.* (2015) of long years of vegetable farming experience in Kwara State. The length of experience would have exposed them to a wide range of practices in vegetable production and also encourage the acquisition of skills which may lead to increased farm productivity (Obinne, 1991). This implies that with the wealth of experience they have acquired over the years on vegetable farming, they are more likely to be aware of safe practices for pesticide handling.

4.1.7 Membership of association

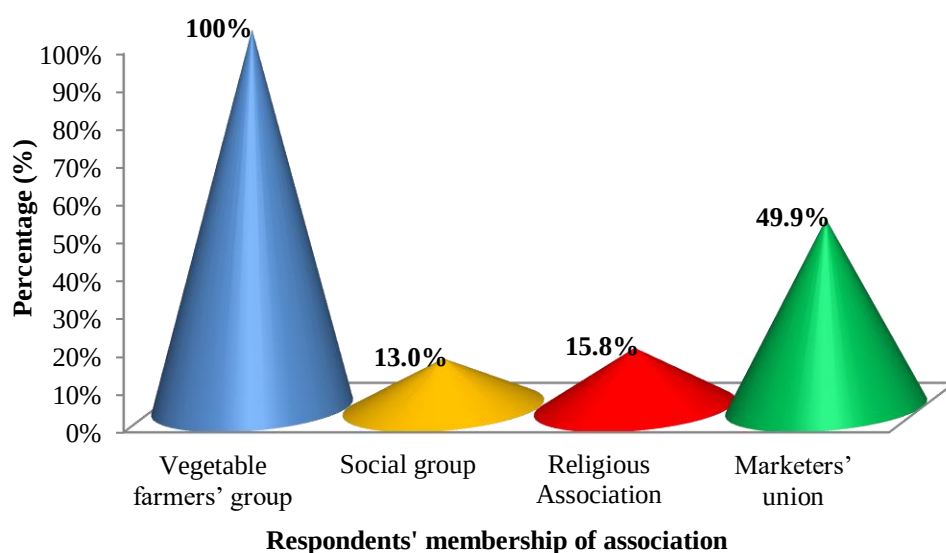


Figure 4.7: Distribution of respondents according to their membership of various associations

Source: Field survey (2016)

Figure 4.7 shows that all (100%) of the respondents were member of vegetable farmer's group. About half (49.9%) of the farmers are members of the marketers union while 15.8% and 13% of the farmers belong to religious association and social group respectively. Several studies have stated some benefits of farmers' group among members to include production and marketing of farm produce (Ibitoye, 2012), granting credit facilities to members (Adefila, 2012), mobilizing and distributing credit to the farmers (Nweze, 2002; Omotesho, 2007), and tool towards improving farmers' productivity (Toluwase and Apata, 2013). Aside the benefits of helping each other, vegetable farmers in the study area had the group structure through which vegetable production technology can easily reach them collectively by extension agents. This implies that information will easily and quickly flow to the farmers if it is passed through the association. Trainings, demonstrations, intervention and researches can also be effectively conducted by using this already established structure in the communities. The

interaction can also result in better involvement in improved vegetable production since ideas can easily spread among members of an organization or society. This corroborates the position of Ekong (2003) who opined that members of cooperative societies have advantages such as access to micro-credit, input subsidy and also as avenue for cross breeding ideas and information.

4.1.8 Sources of Farm Labour for Vegetable Farming

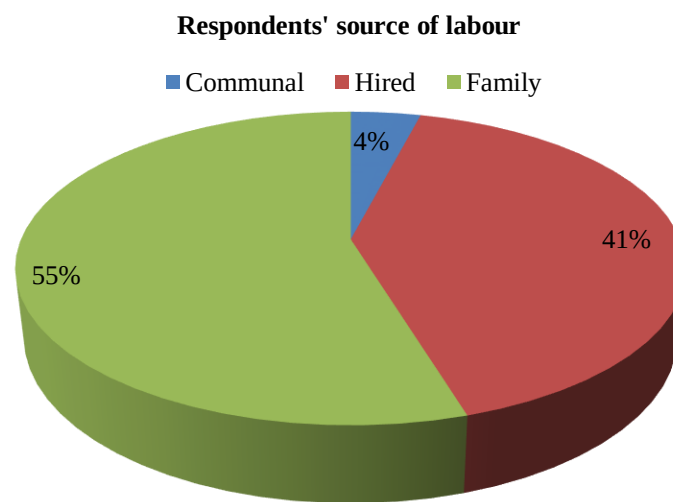


Figure 4.8: Distribution of respondents according to their sources of farm labour for vegetable farming

Source: Field survey (2016)

Results in Figure 4.8 showed that 55% of the respondents sourced their farm labour from family members, only 4% were through communal help while 41% of respondents hired labourers for their vegetable farming activities. This finding implies that family labour is the major source of farm labour used by the respondents in the study area. This finding may be connected with the fact that majority of the respondents are married and operate on small-scale production. Muhammed-Lawal *et al.* (2009) had opined that in order to reduce cost of labour, a rational farmer would likely exhaust all sources of labour

available in the household before considering the hiring of labour. This is buttressed by Yisa *et al.* (2010) who concluded that family labour is a cheaper alternative compared to hired labour.

4.1.9 Extension Visit for Vegetable Production

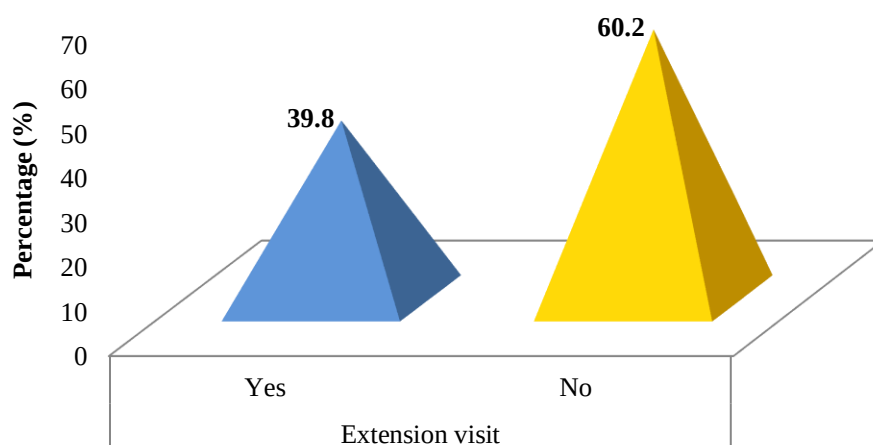


Figure 4.9: Distribution of respondents according to their contact with extension agents

Source: Field survey, 2016

Results in Figure 4.9 showed that majority (60.2%) of the respondents had no extension contact at all. This suggests a low level of extension contact among the vegetable farmers in the study area. This finding is in line with Omotesho (2013) who reported that most women vegetable farmers claimed not to have any contact with agricultural extension agents. This suggests low level of improved vegetable production technology practices among vegetable farmers in Kwara State. This is because the frequency of extension service that a farmer enjoys is expected to reflect in the level of his/her participation in the adoption of suitable farming techniques which include the adoption of best management practices when handling pesticides. The extension agent is expected to raise

the awareness of farmers and also facilitate trainings on best management practices during pesticide application.

4.1.10 Types of Vegetable Grown by Respondents

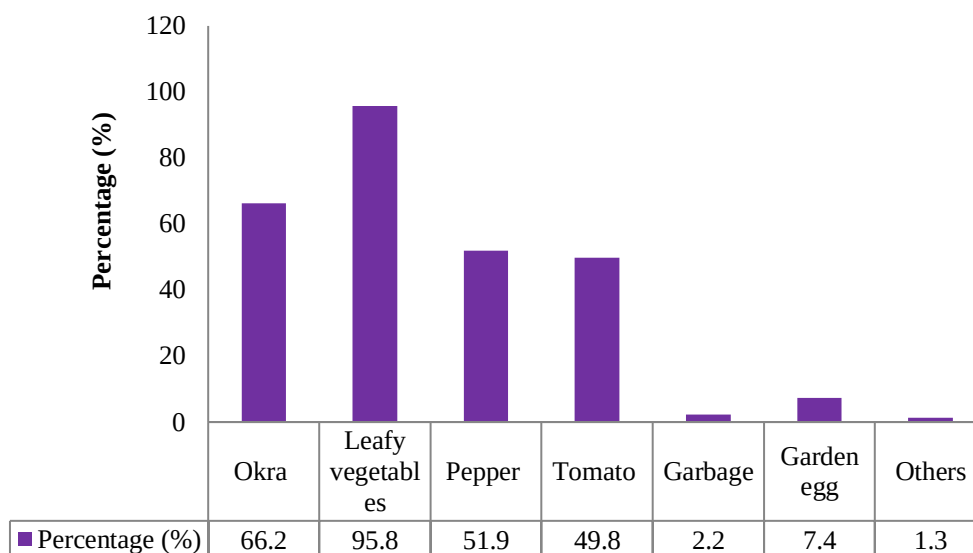


Figure 4.10: Distribution of respondents according to types of vegetable grown
Source: Field survey (2016)

Result presented in Figure 4.10 shows that majority (95.8%) of the vegetable farmers plants leafy vegetables, 66.2% of the respondents plants okra, 51.9% plants pepper, 49.8% plants tomatoes, 7.4% plants garden egg, 2.2% plants cabbage while only 1.3% plants onions. This indicates that almost all the respondents interviewed plant leafy vegetable in addition to other types of vegetable. This may be because of higher demand for leafy vegetables by consumers due to the crucial role it plays in alleviating hunger and it is also considered as a very important component in diet of many people because of its nutritional value (Badmus and Yekini, 2011).

4.1.11 Number of Years of Using Pesticide for Vegetable Farming

Table 4.1: Number of years of using pesticide for vegetable farming

Years	Frequency	Percentage	Mean
1-5	188	41.3	7.4 years
6-10	199	43.7	
11-15	42	9.2	
16-20	16	3.5	
>20	10	2.2	
Total	455	100.0	

Sources: Field survey (2016)

Results presented in Table 4.1 illustrated respondents' experience of using pesticides in vegetable farming. The result shows that the average years of using pesticide was 7 years. This implies that regular use of pesticides for vegetable farming in the study area can be trace down to 7 years ago. 7 years in this study is suggested to be relatively long years. This is to confirm that respondents are not new in the use of pesticide to control pests on vegetable farms. It is therefore expected that an average vegetable farmer in Kwara State would be able to report some noticeable symptoms of ill health they often experience as a result of their exposure to pesticides. Fangbin, Jikun, Linxiu and Scott (2012) in a similar study had reported that farmers with long time of exposure to pesticides are more likely to experience nausea, headache, and skin problems.

4.1.12 Average Annual Income of Respondents from Vegetable Farming

Table 4.2: Distribution of respondents according to their average annual income

Income in Naira	Frequency	Percentage	Mean (Naira)
≤50,000	401	88.1	40,659.56
51,000-200,000	37	8.1	
201,000-350,000	12	2.6	
351,000-500,000	1	0.2	
501,000-650,000	1	0.2	
>650,000	3	0.7	
Total	455	100.0	

Source: Field Survey (2016)

Results presented in Table 4.2 reveals that the mean annual income from vegetable production among respondents in the study is forty thousand naira with majority (88.1%) of the vegetable farmers earning fifty thousand naira or less annually. This finding is similar to that of Omotesho *et al.* (2013). Although vegetable farming has been found to be a very lucrative source of income in Nigeria, the low income generated from the venture by respondents in Kwara State may be due to small scale vegetable production in the study area.

4.2 Prevalent Types of Pesticides Used by Respondents

This section of the study presents the results and discussion of the types of pesticides used by respondents, factors considered by respondents before purchasing pesticides, safety precautions taken by respondents during pesticide application, actions taken by respondents when pesticide spill occur, methods of storing pesticide by respondents, and methods of disposing pesticide container.

4.2.1 Types of Pesticide Used by Respondents

Table 4.3: Distribution of respondents according to the type of pesticide used

S/n	Trade Name	Common Name	Type	WHO Class	Frequency (Multiple responses)	Percentage
1.	AtraForce	Atrazin*	Herbicide	III	398	87.5
2.	Best	Cypermethrin	Insecticide	II	412	90.5
3.	Caterpilla	Emamectine benzoate	Insecticide	II	97	21.3
4.	Crush	DDVP*	Insecticide	Ib	56	12.3
5.	DD Force	DDVP*	Insecticide	Ib	108	23.7
6.	Indosine	Mancozeb	Fungicide	III	210	46.2
7.	Gamalin 20	Lindane**	Insecticide	II	89	19.6
8.	Imi Force	Imidacloprid	Insecticide	II	87	19.1
9.	Paraquat	Paraquat Dichloride**	Herbicide	II	287	63.1
10.	Magic	Lambda- cyhalothrin*	Insecticide	II	92	20.2
11.	Force Rocket	Chlorpyriphos**	Insecticide	II	113	24.8

Source: Field Survey, 2016

Note: Ib = highly hazardous; II = moderately hazardous; III = slightly hazardous; (WHO, 2004; PAN, 2009). **Banned product and highly hazardous

Table 4.3 presented above shows the various types of pesticides used by vegetable farmers in Kwara State. Results revealed that herbicides, insecticides and fungicides are the three pesticide types used by vegetable farmers in this study. Atrazin is the most widely used type of herbicide (87.5%) by the vegetable farmers. Although, Atrazin belongs to the WHO class III which has been grouped as slightly hazardous, recent health studies has shown that exposure to atrazin has been associated with increased risk of preterm deliveries. Maternal exposure to atrazin has been associated with low foetal weight, heart, urinary and limb defect in humans (Toxic Substance Portal-Atrazin, 2003). However, research conducted by the U.S National Cancer Institute in 2011 Agricultural Health Study concluded that there was no consistent evidence of an association between atrazin use and any cancer site (Laura *et al.* 2011). This finding is in agreement with the conclusion by a 2011 review of the mammalian reproductive toxicology of atrazin jointly

conducted by the WHO and FAO of the United Nations. They posit that atrazin is not teratogenic. Nevertheless, reproductive effects were seen in rats and rabbits at toxic doses. Such effects are foetal re- absorption, delay in sexual development in female rats and decreased birth weight which is an indication of its possible effect on other mammals too.

As regards Paraquat usage among majority (63.1%), according to Meriel (2011), paraquat is the most toxic herbicide. It has been banned, or restrictions have been placed on its use in 32 countries, mainly due to health reasons. Paraquat is corrosive to the skin and it is easily absorbed into the body once there is contact with the skin. The minimum lethal dose of paraquat is about 35mg/kg body weight for humans (WHO, 1984) and toxicity is more severe and fatal at doses above 40 mg/kg body weight in humans resulting in multiple organ failure within 24-48 hours (IPCS, 2000). Common exposure symptoms include nausea, burns to the mouth, loss of appetite, abdominal pain, thirst, eye injuries, shortness of breath, vomiting, muscle pain, diarrhoea, giddiness, acute respiratory distress, headache, fever, lethargy, and rapid heartbeat. There can be nosebleeds, skin fissures, peeling, burns and blistering, and nail damage including discolouration and temporary nail loss.

This study can deduce from this finding that vegetable farmers are following in path towards bad health if the purchase and use of paraquat persist in the study area. Similar finding was reported by Oluwole and Cheke (2009) of the use of highly hazardous pesticides such as Paraquat and Metolachlor and Monocrotophos among majority of farmers in Ekiti State, Nigeria.

Also shown in Table 4.3 is the WHO classification of the various pesticides used by the vegetable farmers. Results presented revealed that cypermethrin is the insecticide used

by majority (90.5%) of the farmers. Cypermethrin belongs to group II which has been classified as Moderately Hazardous according to the WHO classification. Although, FAO has reported that cypermethrin is neither mutagenic nor teratogenic to man, (Hayes *et al.* 1990), other studies have reported that long-term exposure may cause liver changes and also have adverse effect on the central nervous system. The EPA has reported cypermethrin as a weak possible carcinogen in man because it caused benign lung tumour although at high doses in some species of rats tested (U.S EPA, 1989). The huge concern is the effect of cypermethrin on aquatic organisms. Studies have confirmed that cypermethrin is very lethal to aquatic organisms and bees even at low doses (Waller *et al.* 1988, U.S EPA, 1989).

Results also revealed that about 36% of the vegetable farmers use DDVP, an insecticide belonging to group Ib which is classified as Highly hazardous according to the WHO classification. The FAO Provisional Guidelines on Tender Procedures for the Procurement of Pesticides states that pesticides belonging to this group are restricted and can only be used by specially trained and certified applicators. According to FAO, 1994, such pesticides should not be used by small holder farmers or untrained and unprotected workers in developing countries.

4.2.2 Factors Considered by Respondents Before Purchasing Pesticides

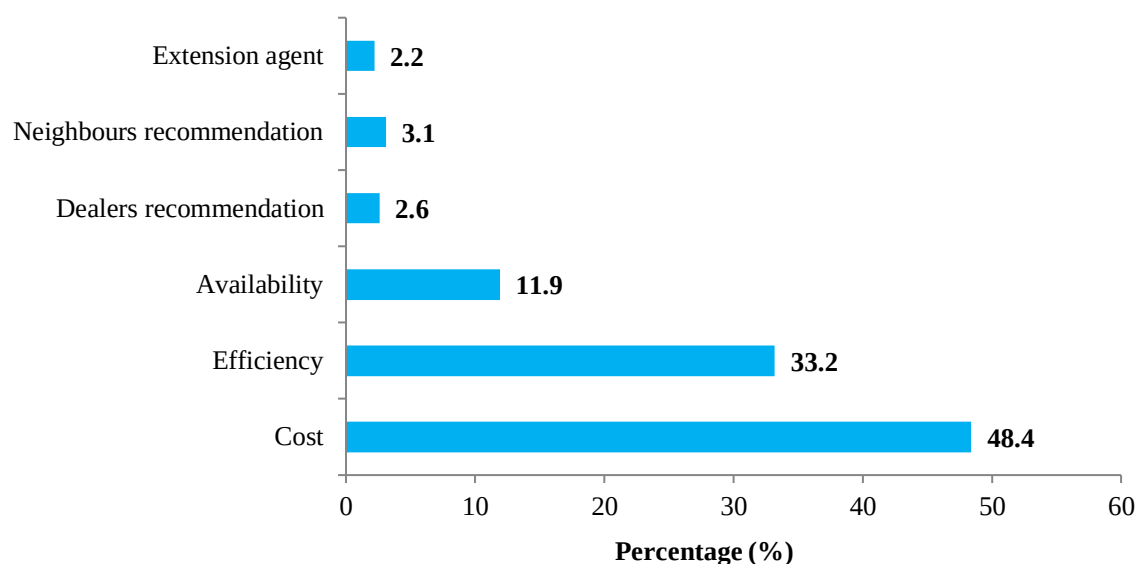


Figure 4.11: Distribution of respondents according to factors they consider before purchasing pesticide

Source: Field survey (2016)

The Figure 4.11 revealed various factors that respondents considered before purchasing pesticides for use on their vegetable farm. Result presented revealed that cost was ranked as the foremost factor considered by vegetable farmers in the study area before making their choice on the type of pesticide to use on their farms. This implies that the cost price of a pesticide formulation would determine whether a farmer could afford to use it or not. Farmers may not buy a particular brand of pesticide if it is perceived costly. The efficacy of the pesticide was ranked as the second factor that vegetable farmers considered before choosing pesticide to be used on their farm. This implies that farmers would prefer to use a pesticide that they perceive to be strong and potent. Availability of pesticide, dealers' recommendation, recommendation by plot neighbours and recommendation by extension agents were ranked third, fourth, fifth and sixth respectively by the farmers. This finding affirmed the earlier studies that cost and efficacy are the most influencing factors for the choice and purchase of pesticide among

farmers in Ekiti State (Oluwole and Cheke, 2009) and in developing countries (Williamson *et al.* 2008).

4.2.3 Technique of Pesticide Application

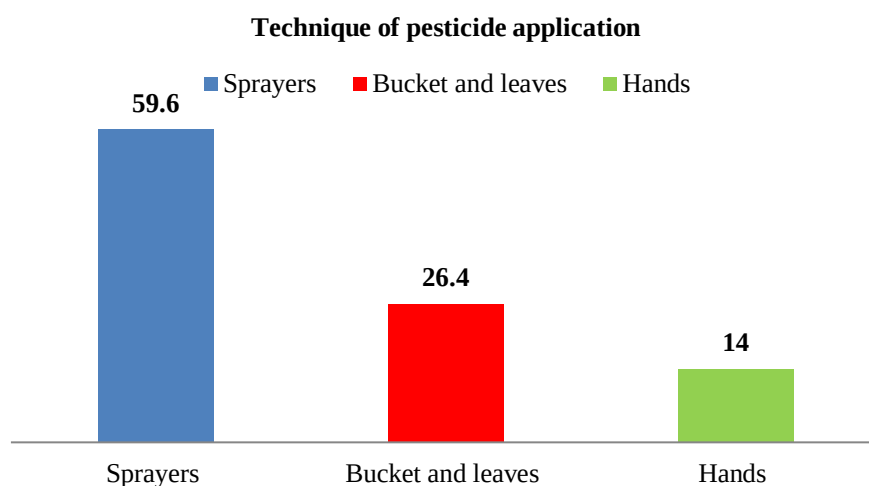


Figure 4.12: Distribution of respondents according to technique of pesticide application

Source: Field Survey (2016)

Figure 4.12 showed that most (59.6%) of the vegetable farmers use knapsack sprayers to apply pesticide on their vegetable farms while 40.4% of the farmers use other materials like buckets with bowl and twigs to sprinkle pesticides on their farms. This finding is consistent with report by Ugwu *et al.* (2015) who found Knapsack sprayer as commonly used equipment for spraying pesticide in Oyo State. However, according to FAO standard, pesticide application should be done with a sprayer. Knapsack sprayer is widely used for pesticide application on small scale farms. Applying pesticide with buckets and twig is the major course through which farmers and the environment are exposed to the adverse effect of pesticide. This is because it is very difficult to regulate the discharge rate of the pesticide solution reaching the crop. Also, the risk of pesticide spill is higher when a sprayer is not used. Inhalation, ingestion and contact with skin are

also unavoidable. The risk of exposure is further compounded because of the usual practice of depending on children to help in fetching water that would be used to mix pesticide. Some farmers also send their children on errand to buy pesticides from chemical peddlers. These practices invariably expose the whole household to the risk of pesticide poisoning. This confirms the findings of Oluwole and Cheke (2009) who reported the involvement of children in pesticide application task such as fetching water for mixing pesticide and purchasing of pesticides from local stores in Ekiti State.

4.2.4 Safety precautions taken by respondents during pesticide application

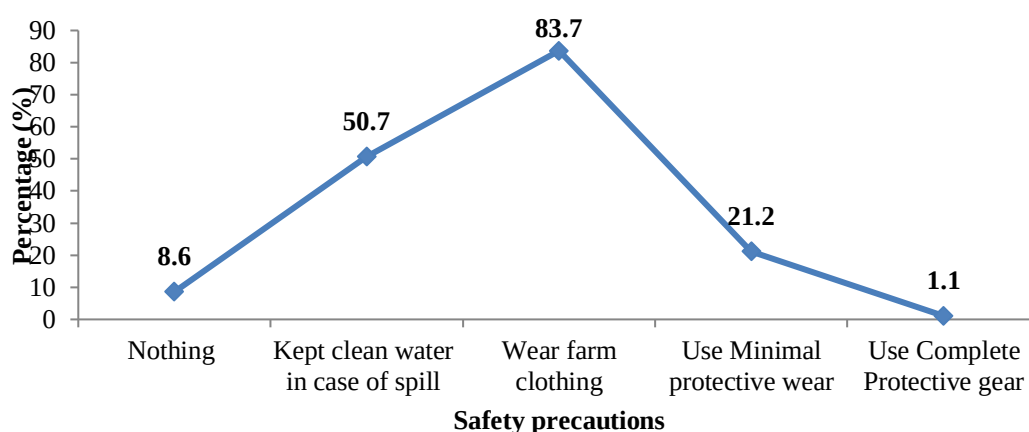


Figure 4.13: Distribution of respondents according to precautions they take when applying pesticide

Source: Field survey (2016)

Results in Figure 4.13 showed the various precautions taken by vegetable farmers when they want to use pesticide on their farms. The majority (83.7%) of the farmers apply pesticide wearing their regular farm clothing and they do not remove such clothing immediately after applying pesticides. About 21% of the farmers wear minimal protective wear which they put on only when they want to apply pesticide and they pull it off after pesticide application. The minimal protective clothing described by the farmers comprise of long sleeve top, long trousers, cap, nose guard, rain booth and

rubber gloves. However, the clothing materials used by majority of the farmers are mostly cotton, wool or synthetic materials which may allow permeation of pesticide thereby bringing it in contact with the farmer's skin. This finding is supported by that of Ajayi *et al.* (2007) and Cheke *et al.* (2009). Majority of the respondents do not follow the FAO recommendation that an overall made of impermeable rubber material be worn on whichever clothing that a farmer wears before handling pesticide. Only 1% of the respondents wear the FAO recommended full protective gear during pesticide application.

This finding suggests that almost 80% of the vegetable farmers in Kwara State do not kit appropriately when applying pesticide, this invariably expose them to the adverse health effect of pesticide. This finding is in agreement with that of Abubakar *et al.* (2015).

4.2.5 Actions Taken by Respondents When Pesticide Spill on the Body Occur

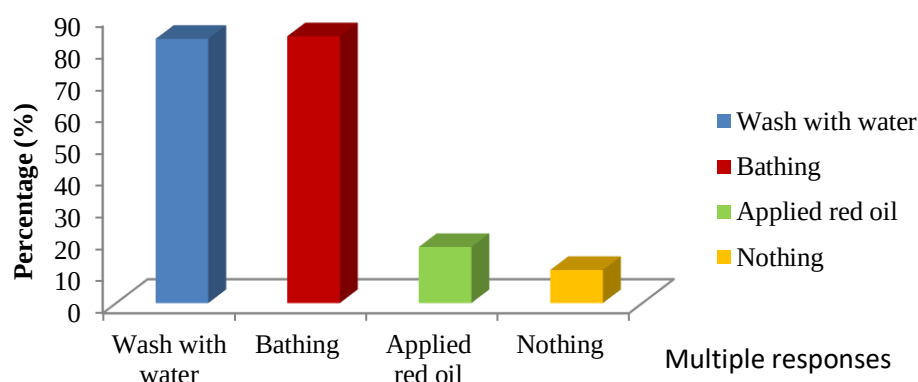


Figure 4.14: Distribution of respondents according to the actions taken when pesticide spill occur

Source: Field survey (2016)

Note: Multiple responses were allowed

The results in Figure 4.14 revealed actions taken by respondents whenever pesticide spills on them during pesticide application. Majority (90%) of the respondents have experienced pesticide spill at one time or the other. A quick wash of the affected part

with water was the first thing done by 82.9% of the respondents and 83.7% of the respondents admit that they quickly rush to take a bath whenever there is incidence of pesticide spill.

4.2.6 Methods of Storing Pesticide by Respondents

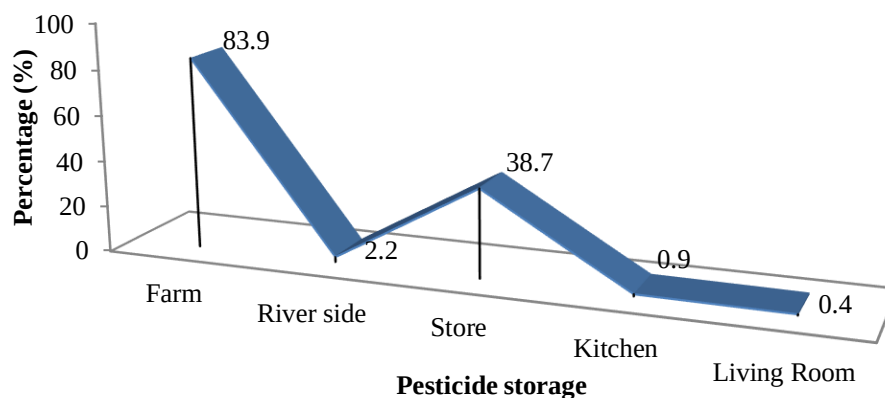


Figure 4.15: Distribution of respondents according to where they store pesticide

Source: Field survey (2016).

Note: Multiple responses were allowed

Figure 4.15 showed the various places where vegetable farmers store their pesticides. Result presented in Figure 4.15 revealed that majority (83.9%) of the farmers store pesticides on the farm usually under trees. About 39% of the farmers keep their pesticides in their stores at home, 2.2% of the vegetable farmers store pesticide near the river within their farm land while 0.9% and 0.4% of the farmers store pesticides on shelves in the kitchen and living rooms respectively. Storing pesticide inappropriately is very dangerous as it predisposes the whole household especially children to hazards associated with pesticides (Tijani, 2006).

4.2.7 Methods of Disposing Pesticide Container

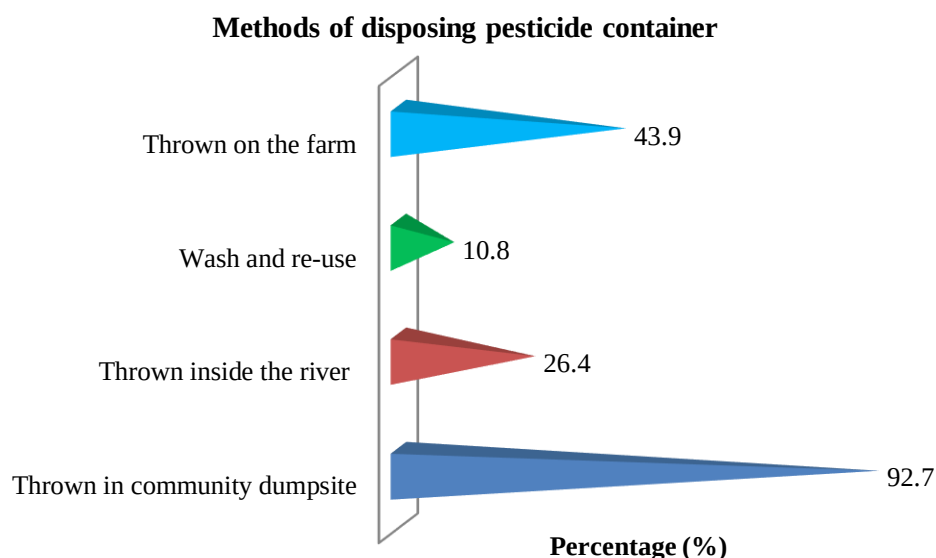


Figure 4.16: Distribution of respondents on how pesticide container is disposed

Source: Field survey (2016)

Note: Multiple responses were allowed

Results in Figure 4.16 revealed how vegetable farmers dispose empty pesticide containers. The results showed that majority (92.7%) of the farmers dump empty pesticide containers in the community dumpsite where they would be burnt. About 44% of the farmers just drop empty pesticide containers on the ground in the farm, 24% of the farmers drop empty pesticide containers in flowing river from which animals drink and also serves as source of water for washing and bathing by community members, while about 11% of the farmers wash and re-use pesticide containers for storage purposes like storing kerosene, liquid soap, used to buy pesticide from retailers or even as water bottle. This finding is buttressed by Tijani (2006) who opined that these practices pose health hazard to the whole household.

4.3 Knowledge of Respondents on Safe Practices during Handling and Application of Pesticides

This section of the study presents the results and discussion on the sources of information on pesticide usage and practices, previous training on pesticide use, awareness of respondents on Best Management Practices for safe handling and application of pesticide and knowledge level of vegetable farmers on Best Management Practices for safe handling and application of pesticide.

4.3.1 Sources of Information on Pesticide Usage and Practices

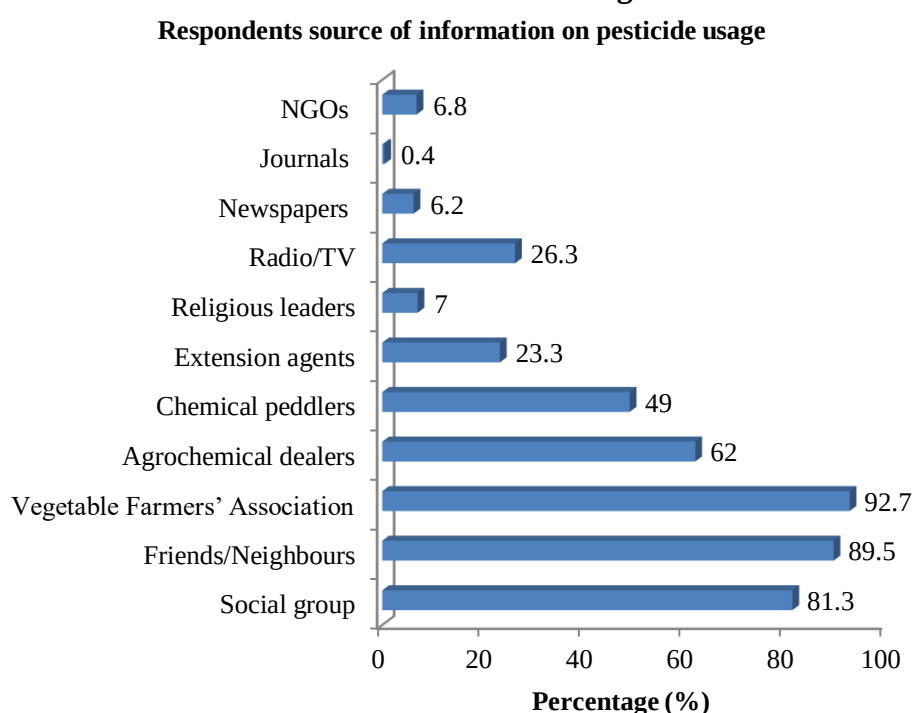


Figure 4.17: Distribution of respondents according to their source of information on pesticide handling and application

Source: Field survey (2016)

Note: Multiple responses were allowed

Results presented in Figure 4.17 reveals that the main sources through which vegetable farmers in the study receive information are through vegetable farmers association (92.7%), plot neighbours (89.5%), social group (81.3%) and agrochemical dealer (62%). This finding is in line with the opinion of Tologbonse *et al.* (2006) that rural households

depend on friends and neighbours for information. Figure 4.17 also revealed that 49% of the farmers get information on pesticide handling from chemical peddlers from whom they buy their chemicals usually on market days. This is in line with the findings of Cheke *et al.* (2009). The implication of this according to Tijani (2006) is the fact that information might be distorted or wrongly passed from person to person since majority of these chemical peddlers are generally illiterates who may not be able to give correct and adequate information like a trained and experienced extension agent would.

4.3.2 Respondents Previous Training on Pesticide Use

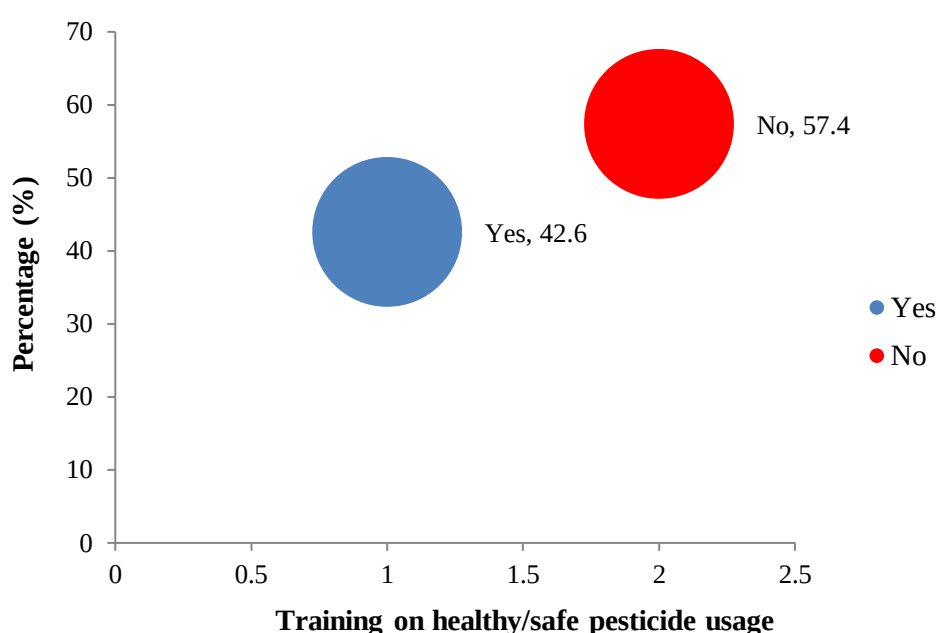


Figure 4.18: Distribution of respondents according to previous training on pesticide handling and usage

Source: Field Survey (2016)

Result in Figure 4.18 revealed that 57.4% of the respondents have never received any training on pesticide handling and usage while a lesser proportion (42.6%) of the respondents indicated that they have had one form of training or the other on pesticide usage. This is in agreement with the findings of Tijani (2006).

4.3.3 Awareness of Respondents on Safe Handling and Application of Pesticide

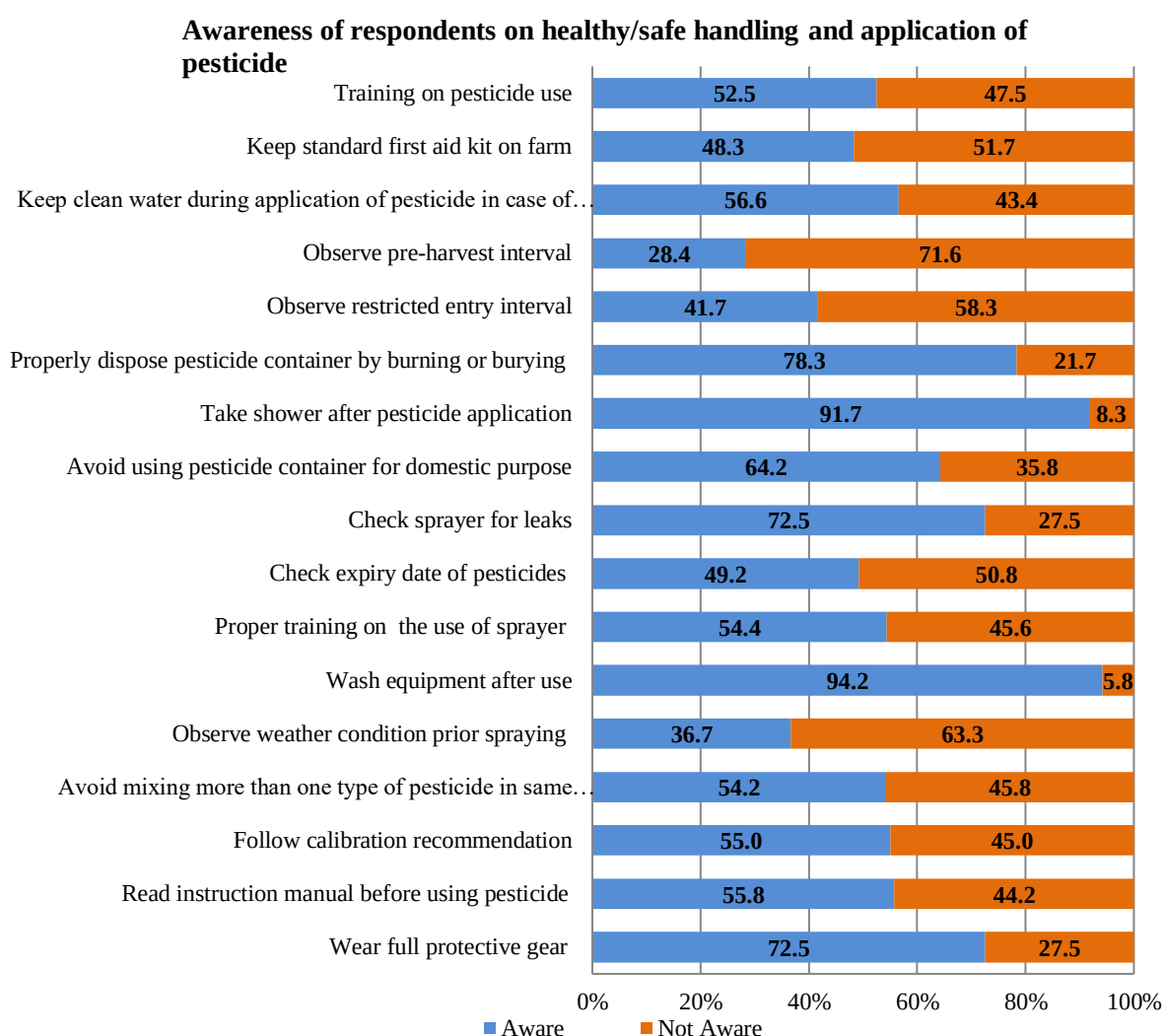


Figure 4.19: Level of Awareness of respondents on recommended practices for safe handling and application of pesticide

Source: Field survey (2016)

The result presented in Figure 4.19 shows the awareness of vegetable farmers on safe practices for pesticide handling and application. The findings reveals that majority of the respondents indicated that they are aware of safe practices during handling and application of pesticide as follows: washing equipment after use (94.2%), taking a bath after pesticide application (91.7%), proper disposal of pesticide container (78.3%), checking sprayer for leaks (72.5%), wearing of protective gear (72.2%), and avoidance of re-using pesticide container for domestic purpose (64.2%). This finding implies that

washing equipment after use, bathing after pesticide application, proper disposal of pesticide container, checking sprayer for leaks, wearing of protective gear, and avoidance of re using pesticide container for domestic purposes are areas where vegetable farmers show high level of awareness and this is expected to influence their pesticide use practices.

4.3.4 Knowledge Level of Vegetable Farmers on Safe Practices for Handling and Application of Pesticide

Table 4.4: Perceived knowledge level of vegetable farmers on safe practices for pesticide handling and application

Knowledge level of vegetable farmers on safe Practices	High Knowledge (%)	Average Knowledge (%)	Little Knowledge (%)	No Knowledge (%)	Mean ($\pm$ SD)	Remark
Wear protective gear	27.2	24.6	24.2	23.9	1.94 $\pm$ 0.62	Low
Read instruction manual before using pesticide	25.1	33.6	28.2	13.1	2.47 $\pm$ 0.74	Low
Follow calibration recommendation	26.5	37.9	19.8	15.8	2.05 $\pm$ 0.82	Low
Avoid mixing more than one type of pesticide in same spraying container	26.9	26.1	11.7	25.3	1.84 $\pm$ 0.59	Low
Observe weather condition prior spraying	27.8	18.3	20.3	33.6	1.48 $\pm$ 0.65	Low
Wash equipment after use	34.6	35.1	16.6	13.8	2.82 $\pm$ 0.83	High
Proper training on the use of sprayer	22.4	37.6	25.5	14.5	2.16 $\pm$ 0.82	Low
Check sprayer for leaks	36.6	39.1	21.2	3.1	3.09 $\pm$ 0.84	High
Avoid using pesticide container for domestic purpose	43.4	27.2	24.3	5.1	2.52 $\pm$ 0.78	High
Take bath after pesticide application	43.3	29.4	13.2	14.1	2.88 $\pm$ 0.81	High
Properly dispose pesticide containers	43.3	36.1	15.5	5.1	3.17 $\pm$ 0.85	High
Observe restricted entry interval	23.8	27.4	27.2	21.6	2.33 $\pm$ 0.85	Low
Observe pre-harvest interval	21.9	26.2	25.4	26.5	2.26 $\pm$ 0.59	Low
Keep clean water during application of pesticide in case of accidental spill	41.0	41.0	14.0	4.0	3.18 $\pm$ 0.73	High
Keep first aid kit on farm	37.1	25.7	22.1	15.1	2.10 $\pm$ 0.77	Low
Training on pesticide use	24.1	28.4	22.9	24.6	2.29 $\pm$ 0.78	Low
Overall mean					2.43	64.7% Low

Source: Field survey (2016)

Benchmark = Mean score of 2.5. Mean score $\geq$ 2.5 = “High knowledge”, and mean score $\leq$ 2.5 = “Low knowledge”.

Results in Table 4.4 showed the knowledge level of vegetable farmers on safe practices for pesticide handling and application using mean score and standard deviation to rate the respondents' knowledge level. As revealed in the Table 4.4, few knowledge areas were perceived to be high. Knowledge areas perceived to be high were washing of equipment after use (mean=3.22), avoidance of using pesticide container for domestic purpose (mean=3.19), taking bath after pesticide application (mean=3.24), and proper disposal of pesticide container (mean=3.17).

The overall mean score of 2.43 indicates low knowledge level with total average percentage of 64.7%. This finding supports report by Williamson, Ball & Pretty (2008) that safety measure that reduces pesticide exposure is largely unknown, with none practice by 86% of farmers in West Africa. This finding implies that vegetable farmers are likely to comply with only few areas of safe practices where they have the applicable knowledge and do otherwise in major areas where knowledge levels were low. In view of this, Badilescu-Biga (2013) identified that knowledge gap is a major element in process of adoption of new innovation; although Badcock-walter (2004) had opined that knowledge is not equivalent to change. Uwagboe (2010) further affirmed that farmers who were trained on Integrated Pests Management (IPM) did not adhere to the practice. This study further suggests that the identified high knowledge areas of safe practices may not translate to use of those practices among vegetable farmers in Kwara State.

4.4 Use of Safe Practices during Handling and Application of Pesticides among Respondents

This section of the study presents the results and discussion on the level of use of safe practices of handling and application of pesticide and the extent of use of safe practices during handling and application of pesticide.

4.4.1 Level of use of safe practices during handling and application of pesticide by vegetable farmers

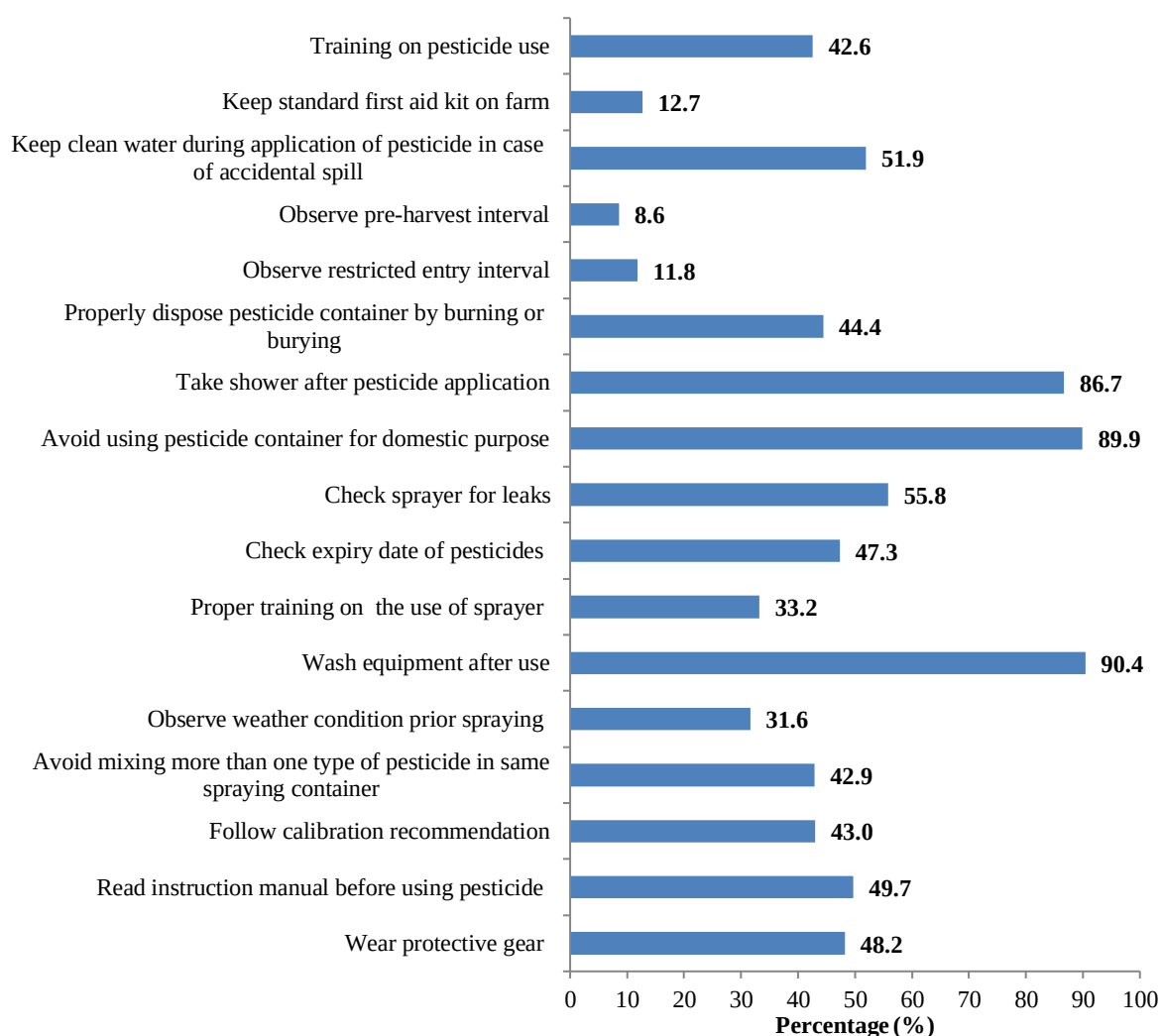


Figure 4.20: Safe practices used by respondents during pesticide handling and application

Source: Field survey (2016)

Results in Figure 4.20 revealed various safe practices being carried out by the respondents during pesticide handling and application in the study area. It was revealed that the practice of washing spraying equipment after use, taking bath after pesticide application and avoid re-using empty pesticide containers for domestic purpose (90.4%, 86.7% and 89.9% respectively) were the major aspects of best management practices mostly observed among vegetable farmers in Kwara State. Result further revealed low compliance with practices like wearing protective gear (48.2%), keeping first aid kit on farm (12.7%), observing weather condition prior spraying (31.6%), and observing restricted entry interval (11.8%). Non-compliance with these practices put farmers and their household at risk of contact with pesticides (Ajayi and Akinnifesi, 2007). Also, following calibration recommendation (43%) and observing pre-harvest interval (8.6%) were not highly used among vegetable farmers. This may increase the risk of pesticide residue in vegetable crops above the Maximum Residue Limit which invariably exposes consumers to health hazards (Sosan and Akingbohunge, 2009). Result in Figure 4.20 also showed low level of compliance with practices like reading instruction manual before using pesticide (42.9%), checking for expiry date (47.3%) and avoid mixing more than one type of pesticide in the same spraying container (42.9%). Such practices tend to alter the potency of pesticides and it has been reported to account for the problem of pest build up and resistance to pesticides (Damalas *et al.* 2006). Furthermore, literature have confirmed that farmers react to the problem of pest build up and resistance by increasing the quantity of pesticide use thereby increasing the risk to their health and the environment likewise (Oluwafemi *et al.* 2009)

4.4.2 Extent of Use of Safe Practices during Handling and Application of Pesticides among Vegetable Farmers

Table 4.5: Extent of use of safe practices during handling and application of pesticides

Recommended safe Practices	Greatly used (%)	Moderately used (%)	Less used (%)	Mean (±SD)	Remark
Wear protective gear	55.2	27.3	17.5	1.71±0.17	Low
Read instruction manual before using pesticide	34.3	32.2	33.5	1.48±0.47	Low
Follow calibration recommendation	29.2	35.8	35	1.46±0.55	Low
Avoid mixing more than one type of pesticide in same spraying container	41.6	32.7	25.7	1.65±0.43	Low
Observe weather condition prior spraying	41.1	34.2	24.7	1.36±0.76	Low
Wash equipment after use	61.7	32.5	5.8	2.32±0.44	High
Proper training on the use of sprayer	40.2	28.2	31.6	1.37±0.62	Low
Check expiry date of pesticides	33.7	32.5	33.8	1.97±0.85	Low
Check sprayer for leaks	56.7	31.4	11.9	2.51±0.57	High
Avoid using pesticide container for domestic purpose	63.2	27.5	9.3	2.58±0.65	High
Take bath after pesticide application	74.2	20.5	5.3	2.65±0.81	High
Properly dispose pesticide container	43.3	25.8	30.9	1.69±0.64	Low
Observe restricted entry interval	25.2	28.5	46.3	1.49±0.73	Low
Observe pre-harvest interval	19.5	26.7	53.8	1.14±0.58	Low
Keep clean water during application of pesticide in case of accidental spill	51.6	38.8	9.6	2.42±0.46	High
Keep first aid kit on farm	21.4	19.3	59.3	1.34±0.64	Low
Training on pesticide use	19.5	34.4	46.3	1.09±0.53	Low
Overall mean				1.7	Low

Source: Field survey (2016)

Benchmark = Mean score of 2.0. Decision rule: Any mean score >2.0 = “Highly used”, mean score of 2.0 = “Moderately used” and mean score < 2.0 = “Low use”

The results in Table 4.5 revealed the extent of use of safe practices during pesticide handling and application among vegetable farmers. Main safe practices used to greater

extent among majority were washing of equipment after use (mean = 2.32), checking sprayer for leaks (mean = 2.51), avoidance of using pesticide container for domestic purpose (mean = 2.58), taking bath after pesticide application (mean = 2.65), and keeping clean water during application of pesticide in case of accidental spill (mean = 2.42).

Other practices where use are limited were wearing of protective gear (mean=1.71), avoid mixing more than one type of pesticide in same spraying container (mean=1.65), observing weather condition prior spraying (mean=1.36), proper training on the use of sprayer (mean=1.37) and proper disposal of pesticide container (mean=1.69). These were not highly used among the vegetable farmers.

The overall mean value of extent of use was 1.7 and was considered low. This suggests that vegetable farmers had low usage in some key areas of pesticide best management practices. Similar finding was reported by Adeola (2012) that majority of farmers did not use safety measure when applying pesticides in Ogbomoso. Studies have also shown that methods for safe handling and application of pesticides are not highly used in many developing countries (Sibanda *et al.* 2000; Tettey, 2001; Addo *et al.* 2002; Dinham, 2003), especially in Africa (Williamson *et al.* 2008).

4.5 Perceived Ill-Health Conditions Experienced as Influenced by the Use of Pesticide among Respondents

Table 4.6: Distribution of respondents according to various symptoms of ill-health observed after pesticide handling and application

Symptoms experienced	Frequency(*)	Percentage
Conjunctivitis (red eye)	297	65.3
Vomiting	56	12.4
Cough	278	61.1
Running nose	157	34.4
Skin blisters/ itchy skin	90	19.7
Headache	120	26.3
Shortness of breath	76	16.7
Rapid heartbeat	32	7.0
Diarrhoea	43	9.5
Dry throat	89	19.6
Dizziness	118	26.0
Convulsion	4	0.9
Flatulence	6	1.3

Source: Field survey (2016)

(*) = Multiple responses

Table 4.6 shows various symptoms experienced by farmers as a result of exposure to pesticide. As shown in the table, majority of the vegetable farmers have experienced conjunctivitis (65.3%) and cough (61.1%). According to Linda (2015) persistent cough can be the signal of a more serious medical complication. Linda (2015) further affirmed that constant coughing can interrupt one's lifestyle in a number of ways. Chronic coughing depletes one's energy, interrupts sleep, leaving one tired all day. In addition to energy depletion, other side effects of coughing include headaches, excessive sweating,

and it makes talking difficult. This shows that cough is a state of illness that is capable of reducing farmers' labour efficiency, reducing man-day work and consequently reduced vegetable production in the study area. This finding is consistent with report by Hawks and Ruel (2006) who noted that in agricultural communities, poor health of farmers leads to reduction in efficiency, productivity and consequently their income reduces.

Other ill health symptoms experienced by few respondents are skin blisters (34.4%), dizziness (26.0%), Headache (26.3%), running nose (19.7%), vomiting (12.4%), shortness of breath (16.7%), flatulence (1.3%), diarrhoea (9.5%), rapid heartbeat (7.0%) and convulsion (0.9%). Similar findings was reported by Oluwole and Cheke (2009) that majority of farmers in Ekiti State suffered from discomforts ranging from eye irritation, skin problems, nausea, headache and vomiting as a result of pesticide use. This study also corroborates the report of Kim, Kabir and Jahan (2017) that health effects of pesticide on farmers include hazards rang from skin and eye irritation, headaches, dizziness, and nausea. Similar study on the effect of pesticide on human by Kim *et al.* (2017) revealed various signs of ill health associated with pesticide use which include skin and eye irritation, headaches, dizziness, and nausea.

Studies had established the relationship between ill health symptoms and productivity of farmers (Ugwu, 2006; Hawkes and Ruel, 2006; Onuche *et al.* 2014; Komolafe *et al.* 2016). So, this study is certain that health hazard arising from the use of pesticide among the vegetable farmers can affect their agricultural production in terms of the efficiency of farm labour for vegetable farm operations. This is because sometimes when farmers are sick they still go to the farm and they are counted fully as being part of the farm labour force. However, their contribution to vegetable farm productivity may be lower because of reduction in the number of hours put into active farming activities and increased absenteeism at work place. This situation occurs often during the incubation stages of

illness until it is full blown when the person becomes bed-ridden (Danjuma and Bashir, 2013). Ugwu, (2006) further found that health affect agricultural system because poor health results in loss of work days or decreases workers capacity, decrease innovation ability and ability to explore diverse farming practices.

In relation to earlier results of low knowledge and use of safe handling and application practices among farmers in Table 4.4 and 4.5, this study suggests that ill health symptoms experienced by vegetable farmers in Kwara State resulted from low use of safety measures of recommended safe practices. This finding corroborates reports by Onasanya and Onasanya 2006; Damalas *et al.* (2006); Ajayi *et al.* (2008) and Sosan and Akingbohunbe (2009) that farmers are exposed to agro-chemical related hazards because they do not apply the necessary safety practices when using agro-chemicals.

4.6 Perceived Health Status of Vegetable Farmers

Table 4.7: Distribution of respondents according to their actual raw scores for the twelve items (SF-12v2) to measure health status

S/no	Raw Scores	Frequency	Percentage
1A	Physical functioning for moderate activities, such as trekking to farm, fetching water etc)		
	1	6	1.3
	2	290	63.7
	3	159	34.9
1B	Physical functioning for weeding plot, thinning and pesticides application		
	1	5	1.1
	2	325	71.4
	3	125	27.5
2A	Role Physical (Accomplished less than you would like)		
	1	49	10.8
	2	123	27.0
	3	256	56.3
	4	13	2.9
	5	14	3.1
2B	Role Physical (Limited in your work or other activities)		
	1	2	.4
	2	1	.2
	3	92	20.2
	4	284	62.4
	5	76	16.7
	Bodily Pain		
3	4	28	6.2
	3	42	9.2
	2	290	63.7
	1	95	20.9
	General Health		
4	2	34	7.5
	3	155	34.1
	4	174	38.2
	5	92	20.2
	Vitality		
5	4	11	2.4
	3	118	25.9
	2	217	47.7
	1	109	24.0

Table 4.7b: Distribution of respondents according to their actual raw scores for the twelve items (SF-12v2) to measure health status

6	Social Functioning		
	1	1	.2
	2	11	2.4
	3	96	21.1
	4	272	59.8
	5	75	16.5
	Role Emotional (Accomplished less than you would like)		
7A	2	17	3.7
	3	68	14.9
	4	347	76.3
	5	23	5.1
	Role Emotional (Did work or other activities less carefully than usual)		
7B	1	2	.4
	2	22	4.8
	3	52	11.4
	4	321	70.5
	5	58	12.7
	Mental Health (Have you felt calm and peaceful)		
8A	1	16	3.5
	2	17	3.7
	3	60	13.2
	4	333	73.2
	5	29	6.4
	Mental Health (Have you felt downhearted and depressed)		
8B	2	7	1.5
	3	47	10.3
	4	357	78.5
	5	44	9.7

Source: Field Survey (2016)

Health status is then calculated for each respondent as the summation of actual raw score minus summation of the lowest possible score (12) divided by summation of the possible raw score (44) multiplied by 100. i.e.: $(\sum A - \sum B) \div \sum D \times 100$. (See table 3).

$$\text{HEALTH STATUS} = \frac{\sum \text{raw scores} - 12}{44} \times 100$$

Table 4.7: Summary of Health Status of Vegetable Farmers in the study area

Health Status	% Score	Frequency	Percentage	Load	Mean Health Status
Excellent (5)	81-100	34	7.5	170	0.374
Good (4)	61-80	381	83.7	1504	3.305
Fair (3)	41-60	39	8.6	117	0.257
Poor (2)	21-40	1	0.2	2	0.004
Bad (1)	0-20	0	0	0	0
Total		455	100	1793	3.94

Source: Field survey (2016)

After respondents were subjected to the Short-Form 12 items version 2 (SF12v2) procedure as measuring tool for health status, the summary of the calculated health status in Table 4.7 shows that majority of the respondents had good health status (83.7%) with total load of 1504 and highest mean score of 3.305. Present health status of respondents shows that vegetable farmers in the study area are capable health-wise to carry-out vegetable farming activities efficiently for increased vegetable production.

This suggests that the general health status of vegetable farmers is found to be good (Table 4.7). The implication is that health challenges are likely not going to be constraint to vegetable production in Kwara State presently (period of this survey). However, the trend of ill-health experienced by vegetable farmers as a result of unavoidable use of pesticides presented in Table 4.6 is the subject of concern. If the trend of farmers' exposure and unsafe application of pesticide continues, the ill health symptoms will continue to increase even to chronic state and therefore, result to poor health status of vegetable farmers in the future. The implication of poor health status will include reduction in farmer's labour efficiency and low vegetable productivity. Related report by Egbetokun *et al.* (2012) on impact of health on agricultural technical efficiency in Nigeria, found that one percent improvement in the health condition of the farmers will increase efficiency by 21 percent. In other words, Hawks *et al.* (2006) noted that in

agricultural communities, poor health of farmers reduces their efficiency, income and productivity.

4.7 Capacity Building Needs of Respondents on Safe Handling and Application of Pesticides

4.7.1 Capacity Building Needs of Vegetable Farmers on Pesticide Handling and Application

The capacity building needs of respondents on certain areas of pesticide handling and application were determined using the Food and Agriculture Organization (FAO, 1992) model of Task and Skill-gap analyses.

4.7.1.1 Task Analysis

In task analysis, the frequency of performance, level of importance and difficulty of carrying out certain task were determined.

4.7.2.1.1 Frequency of Performance of Safe Practices during Pesticide Handling and Application

Table 4.8: Distribution of respondents by frequency of performance of recommended safe practices during pesticide handling and application

Recommended safe practices Task	Seldom (%)	Occasional ly (%)	Monthly (%)	Weekly (%)	Daily (%)	Mean (±SD)	Rating
Wear protective gear	79.4	10.1	3.2	4.8	2.5	1.25±0.46	17 th
Read instruction manual before using pesticide	5.8	31.6	8.4	48.9	5.3	3.23±1.04	5 th
Follow calibration recommendation	1.2	1.2	80.2	9.5	7.9	3.38±0.64	3 rd
Avoid mixing more than one type of pesticide in same spraying container	25.2	21.4	15.9	12.4	25.1	2.98±1.47	7 th
Observe weather condition prior spraying	3.2	2.1	70.1	22.4	2.2	3.29±0.71	4 th
Wash equipment after use	89.1	3.3	3.1	1.4	3.1	1.42±0.35	16 th
Proper training on the use of sprayer	7.5	18.3	38.5	1.2	34.5	3.46±1.29	2 nd
Check sprayer for leaks	14.1	1.9	76.5	6.2	1.3	2.85±0.83	8 th
Avoid using pesticide container for domestic purpose	64.5	25.3	5.1	1.5	3.6	1.98±0.56	12 th
Take bath after pesticide application	65.5	23.8	6.1	2.9	1.7	1.69±0.57	14 th
Properly dispose pesticide container	66.6	25.3	4.4	1.3	2.4	1.89±0.84	13 th
Observe restricted entry interval	25.5	39.9	24.6	8.4	1.6	2.48±0.85	10 th
Observe pre-harvest interval	68.2	18.8	6.1	5.5	1.4	2.65±0.94	9 th
Keep clean water during application of pesticide in case of accidental spill	87.4	4.2	2.1	5.2	1.1	1.55±0.48	15 th
Keep first aid kit on farm	33.4	14.8	45.1	3.2	3.5	1.99±1.78	11 th
Training on pesticide use	17.6	16.6	24.3	5.9	35.7	3.67±1.52	1 st

Source: Field survey (2016)

Results in Table 4.8 showed the frequency of performance of recommended safe practices during pesticide application task among the respondents in the study area, using mean score and standard deviation to rate the opinion of the respondents. It was revealed that training on pesticide use with mean score of 3.67 and standard deviation of 1.52 was rated first among other healthy practices for pesticide application task followed by proper training on the use of sprayer (3.46±1.29) and following calibration recommendation

(3.38 ± 0.64) which ranked 2nd and 3rd respectively. Also, observing weather condition prior spraying (3.29 ± 0.71), reading instruction manual before using pesticide (3.23 ± 1.04), checking expiry date of pesticides (2.99 ± 1.25), avoid mixing more than one type of pesticide in same spraying container (2.98 ± 1.47), checking sprayer for leaks (2.85 ± 0.83), observing pre-harvest interval (2.65 ± 0.94) and observing restricted entry interval (2.48 ± 0.85) rated fourth, fifth, sixth, seventh, eighth, ninth and tenth respectively. Findings revealed that the frequency of performance of pesticide handling and application task of keeping first aid kit on farm (1.99 ± 1.78) was rated eleventh, followed by avoid using pesticide container for domestic purpose (1.98 ± 0.56) which rated twelfth, properly dispose pesticide container (1.89 ± 0.84) rated thirteenth, taking bath after pesticide application (1.69 ± 0.57) rated fourteenth and keeping clean water during application of pesticide in case of accidental spill (1.55 ± 0.48) rated fifteenth. Washing equipment after use (1.42 ± 0.35) and wearing protective gear (1.25 ± 0.46) were the least and rated sixteenth and seventeenth respectively.

4.7.2.1.2 Importance of Safe Practices during Pesticide Handling and Application Task

Table 4.9: Level of importance of safe practices during pesticide handling and application task among respondents

Level of Importance of safe practices for Pesticide application task	Marginally Important (%)	Moderately Important (%)	Extremely Important (%)	Mean (±SD)	Rating
Wear protective gear	7.2	24.6	68.2	2.54±0.68	4 th
Read instruction manual before using pesticide	8.1	28.4	63.5	2.51±0.86	5 th
Follow calibration recommendation	5.5	25.9	68.6	2.59±0.72	3 rd
Avoid mixing more than one type of pesticide in same spraying container	11.2	30.5	58.3	2.49±0.99	7 th
Observe weather condition prior spraying	10.1	40.3	49.6	1.96±0.79	16 th
Wash equipment after use	9.3	42.6	48.1	1.89±0.96	17 th
Proper training on the use of sprayer	10.7	18.7	70.6	2.65±0.49	2 nd
Check expiry date of pesticides	4.5	34.1	61.4	2.50±0.86	6 th
Check sprayer for leaks	11.6	30.3	58.1	2.48±0.99	8 th
Avoid using pesticide container for domestic purpose	9.7	35.4	54.9	2.42±0.75	12 th
Take bath after pesticide application	8.1	39.1	52.8	2.35±0.82	14 th
Properly dispose pesticide container	10.0	35.9	54.1	2.39±0.69	13 th
Observe restricted entry interval	9.8	32.5	57.7	2.47±0.89	10 th
Observe pre-harvest interval	6.3	32.8	60.9	2.48±0.73	9 th
Keep clean water during application of pesticide in case of accidental spill	10.9	38.6	50.5	2.19±0.94	15 th
Keep first aid kit on farm	7.8	35.2	57.0	2.46±0.92	11 th
Training on pesticide use	2.2	24.6	73.2	2.78±0.64	1 st

Source: Field survey (2016)

Benchmark = 2.0, meaning that any mean score of 2 and above is considered “important” and mean score below 2.0 is regarded as “not important”.

Results shown in Table 4.9 revealed the level of importance of safe practices for pesticide handling and application task among respondents in the study area from highest to the lowest as follows: Training on pesticide use (2.78±0.64) ranked 1st, proper training on the use of sprayer (2.65±0.49) ranked 2nd, following calibration recommendation (2.59±0.72) ranked 3rd, wearing protective gear (2.54±0.68) ranked 4th, reading instruction manual before using pesticide (2.51±0.86) ranked 5th, and checking expiry date of pesticides (2.50±0.86) ranked 6th. Also, avoid mixing more than one type of pesticide in same spraying container (2.49±0.99) ranked 7th, checking sprayer for leaks

(2.48 ± 0.99) ranked 8th while observing pre-harvest interval (2.48 ± 0.73) ranked 9th. Observing restricted entry interval (2.47 ± 0.89) ranked 10th and keeping first aid kit on farm (2.46 ± 0.92) ranked 11th, and were considered important among the pesticide handling and application tasks. Further findings showed that avoid using pesticide container for domestic purpose (2.42 ± 0.75), properly disposing pesticide container (2.39 ± 0.69), taking bath after pesticide application (2.35 ± 0.82), keeping clean water during application of pesticide in case of accidental spill (2.19 ± 0.94) were ranked twelfth, thirteenth, fourteenth and fifteenth respectively and regarded as important in pesticide application task. On the other hand, observing weather condition prior spraying (1.96 ± 0.79) and washing equipment after use (1.89 ± 0.96) were ranked sixteenth and seventeenth and considered not important.

4.7.2.1.3 Difficulty of Usage of Safe Practices during Pesticide Handling and Application among the Respondents

Table 4.10: Distribution of respondents by difficulty of usage of safe practices during pesticide handling and application tasks

Level of Difficulties in using safe practices during pesticide handling and application	E (%)	MD (%)	VD (%)	ED (%)	Mean (±SD)	Rating
Wear protective gear	96.1	3.4	0.5	0	1.04±0.16	17 th
Read instruction manual before using pesticide	24.2	26.3	10.1	39.4	2.94±1.24	5 th
Follow calibration recommendation	19.3	25.4	9.5	45.8	3.04±1.29	3 rd
Avoid mixing more than one type of pesticide in same spraying container	41.4	6.7	36.5	15.4	2.35±1.13	7 th
Observe weather condition prior spraying	22.1	28.4	15.2	34.3	2.97±1.31	4 th
Wash equipment after use	95.6	3.5	0.6	0.3	1.05±0.15	16 th
Proper training on the use of sprayer	16.9	24.0	16.8	42.3	3.11±1.19	2 nd
Check expiry date of pesticides	37.5	14.3	26.1	22.1	2.76±1.17	6 th
Check sprayer for leaks	53.6	25.7	2.6	18.1	1.99±1.16	8 th
Avoid using pesticide container for domestic purpose	75.5	14.3	8.1	2.1	1.39±0.64	12 th
Take bath after pesticide application	92.2	2.8	3.2	1.8	1.07±0.39	14 th
Properly dispose pesticide container	85.4	6.9	3.7	4.0	1.19±0.97	13 th
Observe restricted entry interval	64.2	19.7	7.7	8.4	1.57±0.68	10 th
Observe pre-harvest interval	56.3	24.7	3.4	15.6	1.97±1.14	9 th
Keep clean water during application of pesticide in case of accidental spill	94.1	3.8	1.6	0.5	1.06±0.37	15 th
Keep first aid kit on farm	75.1	11.9	10.2	2.8	1.45±0.78	11 th
Training on pesticide use	9.8	3.1	11.7	75.4	3.46±0.72	1 st

Source: Field survey (2016)

E= Easy, MD= Moderately Difficult, VD= Very Difficult, ED= Extremely Difficult

Benchmark = 2.5. Any mean score > 2.5 = extremely difficult, mean score = 2.5 = moderately difficulty and mean score < 2.5 = easy

Results illustrated in Table 4.10 shows the level of difficulty in complying with safe practices for pesticide handling and application from highest to the lowest task among the vegetable farmers. Using mean score and standard deviation to rate respondents' opinion, training on pesticide use (3.46±0.72) ranked 1st, proper training on the use of sprayer (3.11±1.19) ranked 2nd, following calibration recommendation (3.04±1.29) ranked 3rd, observing weather condition prior spraying (2.97±1.31) ranked 4th, reading instruction

manual before using pesticide (2.94 ± 1.24) ranked 5th and checking expiry date of pesticides (2.76 ± 1.17) ranked 6th and were regarded as extremely difficult pesticide handling and application tasks among the respondents. The difficulty experienced by the respondents in reading instruction manual may be connected to their level of education as more than half of the population surveyed are non-literate. Also, findings in Table 4.10 revealed that avoid mixing more than one type of pesticide in same spraying container (2.35 ± 1.13), checking sprayer for leaks (1.99 ± 1.16), observing pre-harvest interval (1.97 ± 1.14), observing restricted entry interval (1.57 ± 0.68), keeping first aid kit on farm (1.45 ± 0.78), avoid using pesticide container for domestic purpose (1.39 ± 0.64) and properly dispose pesticide container (1.19 ± 0.97) were ranked 7th, 8th, 9th, 10th, 11th, 12th and 13th respectively and regarded as easy tasks during pesticide handling and application. Others tasks that were regarded as easy task include taking bath after pesticide application (1.07 ± 0.39), keeping clean water during application of pesticide in case of accidental spill (1.06 ± 0.37), washing equipment after use (1.05 ± 0.15) and wearing protective gear (1.04 ± 0.16) and they ranked 14th, 15th, 16th and 17th accordingly.

4.7.2.1.4 Analysis of Capacity Building Needs of Vegetable Farmers on Safe Practices for Pesticide Handling and Application

Table 4.11: Capacity building needs of vegetable farmers on safe practices during pesticide handling and application

Safe practices for pesticide application task	Mean of Frequency of Performance	Mean of Importance	Mean of Difficulties	Total Mean Score	Remark (Capacity building)
Wear protective gear	1.25	2.54	1.04	4.83	Not needed
Read instruction manual before using pesticide	3.23	2.51	2.94	8.68	Needed
Follow calibration recommendation	3.38	2.59	3.04	9.01	Needed
Avoid mixing more than one type of pesticide in same spraying container	2.98	2.49	2.35	7.82	Needed
Observe weather condition prior spraying	3.29	1.96	2.97	4.43	Not needed
Wash equipment after use	1.42	1.89	1.05	4.18	Not needed
Proper training on the use of sprayer	3.46	2.65	3.11	9.22	Needed
Check expiry date of pesticides	2.99	2.5	2.76	8.25	Needed
Check sprayer for leaks	2.85	2.48	1.99	7.32	Needed
Avoid using pesticide container for domestic purpose	1.99	2.42	1.39	5.8	Not needed
Take bath after pesticide application	1.69	2.35	1.07	5.11	Not needed
Properly dispose pesticide container	1.89	2.39	1.19	5.47	Not needed
Observe restricted entry interval	2.48	2.47	1.57	6.52	Not needed
Observe pre-harvest interval	2.65	2.48	1.97	7.1	Needed
Keep clean water during application of pesticide in case of accidental spill	1.55	2.19	1.06	4.8	Not needed
Keep first aid kit on farm	2.01	2.46	1.45	5.92	Not needed
Training on pesticide use	3.67	2.78	3.46	9.91	Needed
Threshold value				7.00	

Source: Field survey (2016)

Decision rule: Aggregate mean > 7.00 is considered as “capacity building needed” area.

Table 4.11 present the results of task analysis of respondents on pesticide handling and application in the study area. The analysis covers the frequency of performance of each task, the level of importance of such task and level of difficulty encountered in learning the pesticide handling and application tasks. As shown in Table 4.11, tasks where the aggregate mean exceeded the threshold value (7.00) were considered as areas where capacity building is needed. The findings revealed that vegetable farmers need capacity building especially in the area of reading instruction manual before using pesticide

(8.68), following calibration recommendation (9.01), avoid mixing more than one type of pesticide in same spraying container (7.82), proper training on the use of sprayer (9.22), checking expiry date of pesticides (8.25), checking sprayer for leaks (7.32), observing pre-harvest interval (7.10) and training on pesticide use (9.91).

4.7.2.2 Gap Analysis of Vegetable Farmers

4.7.2.2.1 Proficiency Level on Safe Practices during Pesticide Handling and Application among Respondents

Table 4.12a: Level of proficiency on safe practices during handling and application of pesticides

Recommended safe practices for pesticide handling and application task	Cannot complete any part (1)	Can complete less than half the task (2)	Can complete more than half but less than the total (3)	Can complete the entire task but takes too long (4)	Complete the task within time standard (5)	Mean ($\pm\sigma$)
Wear protective gear	3.3	10.2	14.1	30.2	42.2	3.02 $\pm$ 1.72
Read instruction manual before using pesticide	20.3	29.0	45.9	4.8	1.9	2.43 $\pm$ 0.69
Follow calibration recommendation	53.5	25.6	15.7	4.1	1.1	1.85 $\pm$ 0.74
Avoid mixing more than one type of pesticide in same spraying container	38.4	33.9	22.1	5.3	0.3	1.67 $\pm$ 0.89
Observe weather condition prior spraying	1.6	13.5	14.1	25.4	45.4	3.01 $\pm$ 0.63
Wash equipment after use	0.0	0.1	3.2	4.8	91.9	4.22 $\pm$ 0.89
Proper training on the use of sprayer	87.5	10.3	1.7	0.4	0.1	1.29 $\pm$ 0.65
Check expiry date of pesticides	34.5	41.2	21.2	2.9	0.2	2.41 $\pm$ 0.54
Check sprayer for leaks	0.0	0.0	0.8	33.1	66.1	3.98 $\pm$ 0.64
Avoid using pesticide container for domestic purpose	0.0	1.9	4.6	24.2	69.3	3.77 $\pm$ 0.83

Table 4.12b: Level of proficiency on safe practices during handling and application of pesticides

Take bath after pesticide application	0.0	0.0	0.0	3.2	96.8	4.41±0.37
Properly dispose pesticide container	0.0	1.2	4.5	9.6	84.7	3.32±0.75
Observe restricted entry interval	0.0	0.0	3.6	11.8	84.6	3.32±0.44
Observe pre-harvest interval	1.8	6.1	14.2	31.2	46.7	2.25±0.56
Keep clean water during application of pesticide in case of accidental spill	0.0	0.0	1.2	1.7	97.1	4.52±0.53
Keep first aid kit on farm	1.2	1.9	4.6	36.1	56.2	3.14±0.37
Training on pesticide use	23.4	24.8	35.2	16.1	0.5	2.46±0.84

Source: Field survey (2016)

The results in Table 4.12 present the proficiency level of pesticide handling and application tasks among the respondents. Using mean score and standard deviation, the order of proficiency of respondents in pesticide handling and application tasks from highest to the lowest is as follows: keeping clean water during application of pesticide in case of accidental spill (4.52±0.53), taking bath after pesticide application (4.41±0.37), washing equipment after use (4.22±0.89), checking sprayer for leaks (3.98±0.64), avoid using pesticide container for domestic purpose (3.77±0.83), properly dispose pesticide container (3.32±0.75), observing restricted entry interval (3.32±0.44), keeping first aid kit on farm (3.14±0.37), wearing protective gear (3.02±1.72), observing weather condition prior spraying (3.01±0.63), training on pesticide use (2.46±0.84), reading instruction manual before using pesticide (2.43±0.69), checking expiry date of pesticides (2.41±0.54), observing pre-harvest interval (2.25±0.56), following calibration recommendation (1.85±0.74), avoid mixing more than one type of pesticide in same spraying container (1.67±0.89) and proper training on the use of sprayer (1.29±0.65).

4.7.2.2.2 Identification of Tasks with Low Proficiency and Trainable Skills by Vegetable Farmers

Table 4.13: Distribution of respondents by tasks with low proficiency

Safe handling and application practices	Mean score	Level of proficiency					Is proficiency a problem?	Can problem be solved by capacity building
Wear protective gear	3.02	1	2	3	4	5		
Read instruction manual before using pesticide	2.43	1	2	3	4	5	Yes	Yes
Follow calibration recommendation	1.85	1	2	3	4	5	Yes	Yes
Avoid mixing more than one type of pesticide in same spraying container	1.67	1	2	3	4	5	Yes	Yes
Observe weather condition prior spraying	3.01	1	2	3	4	5		
Wash equipment after use	4.22	1	2	3	4	5		
Proper training on the use of sprayer	1.29	1	2	3	4	5	Yes	Yes
Check expiry date of pesticides	2.41	1	2	3	4	5	Yes	Yes
Check sprayer for leaks	3.98	1	2	3	4	5		
Avoid using pesticide container for domestic purpose	3.77	1	2	3	4	5		
Take bath after pesticide application	4.41	1	2	3	4	5		
Properly dispose pesticide container	3.32	1	2	3	4	5		
Observe restricted entry interval	3.32	1	2	3	4	5		
Observe pre-harvest interval	2.25	1	2	3	4	5	Yes	Yes
Keep clean water during application of pesticide in case of accidental spill	4.52	1	2	3	4	5		
Keep first aid kit on farm	3.14	1	2	3	4	5		
Training on pesticide use	2.24	1	2	3	4	5	Yes	Yes

Source: Field survey (2016)

Decision rule:

i. Is proficiency a problem?

Total number of numeral assigned to scales divided by number of scale
 $(1+2+3+4+5)/5=3$. Benchmark= 3. Any mean score < 3.0 indicated as “Yes” and regarded as area where proficiency is a problem.

ii. Can it be solved by capacity building?

Average of number of scale =2.5 was used as benchmark. Any scale below the 2.5 benchmark is regarded “Yes” as skill problem that can be solved through capacity building.

Table 4.13 present the results of gap analysis indicating whether or not a task can be improved upon by capacity building of the respondents. The findings revealed the magnitude of the requirement for capacity building of each task; it revealed the gap between actual performance and the standard. The respondents had low proficiency in the area of reading instruction manual before using pesticide (2.43), checking expiry date of pesticides (2.41), observing pre-harvest interval (2.25), training on pesticide use (2.24), following calibration recommendation (1.85), avoid mixing more than one type of pesticide in same spraying container (1.67) and proper training on the use of sprayer (1.29). The results of gap analysis suggested that all these task deficiencies can be solved or addressed through capacity building of the respondents.

4.8 Constraints to Use of Safe Practices during Handling and Application of Pesticides among Respondents

Table 4.14: Respondent's perception on constraints to the use of safe practices during handling and application of pesticides

Constraints to the usage of safe practices among vegetable farmers when handling pesticide	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	Mean ($\pm\sigma$)	Ranking	Decision
Poor access to pesticides/equipment	29.7	22	28.6	19.7	2.61 $\pm$ 1.11	10 th	Severe
Poor knowledge on pesticide use	53.9	44.6	1.1	0.4	3.52 $\pm$ 0.56	4 th	Severe
Inadequate information on dosage of pesticide	62.7	36.2	0.4	0.7	3.60 $\pm$ 0.58	3 rd	Severe
Lack of government intervention	20	55.4	21.7	3	2.91 $\pm$ 0.77	9 th	Severe
Lack of training on safety measures	10	39	45.9	5.1	2.51 $\pm$ 0.83	11 th	Severe
Financial problem	78.9	19.5	1.3	0.4	3.77 $\pm$ 0.50	1 st	Severe
Difficulty in handling and maintenance of equipment	46.3	41.5	11.8	0.4	3.33 $\pm$ 0.71	5 th	Severe
Literacy and Numeracy problem	64.7	34.2	0.7	0.4	3.63 $\pm$ 0.54	2 nd	Severe
Poor extension services	41.7	36.6	20.2	1.4	3.18 $\pm$ 0.83	6 th	Severe
Lack of public awareness on pesticide classification by hazard	11.8	39.3	35	13.8	2.50 $\pm$ 0.92	12 th	Severe
Lack of understanding of instruction manual	18.4	69.4	8.6	3.7	3.00 $\pm$ 0.74	8 th	Severe
Traditional beliefs	43.7	28.2	25.9	2.2	3.12 $\pm$ 0.93	7 th	Severe
Superstition	0.7	13.1	59.2	27	1.87 $\pm$ 0.65	13 th	Not severe
Grand mean					3.0		Severe

Source: Field survey (2016)

Decision rule: Mean score < 2.50 = Not severe, mean score $\geq$ 2.5 = Severe

Results in Table 4.14 revealed the results of the constraints militating against the usage of safe practices during pesticide application among the respondents' in the study area. From the results using mean score and standard deviation to rank the constraints level according to their order of severity as indicated by the respondents, "financial problem" (mean=3.77 $\pm$ 0.50) was ranked 1st and categorized as severe constraint. Also, "literacy and numeracy problem" (mean=3.63 $\pm$ 0.54), "inadequate information on dosage of pesticide" (mean=3.60 $\pm$ 0.58), "poor knowledge on pesticide use" (mean=3.52 $\pm$ 0.56), "difficulty in handling and maintenance of equipment" (mean=3.33 $\pm$ 0.71), "poor

extension services” (mean=3.18±0.83) were considered as severe and ranked 2nd, 3rd, 4th, 5th and 6th respectively by the respondents.

Furthermore, Table 4.14 showed that “cultural beliefs” (mean=3.12±0.93), “lack of understanding of instruction manual” (mean=3.00±0.74), “lack of government intervention” (mean=2.91±0.77), “poor access to pesticides and equipment” (mean=2.61±1.11) and “lack of training on safety measure” (mean=2.51±0.83) ranked 7th, 8th, 9th, 10th and 11th respectively and likewise considered as severe constraints to the usage of safe practices for pesticide handling and application among respondents. Other constraints include “lack of public awareness on pesticide classification by hazard” (mean=2.47±0.92) and “superstition” (mean=1.87±0.65) which were ranked as 12th and 13th respectively and regarded as severe and not severe constraints respectively

4.9 Test of Hypotheses

4.9.1 Hypothesis One (H₀₁)

There is no significant relationship between usage of safe practices and perceived ill-health experiences among vegetable farmers

Table 4.15: Results of Multiple regressions showing relationship between perceived ill-health experienced and usage of safe practices among vegetable farmers

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig. (p-value)
	(B)	Std. Error	Beta		
(Constant)	0.715	0.330		2.166	0.032
Skin blister	0.294**	0.145	0.114	2.03	0.045
Vomiting	0.197	0.126	0.182	1.566	0.120
Running nose	0.223***	0.071	0.224	3.157	0.002
Dizziness	0.063	0.128	0.059	0.489	0.626
Red eyes	0.296***	0.052	-0.323	5.66	0.001
Flatulence	0.198***	0.072	-0.140	2.756	0.007
Cough	0.132**	0.059	0.121	2.224	0.027
Convulsion	0.104	0.284	-0.013	0.366	0.715
R Square	0.963				
Adjusted Square	R				
	0.938				

Note: ***Significant at 1%, **Significant at 5%.

Result of regression analysis presented in Table 4.15 to identify eight perceived ill-health symptoms in relation to usage of safe practices by vegetable farmers produced R² value of 0.963. This implies that the variables accounted for 96.3% of the observed variations in determining the pesticide practices used by respondents in the study area.

Findings in Table 4.15 further showed that skin blister, running nose, red eyes, flatulence and cough were positive and significant at $p \leq 0.01$ and $p \leq 0.05$ alpha level. Hence, the null hypothesis is rejected and the alternative is accepted. This implies that increase in the persistence of current practices of pesticide use will increase the prevalence of skin

blister, running nose, red eyes, flatulence and cough among vegetable farmers in Kwara State.

4.9.2 Hypothesis Two (H_{02})

There is no significant relationship between selected socio-economic characteristics and the use of safe practices during handling and application of pesticides among respondents

Table 4.16: Results of Significant p-values of Multiple Regression Analysis indicating socio-economic factors determining the level of use of safe practices during handling and application of pesticides among respondents

Socioeconomic Factors	Use of Protective gear	Read instruction manual	Follow calibration recommendation	Avoid mixing pesticide	Use sprayer to apply pesticide	Check for leakages in sprayer before use	Avoid re-use of pesticide containers	Observe restricted entry interval	Observe pre-harvest interval	Keep first aid facility	Training on use of spraying equipment	Training on pesticide use
Age	0.0046**	0.0091**	0.0051**	0.0048*	0.0086***	0.0075**	0.0029**	0.0023*	0.0032*	0.0028**	0.0062*	0.0017
Education	0.0046	0.0544**	0.0671**	-0.0014	0.0505**	0.0789**	0.0315	-0.0231	0.0345*	0.043	-0.0005	-0.065*
Types of vegetable grown	-0.0478	-0.0674	0.0902*	-0.0717*	-0.0652	-0.0033	-0.1587**	-0.0047	-0.111**	-0.0245	-0.0563	0.0544**
Farm size	-0.0621	0.2331*	-0.0142	0.2945*	-0.0803	0.1063	0.0045	0.4432*	0.1467*	0.0762	0.3224*	0.276***
Farming experience	0.0764**	0.0899**	-0.0902**	-0.0631*	-0.0919**	0.1039***	0.0251**	-0.0217	0.0416*	0.054***	-0.07***	-0.024**
Membership of cooperative	0.0953*	-0.5122**	-0.4770*	0.1618*	0.42296**	-0.3512**	0.0701**	0.0628	0.093**	-0.0045	-0.0533	0.059
Extension contact	-0.0414	-0.0384	0.0036	0.1857**	0.0952**	0.0472	0.0857**	0.1310*	0.1663*	0.1274**	0.1804*	-0.0085
Income	0.0069	0.1276	0.3118*	0.3113*	0.00323	0.1418	0.2552*	0.3589*	0.2285*	0.0193	0.1768	0.285***
Constant	2.2618	1.8918	1.9555	0.9785	1.69246	1.5523	1.0108	0.6778	1.1294	1.4434	0.8785	0.5762
R square	0.123	0.513	0.477	0.269	0.052	0.447	0.160	0.232	0.188	0.102	0.128	0.470
Adjusted R square	0.107	0.480	0.426	0.203	0.045	0.409	0.151	0.212	0.108	0.089	0.117	0.463

Source: Field survey (2016)

Note: *Sig at 1%, ** Sig at 5%, ***Sig at 10% level

Table 4.16 presents the analysis of socioeconomic factors determining the usage of recommended safe practices during pesticide application among vegetable farmers in the study area. Eight factors were hypothesized as factors determining vegetable farmers' likelihood to use recommended safe practices during pesticide application. The factors are age, education, types of vegetable crop grown, farm size, farming experience, membership of cooperative group, extension contact and income.

Results presented in Table 4.16 revealed 0.5136, 0.4774, 0.2695, 0.1166, 0.523, 0.4476, 0.1603, 0.0295, 0.0545, 0.2325, 0.1886, 0.1211, 0.1029, 0.1388 and 0.1772 variation in the use of protective gear, reading instruction manual, following calibration recommendation, avoid mixing more than one type of pesticide in same container, washing equipment after use, using sprayer for pesticide application, checking for leakages in sprayer before use, avoid re-using pesticide container for domestic purposes, taking bath after pesticide application, properly discarding pesticide remnant, observing restricted entry interval, observing pre-harvest interval, keeping clean water in case of spill, keeping first aid facility, training on use of spraying equipment and training on pesticide use respectively. The positive values of coefficient implies that increasing the independent variable would increase the farmers likelihood to observe recommended safe practices while those with negative values of coefficient would decrease vegetable farmers likelihood to observe recommended safe practices during pesticide application.

Age was positive and significant at 10% probability level for the use of sprayer for pesticide application; 5% level of probability for the use of protective gear, reading instruction manual, following calibration recommendation, checking for leakage before using sprayer, avoiding re-use of pesticide containers for domestic purposes and keeping first aid kit, while avoid mixing more than one type of pesticide in same container,

observing restricted entry and pre-harvest intervals, and training on use of spraying equipment have positive and significant relationship with age at 1% probability level. This implies that an increase in age will increase the likelihood of vegetable farmers to observe these recommended safe practices during pesticide application.

The level of education of vegetable farmers also has positive and significant relationship with the use of sprayer for pesticide application, reading instruction manual, following calibration recommendation, and checking for leakage before using sprayer, while observing pre-harvest interval was positive and training on pesticide use was negative and significant at 1% level of probability. This suggest that an increase in the level of education of vegetable farmers will likely increase their use of sprayers, reading instruction manual, following calibration recommendation, checking sprayer for leakage and observing pre-harvest interval but reduce their likelihood to get trained on pesticide usage.

Farm size has a positive and significant relationship with the practice of keeping clean water in case of spill and getting trained on pesticide usage both at 10% probability level while reading instruction manual, avoid mixing more than one type of pesticide in same container, washing equipment after each use, training on use of spraying equipment, observing pre-harvest and restricted entry interval have positive and significant relationship with farm size at 1% probability level. This suggests that as farm size increases, the likelihood of vegetable farmers to practice these recommended safe practices during pesticide application would also increase. This implies that farmers with large farms are more likely to observe the above listed recommended safe practices when using pesticide.

Farming experience positively influence the practice of observing pre-harvest interval, use of protective gear, avoiding re-use of pesticide containers, using sprayer for pesticide application, checking sprayer for leakages and keeping first aid facility at 1%, 5%, 5%, 5% and 10% probability level respectively but negatively influenced the practice of avoid mixing more than one type of pesticide in same container, training on the use of spraying equipment at 1% and 10% respectively while it influenced the practice of reading instruction manual, following calibration recommendation and training on pesticide use at 5% significant level. This implies that as farming experience increases, there is a corresponding increase in the likelihood that a vegetable farmer would observe pre-harvest interval, use protective gear, keep first aid facility, use sprayer for pesticide application, check sprayer for leakages before use and avoid re-using pesticide containers. On the other hand, the likelihood that a vegetable farmer would avoid mixing more than one type of pesticide in same container, get trained on the use of spraying equipment, read instruction manual, follow calibration recommendation or get trained on pesticide usage will decrease.

The income level of vegetable farmers has significant and positive influence on the practice of following calibration recommendation, avoid mixing more than one type of pesticide in same container, avoid re-using pesticide container, taking bath after pesticide application, observing restricted entry and pre-harvest intervals and keeping clean water in case of spill at 1% level while it influenced the practice of washing equipment after use and training on pesticide use at 5% and 10% respectively.

Extension contact was positive and significant at 5% level of probability for avoid mixing more than one type of pesticide in same container, using sprayer to apply pesticide, avoid re-using pesticide container, properly discard unused pesticide mixture

and keeping first aid facility while it was significant at 1% level of probability for observing pre harvest and restricted entry intervals and training on the use of spraying equipment.

4.9.3 Hypothesis Three (H₀₃)

There is no significant relationship between the usage level of safe practices during handling and application of pesticides and the perceived health status of respondents.

Table 4.17: Result of Multinomial Regression Analysis showing relationship between the usage level of safe practices during handling and application of pesticides and the perceived health status of respondents

Use of safe handling and application practices of pesticides	Likelihood Ratio Tests			
	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	168.755 ^a	0.001	0	0.001
Use protective gear	169.521 ^b	0.766	3	0.858
Read instruction manual	175.168 ^b	6.413	3	0.093*
Follow calibration recommendation	184.165 ^b	15.409	3	0.001***
Avoid mixing more than 1 type of pesticide in same container	174.563 ^b	5.808	3	0.121
Observe weather condition	175.928 ^b	7.173	3	0.067*
Wash equipment after spraying	172.139 ^b	3.384	3	0.336
Use sprayer	171.898 ^b	3.143	3	0.370
Check expiry date	177.138 ^b	8.382	6	0.211
Check sprayer for leakage	171.800 ^b	3.045	3	0.385
Avoid re-using pesticide container	186.419 ^b	17.663	3	0.001***
Take bath after application	169.618 ^b	0.863	3	0.834
Properly discard container	171.741 ^b	2.985	3	0.394
Observe restricted entry interval	170.857 ^b	2.102	3	0.552
Observe pre harvest interval	183.018 ^b	14.263	3	0.003***
Keep clean water when applying pesticide	177.298 ^b	8.543	3	0.036**
Keep first aid kit	171.853 ^b	3.097	3	0.377
Training on the use sprayer	174.389 ^b	5.634	6	0.465
a. Dependent Variable: health status				

Source: Field survey, 2016.

*Significant at 10%, ** Significant at 5%, *** Significant at 1%

Results in Table 4.17 revealed that following calibration recommendation, avoid re-using pesticide container for domestic purposes and observing pre- harvest interval have positive and significant relationship with farmers' health status at 1% level of significance. Also, keeping clean water as precaution in case of spill during pesticide application has a positive and significant relationship with health status of vegetable farmers at 5% level of significance while reading instruction manual and observing weather condition prior pesticide application both have positive and significant relationship with vegetable farmers' health status at 10% level of significance. Hence, the null hypothesis is rejected and the alternative is accepted. This implies that increase in the level of use of safe practices will improve the health status of vegetable farmers in Kwara State.

4.9. 4 Hypothesis Four (H₀₄)

There is no significant relationship between selected socio-economic characteristics and knowledge level of respondents on safe handling and application practices of pesticides.

Table 4.18: Results of Multiple regression analysis showing relationship between selected socioeconomic characteristics and knowledge level of respondents on safe handling and application practices of pesticides

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	(B)	Std. Error	Beta		
(Constant)	-0.012	0.168		-0.071	0.943
Age	-0.003	0.003	-0.054	-0.899	0.370
Education	0.340***	0.094	0.303	3.604	0.001
Household size	0.001	0.016	0.005	0.065	0.948
Farming experience	0.041***	0.010	0.274	4.091	0.001
Income	0.016**	0.008	0.088	1.986	0.049
a. Dependent variable: knowledge level					
R Square	0.660				
Adjusted Square	R	0.550			

Source: Field survey (2016).

***Significant at 1%; **Significant at 5%

Results of regression analysis shown in Table 4.18 to identify five selected socioeconomic determinants of vegetable farmers' knowledge level on recommended safe practices for pesticide handling and application produced R^2 value of 0.866. This implies that the selected variables accounted for 86.6% of the observed variations in determining the knowledge level of vegetable farmers in the study area.

The findings revealed that level of education ($t=3.604$; $p=0.001$) and farming experience ($t=4.091$; $p=0.001$) have positive and significant relationship with the knowledge level of the respondents while income level of farmers have a positive significant relationship with knowledge level of vegetable farmers ($t=1.986$; $p=0.049$). This implies that more positive change in the level of education, farming experience and income of respondents, the more respondents' knowledge level on pesticide handling and application. Therefore, the null hypothesis is rejected. Other variable include age and household size of respondents which were found to have no significant relationship with knowledge level of respondents in the study area. Therefore, the null hypothesis is accepted. This further

suggests that increase or decrease in the years of age and household size of respondents will not influence their level of knowledge. Knowledge of farming-related hazards is expected to be acquired from farming experience (Adesoji and Kerere, 2013). This submission is buttressed by Adesoji and Kerere (2013) who pointed that that experience also plays a very important role in the process since it is a vital requirement in the transformation of data to wisdom.

4.9.5 Hypothesis five (H₀₅)

There is no significant relationship between the constraints faced and usage level of safe handling and application practices of pesticides among respondents

Table 4.19: Result of Multiple regression analysis showing the level of severity of constraints as determinants of respondents' usage level of safe handling and application practices of pesticides

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig (p-value).
	(B)	Std. Error	Beta		
(Constant)	3.846	0.044		87.628	0.001
Poor access to pesticides/equipment	0.056	0.052	-0.15	-2.354	0.179
Poor knowledge on pesticide use	0.122**	0.041	-0.071	-1.352	0.020
Inadequate information on dosage of pesticide	0.132***	0.036	-0.152	-3.666	0.001
Lack of government intervention	0.082	0.042	-0.07	-1.945	0.055
Lack of training on safety measures	0.087**	0.039	-0.099	-2.196	0.030
Financial problem	0.124***	0.043	-0.145	-2.913	0.004
Difficulty in handling and maintenance of equipment	0.159***	0.028	0.154	-5.725	0.001
Literacy and Numeracy problem	0.099***	0.039	-0.108	-2.524	0.013
Poor extension services	0.137***	0.036	-0.185	-3.804	0.001
Lack of public awareness on pesticide classification by hazard	0.150***	0.041	-0.145	-3.641	0.001
Lack of understanding of instruction manual	0.027	0.045	-0.034	-0.597	0.552
Cultural beliefs	-0.085**	0.041	-0.082	-2.074	0.041
Superstition	0.002	0.052	0.003	0.046	0.964
a. Dependent Variable: Usage level of safe practices					
R Square			0.965		
Adjusted R Square			0.942		

Source: Field survey (2016).

***Significant at 1%, **Significant at 5%,

Result of regression analysis presented in Table 4.19 to identify the severity of constraint variables for determinants of vegetable farmers' use of safe practices for pesticide handling and application produced R² value of 0.965. This implies that the variables accounted for 96.5% of the observed variations in determining the level of usage of safe

practices for pesticide handling and application among vegetable farmers in the study area.

Results further showed that poor knowledge on pesticide use, inadequate information on dosage of pesticide, lack of training on safety measures, financial problem, difficulty in handling and maintenance of equipment, literacy and numeracy problem, poor extension services and lack of public awareness on pesticide classification by hazard were positive and significant at $p \leq 0.01$ and $p \leq 0.05$ levels respectively. Hence, the null hypothesis is rejected and the alternative is accepted. This implies that the more severity of poor knowledge on pesticide use, inadequate information on dosage of pesticide, lack of training on safety measures, financial problem, difficulty in handling and maintenance of equipment, literacy and numeracy problem, poor extension services and lack of public awareness on pesticide classification by hazard constraints among vegetable farmers, the less the usage of safe practices for pesticide handling and application among vegetable farmers in the study area.

4.9.6 Hypothesis six (H_{06})

There is no significant relationship between the types of pesticides used and perceived ill-health symptoms experienced by respondents.

Table 4.20: Result of Multiple regression of the relationship between types of pesticide used and symptoms reported by vegetable farmers

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
(Constant)	0.251	0.019		13.046	.001
Atrazin	0.076**	0.013	0.020	3.411	.002
Cypermethrin	0.044**	0.016	0.131	2.834	.005
Emamectine benzoate	0.008	0.011	0.032	0.713	.476
DDVP-Crush	0.034**	0.014	0.111	2.465	.014
DDVP- DD Force	0.039**	0.011	0.168	3.645	.001
Mancozeb	0.018*	0.009	0.089	1.891	.059
Lindane	0.023*	0.012	0.090	1.960	.051
Imidacloprid	-0.009	0.009	-0.045	-0.985	.325
Paraquat Dichloride	0.038**	0.012	0.149	3.189	.002
Lambda- cyhalothrin	0.002	0.011	0.010	0.218	.827
Chlorpyriphos	0.005	0.010	0.023	0.513	.608

a. Dependent Variable: Symptoms

R square = 0.510

Adjusted R square = 0.429

Source: Field survey (2016).

**significant at 1%, *significant at 5%

Result of multiple regression analysis presented in Table 4.20 to identify the relationship between perceived ill-health symptoms reported and the type of pesticides used by respondents produced R^2 value of 0.510. This implies that the variables accounted for 51% of the observed variations in determining the ill-health symptoms experienced by respondents in the study area.

Findings in Table 4.20 further showed that atrazin, cypermethrin, DDVP and paraquat were positive and significant at $p \leq 0.01$ while mancozeb and lindane were positive and significant at $p \leq 0.05$ alpha level. Hence, the null hypothesis is rejected and the

alternative is accepted. This implies that increase in the use of atrazin, cypermethrin, DDVP, paraquat, mancozeb and lindane will increase the occurrence of ill-health symptoms which include skin blister, running nose, red eyes, flatulence, running nose, vomiting, dizziness, convulsion, diarrhoea, rapid heartbeat, headache, shortness of breath and cough among vegetable farmers in Kwara State.

Prevalence of skin blister, running nose, red eyes, headache, vomiting, shortness of breath, rapid heartbeat, dizziness and cough among respondents may be connected to majority (63.1%) of the respondents (Table 4.3) that used paraquat, an herbicide classified as moderately hazardous according to the WHO classification which is otherwise considered as highly toxic and banned in about 32 countries. The use of Paraquat and DDVP, an insecticide belonging to the WHO hazard class 1b have been attributed to acute respiratory distress, loss of appetite, abdominal pain, thirst, nausea, vomiting, diarrhoea, giddiness, headache, fever, muscle pain, lethargy, shortness of breath and rapid heartbeat among farmers (Meriel, 2011). This finding corroborates studies by Devine and Furlong (2007); Jepson (2009); Kohler and Triebkorn (2013) that risks of ill health are widespread and often severe among farmers because of the nature of pesticide use and the properties of the pesticides themselves. Similarly, Kim *et al.* (2017) had reported that health effects of pesticide on users include hazards ranging from skin and eye irritation, headaches, dizziness, and nausea.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This section presents the summary of major findings, conclusion of the study as well as recommendations made from the study. The section concludes with the recommendations for further studies.

5.1 Socio-Economic Characteristics

The mean age of the vegetable farmers in the study area was 40.3 years. Majority of the respondents were married (85.9%) and grow leafy vegetable (95.8%). More than half of them were female (57.0%), used family labour (55.0%) and had no formal education (50.5%). The mean vegetable farming experience was 24.8 years and majority operated on small scale with mean farm size of 0.3 hectare. All (100%) of the respondents were member of vegetable farmer's group. Majority (60.2%) had no extension contact for vegetable production. Average annual income from vegetable farming was 40,659.56 Naira.

5.1.1 Types of Pesticides used

Cypermethrin Enamectine benzoate (90.5%), Atrazin (87.5%) and Paraquat Dichloride (63.1%) were the commonly used pesticides among majority of the respondents. Cost (48.4%) and efficacy (33.4%) of pesticides were the leading factors considered before purchasing pesticide. Only 59.6% of the respondents used sprayer to apply pesticide. Majority (83.7%) wear farm cloth during application of pesticide as safety precaution measure. If pesticide spill occur, majority wash hands and also take bath (80.0%).

5.1.2 Knowledge on safe handling and application practices of pesticide

Majority were aware of the following safe handling and application practices of pesticide: washing equipment after use (94.2%), bathing after pesticide application (91.7%), proper disposal of pesticide container (78.3%), checking sprayer for leak (72.5%), wearing protective gear (72.2%), and avoidance of re using pesticide container for domestic purpose (64.2%). Few knowledge areas that were perceived to be high were washing of equipment after use (mean=3.22), avoidance of using pesticide container for domestic purpose (mean=3.19), taking bath after pesticide application (mean=3.24), and proper disposal of pesticide container (mean=3.17).

5.1.3 Usage of safe handling and application practices of pesticides

Main safe practices used among majority were washing spraying equipment after use (90.4%), taking bath after pesticide application (86.7%) and avoidance of using empty pesticide containers for domestic purpose (89.9%).

5.1.4 Perceived ill-health conditions experienced as influenced by the use of pesticide

Conjunctivitis (red eye) (65.3%), cough (61.1), and skin blisters (34.4%) were the main symptoms of ill-health perceived to be experienced during or after the application of pesticides.

5.1.5 Perceived health status of respondents

The health status of majority of the respondents based on the SF12v2 measuring tool of health status was good (83.7%) with total load of 1504 and highest mean score of 3.305.

5.1.6 Capacity building needs of respondents on safe handling and application practices of pesticides

The findings revealed that respondents need capacity building especially in the area of reading instruction manual before using pesticide (mean=8.68), following calibration recommendation (mean=9.01), avoid mixing more than one type of pesticide in same spraying container (mean=7.82), proper training on the use of sprayer (mean=9.22), checking expiry date of pesticides (mean=8.25), checking sprayer for leaks (mean=7.32), observing pre-harvest interval (mean=7.10) and training on pesticide use (mean=9.91).

5.1.7 Constraints to the use of safe handling and application practices of pesticides among respondents

Financial problem (mean=3.77±0.50), literacy and numeracy problem (mean=3.63±0.54), inadequate information on dosage of pesticide (mean=3.60±0.58) and poor knowledge on pesticide use (mean=3.52±0.56) were the leading severe constraints to the use of safe practices during handling and application of pesticides among respondents

5.1.8 Test of Hypothesis

5.1.1.1 **Hypothesis one:** Ill-health symptoms such as skin blister ($t=2.03$; $p=0.045$), running nose ($t=3.157$; $p=0.002$), conjunctivitis (red eyes) ($t=5.66$; $p=0.001$), flatulence ($t=-2.756$; $p=0.001$), and cough ($t=2.224$; $p=0.027$) were significantly influenced by the usage of recommended safe practices among respondents.

5.1.1.2 **Hypothesis two:** Socio-economic characteristics such as age, education, types of vegetable grown, farming experience, farm size, membership of vegetable

group, and income were determinant of the level of use of safe handling and application practices of pesticides among respondents.

5.1.1.3 **Hypothesis three:** Use of safe handling and application practices of pesticides such as reading instruction manual ($X^2=6.413$, $p=0.093$), following calibration recommendation ($X^2=15.409$, $p=0.001$), avoid re-using pesticide container ($X^2=17.663$, $p=0.001$), and observing pre-harvest interval ($X^2=14.263$, $p=0.003$), and keeping clean water when applying pesticide ($X^2=8.543$, $p=0.036$) were the practices that significantly influenced the perceived health status of vegetable farmers.

5.1.1.4 **Hypothesis four:** Socio-economic characteristics such as education ($t=3.604$; $p=0.000$), farming experience ($t=4.091$; $p=0.001$), and income ($t=1.986$; $p=0.049$) were determinant for level of knowledge on safe practices for pesticide handling and application among respondents.

5.1.1.5 **Hypothesis five:** Constraints such as poor knowledge on pesticide use ($t=1.352$; $p=0.020$), inadequate information on dosage of pesticide ($t=3.666$; $p=0.001$), financial problem ($t=2.913$; $p=0.001$), difficulty in handling and maintenance of equipment ($t=5.725$; $p=0.001$), literacy and numeracy problem ($t=2.524$; $p=0.013$), poor extension services ($t=3.804$; $p=0.001$) and lack of public awareness on pesticide classification by hazard ($t=3.641$, $p=0.001$) were determinants for the usage of safe practices for pesticide handling and application among respondents.

5.1.1.6 **Hypothesis six:** The types of pesticides used by respondents which include atrazin, cypermethrin, DDVP, paraquat, mancozeb, and lindane were determinants for the reported ill-health experienced by respondents after pesticide application.

5.2 Conclusion

Based on findings, this study concludes that despite the good health status (84%) found among vegetable farmers using pesticides, majority were found to have experienced conjunctivitis (red eye) (65%) and cough (61%) as a form of ill health that were significantly associated with the use of pesticides in Kwara State,

The following specific answers of conclusion were given to each research questions of the study:

- i. With long years of planting leafy vegetable, vegetable farmers in Kwara State still operates small scale vegetable farms.
- ii. Vegetable farmers in Kwara State commonly use Cypermethrin Emamectine Benzoate, Atrazin and Paraquat Dichloride pesticides because of their efficacy and lower cost.
- iii. Knowledge of vegetable farmers in Kwara State on safe practices for pesticide handling and application was considered low. This is explained by 64.7% of the total knowledge areas where knowledge were considered low.
- iv. Main safe practices for pesticide handling and application used by vegetable farmers in Kwara State are washing spraying equipment after use, taking bath after pesticide application and avoidance of re-using pesticide containers for domestic purpose.
- v. Vegetable farmers in Kwara State perceived that they experienced several ill-health conditions as a result of exposure to pesticides which include mainly redness of the eye, cough and skin blisters.

- vi. Health status of vegetable farmers was found to be good regardless of their exposure to pesticide.
- vii. Capacity/competency of vegetable farmers in Kwara State was low in the area of reading instruction manual before using pesticide, following calibration recommendation, avoid mixing more than one type of pesticide in same spraying container, proper training on the use of sprayer, checking expiry date of pesticides, checking sprayer for leaks, observing pre-harvest interval and training on pesticide use.
- viii. Constraints to the use of safe practices during handling and application of pesticides are financial problem, literacy and numeracy problem, inadequate information on dosage of pesticide, and poor knowledge on pesticide use.

5.3 Recommendations

Based on the findings of this study, the following recommendations were made:

- i. Vegetable farmers in Kwara State should take advantage of their membership in the existing vegetable farmers associations where they belong to pool resources together to help themselves. The inclusion of this in vegetable groups where it does not exist is expected to facilitate easy access for finance, market and extension linkage that will result to increased vegetable farm size and income in the area.
- ii. Extension agents should enlighten vegetable farmers on types of pesticides that are safe and effective for the control of pests on vegetable farms to further discourage the purchase of cheap and harmful pesticides which can pose hazardous effect to farmers' health.

- iii. Extension organizations should train and improve the practical knowledge of vegetable farmers on safe practices for pesticide handling and application. Farmers too should be encouraged to attend meetings, on-farm demonstrations, trainings and workshops organized by the extension workers for farmers. This will equip farmers with correct and adequate knowledge on safe pesticide usage.
- iv. Extension agents should also encourage vegetable farmers to always adhere to the usage of safe practices during handling and application of pesticide especially for following specific neglected practices: wearing of protective gear, reading of instruction manual before using pesticide, following calibration recommendation, avoid mixing more than one type of pesticide in same spraying container, observing weather condition prior spraying, checking of expiry date of pesticides, Proper disposal of pesticide containers, observing restricted entry interval, observing pre-harvest interval, and keeping first aid kit on farm.
- v. Extension agents should leverage on farmers recognitions of ill-health symptoms attributed to the use of pesticide as identified by farmers in this study to further discourage farmers from the use of hazardous pesticide, encourage effective use of pesticide safety precautions and enlighten them on other ill-health conditions that could result from continuous use of hazardous practices or unhealthy practices during pesticide application.
- vi. Good health status of vegetable farmers should be maintained for improved labour efficiency of farmers. Vegetable farmers in Kwara State are encouraged to often visit health centers for medical check-up and report any

occurrence of ill-health symptoms observed during pesticide use immediately to medical personnel for proper medical advice.

- vii. While designing training programme for vegetable farmers in Kwara State, extension organizations should incorporate in their training programme for safe use of pesticide in the following areas: reading instruction manual before using pesticide, following calibration recommendation, avoid mixing more than one type of pesticide in same spraying container, knowledge on the use of sprayer, checking expiry date of pesticides, checking sprayer for leaks, and observing pre-harvest interval.
- viii. Government and non-governmental agencies concerned should work hard to minimise the hindrances of financial problem, literacy and numeracy problem, inadequate information on dosage of pesticide, and poor knowledge on pesticide use among vegetable farmers in Kwara State by making available soft loans and adult literacy classes to farmers. This will equip farmers with necessary information and empower them to be able to implement safe practices during pesticide handling and application and thereby remain healthy to carry-out their daily farming activities.

5.4 Suggestions for further Studies

The study had investigated the effects of the use of pesticide on health status of vegetable farmers in Kwara State.

- i. Further study is needful to assess the effect of pesticides residue in vegetable crops on health status of consumers (most especially raw or partly cooked vegetables among farmers, livestock and general public).

- ii. Similar study may also be carried out among farmers that cultivate crop that uses intensive pesticides such as cocoa production in South Western part of the country.
- iii. This study was also limited to the retrospective self-report of health effects of pesticide use; hence, further longitudinal studies can be carried out to assess the effects of pesticides on vegetable farmer's health which may require blood testing, laboratory work and other medical examinations of farmers.

CONTRIBUTION TO KNOWLEGDE

This study had investigated the usage of pesticide and the perceived health status of vegetable farmers in Kwara Stata, Nigeria.

It has been able to establish that contrary to the perceived good health status among vegetable farmers using pesticides in, majority experienced conjunctivitis (red eye) and cough as a form of ill health that were significantly associated with the use of pesticides in Kwara State, Nigeria. It is therefore, recommended that vegetable farmers should be well informed and trained on the importance of safety practices of pesticide use.

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APPENDIX
QUESTIONNAIRE
UNIVERSITY OF ILORIN
FACULTY OF AGRICULTURE
DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL
DEVELOPMENT

**TITLE: PESTICIDE USE PRACTICES AND PERCEIVED HEALTH STATUS
AMONG VEGETABLE FARMERS IN KWARA STATE, NIGERIA**

Dear Respondent,

This questionnaire is designed to obtain information on the above stated topic. All information collected will be used for pure academic exercise and will be treated with utmost confidentiality.

Thanks in anticipated cooperation.

ADEWOLE, Adefunke

Questionnaire ID:

LGA:

Village/community:

Date of interview:

SECTION A: Socio-economic characteristics of respondents

1. Age in years: -----
2. Sex: Male () Female ()
3. Religion: Islam () Christianity () Traditional worshipper ()
4. Education status: No formal () Primary () Secondary () Tertiary () others, specify.
5. Which of the following vegetable crops do you grow: Okro (), Spinach (), Pepper (), Tomatoes (), Cabbage (), Garden egg (), others, specify.
6. How many years have you been planting vegetables: -----

7. How many years have you been using pesticides: -----
8. Farm size in hectares: -----
9. What is your Average Annual Income from vegetable farming in naira:-----
10. What source of labour do you use: Family () Communal () Hired ()
11. Do you have contact with extension agent? Yes () No ()
12. If yes, how often? No contact (), Monthly (), Quarterly (), Yearly ()

SECTION B: Pesticide use Practices among vegetable farmers

Source of information on pesticide use	Always	Sometimes	Never
Social groups			
Farmers' union			
Extension workers			
Religious leaders			
Radio/ television			
Newspaper			
Journals			
NGO			
Friends and neighbours			
Others			

15. Have you received any training on pesticide use and handling?-----

16. What type(s) of pesticide do you use: -----
17. State the different types of pests you have identified on your vegetable farm
18. How many weeks after planting does the infestation usually occur?
17. How do you obtain them? -----
18. What quantity of pesticide do you use per hectare?-----
19. At what interval do you apply pesticides?-----
20. What equipments do you use during pesticide application?-----
21. What precautions do you take when applying pesticides?-----
22. What do you do if pesticide spill occur? -----
23. Where do you store or keep pesticides?-----
24. How do you dispose empty pesticide containers?-----
25. What do you do with left-over/excess pesticide after application? -----
26. The following are factors considered before considering the type of pesticide to use on your vegetable farm. Please rank them accordingly based on their importance

Source of information on pesticide use	Rank
Extension agent recommendation	
Neighbor's recommendation	
Dealer's recommendation	
Availability	
Efficacy	
Cost	

28. Please, tick appropriately based on your level of awareness on safe practices for pesticide handling and application

Awareness of vegetable farmers on Safe Practices	Fully Aware	Somewhat Aware	Not Aware
Wear protective gear			
Read instruction manual before using pesticide			

Follow calibration recommendation			
Avoid mixing more than one type of pesticide in same spraying container			
Observe weather condition prior spraying			
Wash equipment after use			
Proper training on the use of sprayer			
Check expiry date of pesticides			
Check sprayer for leaks			
Avoid using pesticide container for domestic purpose			
Take bath after pesticide application			
Properly dispose pesticide container			
Observe restricted entry interval			
Observe pre-harvest interval			
Keep clean water during application of pesticide in case of accidental spill			
Keep first aid kit on farm			
Training on pesticide use			

29. Please, tick appropriately based on your level of use of the following safe practices for pesticide handling and application

Extent of use of Safety Practices	Used	Not used
Wear protective gear		
Read instruction manual before using pesticide		
Follow calibration recommendation		
Avoid mixing more than one type of pesticide in same spraying container		
Observe weather condition prior spraying		
Wash equipment after use		
Proper training on the use of sprayer		
Check expiry date of pesticides		
Check sprayer for leaks		
Avoid using pesticide container for domestic purpose		
Take bath after pesticide application		
Properly dispose pesticide container		
Observe restricted entry interval		
Observe pre-harvest interval		
Keep clean water during application of pesticide in case of accidental spill		
Keep first aid kit on farm		

Training on pesticide use		
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30. Please, tick appropriately based on your perceived level of knowledge on safe practices for pesticide handling and application

Knowledge of vegetable farmers on Safe Practices	No Knowledge	Low Knowledge	Average Knowledge	High Knowledge
Wear protective gear				
Read instruction manual before using pesticide				
Follow calibration recommendation				
Avoid mixing more than one type of pesticide in same spraying container				
Observe weather condition prior spraying				
Wash equipment after use				
Proper training on the use of sprayer				
Check expiry date of pesticides				
Check sprayer for leaks				
Avoid using pesticide container for domestic purpose				
Take bath after pesticide application				
Properly dispose pesticide container				
Observe restricted entry interval				
Observe pre-harvest interval				
Keep clean water during application of pesticide in case of accidental spill				
Keep first aid kit on farm				
Training on pesticide use				

Capacity building needs of vegetable farmers on pesticide handling and application

i. Frequency of performance of vegetable farmers on pesticide handling and application

Please kindly indicate your level of frequency of performing the following tasks in the table below:

Safe practices for pesticide handling and application task	Seldom (%)	Occasionally (%)	Monthly (%)	Weekly (%)	Daily (%)
Wear protective gear					
Read instruction manual before using pesticide					
Follow calibration recommendation					
Avoid mixing more than one type of pesticide in same spraying container					

Observe weather condition prior spraying					
Wash equipment after use					
Proper training on the use of sprayer					
Check expiry date of pesticides					
Check sprayer for leaks					
Avoid using pesticide container for domestic purpose					
Take bath after pesticide application					
Properly dispose pesticide container					
Observe restricted entry interval					
Observe pre-harvest interval					
Keep clean water during application of pesticide in case of accidental spill					
Keep first aid kit on farm					
Training on pesticide use					

ii. Importance of pesticide handling and application tasks to vegetable farmers

Listed in the table below are safe practices for pesticide handling and application tasks.

Please kindly indicate the level of importance of each task to you.

Safe practices for pesticide handling and application task	Marginally Important (%)	Moderately Important (%)	Extremely Important (%)
Wear protective gear			
Read instruction manual before using pesticide			
Follow calibration recommendation			
Avoid mixing more than one type of pesticide in same spraying container			
Observe weather condition prior spraying			
Wash equipment after use			
Proper training on the use of sprayer			
Check expiry date of pesticides			
Check sprayer for leaks			
Avoid using pesticide container for domestic purpose			
Take bath after pesticide application			
Properly dispose pesticide container			
Observe restricted entry interval			
Observe pre-harvest interval			
Keep clean water during application of pesticide in case of accidental spill			
Keep first aid kit on farm			

Training on pesticide use			
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iii. Difficulty of respondents in performing the pesticide handling and application tasks

Please kindly indicate your level of difficulty in performing the following tasks in the table below:

Safe practices for pesticide handling and application task	Easy (%)	Moderately Difficult (%)	Very Difficult (%)	Extremely Difficult (%)
Wear protective gear				
Read instruction manual before using pesticide				
Follow calibration recommendation				
Avoid mixing more than one type of pesticide in same spraying container				
Observe weather condition prior spraying				
Wash equipment after use				
Proper training on the use of sprayer				
Check expiry date of pesticides				
Check sprayer for leaks				
Avoid using pesticide container for domestic purpose				
Take bath after pesticide application				
Properly dispose pesticide container				
Observe restricted entry interval				
Observe pre-harvest interval				
Keep clean water during application of pesticide in case of accidental spill				
Keep first aid kit on farm				
Training on pesticide use				

iv. Proficiency level of pesticide handling and application skills of vegetable farmers

Please kindly indicate your perceived level of proficiency of performing the following tasks in the table below:

Safe practices for pesticide handling and application task	Cannot complete any part (1)	Can complete less than half the task (2)	Can complete more than half but less	Can complete the entire task but	Complete the task within time

			than the total (3)	takes too long (4)	standard (5)
Wear protective gear					
Read instruction manual before using pesticide					
Follow calibration recommendation					
Avoid mixing more than one type of pesticide in same spraying container					
Observe weather condition prior spraying					
Wash equipment after use					
Proper training on the use of sprayer					
Check expiry date of pesticides					
Check sprayer for leaks					
Avoid using pesticide container for domestic purpose					
Take bath after pesticide application					
Properly dispose pesticide container					
Observe restricted entry interval					
Observe pre-harvest interval					
Keep clean water during application of pesticide in case of accidental spill					
Keep first aid kit on farm					
Training on pesticide use					

31. Which of these symptoms of ill-health do you experience after applying/using pesticides?

SYMPTOMS OF ILL HEALTH	YES	NO
Redness of the eye/ blurring of vision		
Vomiting		
Cough		
Running nose		
Skin blisters/ itchy skin		
Headache		
Shortness of breath		
Rapid heartbeat		
Diarrhoea		
dry throat		
Dizziness		

Convulsion		
Flatulence		

Perceived Health Status of Vegetable Farmers

For each of the items listed in this section, please tick appropriately the option that best suit your response.

Physical Functioning:

32. To what extent have you been limited in performing the following activities?

1a. Moderate activities, such as trekking to farm, fetching water,

1b. Weeding plot, thinning, applying pesticides

Response choices	Score
Yes, limited a lot	1
Yes, limited a little	2
Not limited at all	3

2. Role Physical:

2a. Do you accomplished less than you would like

2b. Are you limited in your work or other activities

Response choices	Score
All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

3. Bodily Pain:

How much does pain interfere with your normal work (farm work and house work)?

Response choices	Pre coded item value
Not at all	1
A little bit	2
Moderately	3
Quite a bit	4
Extremely	5

4. General Health:

In general, would you say your health is

Response choices	Score
Excellent	5

Very good	4
Good	3
Fair	2
Poor	1

5. Vitality:

Do you have a lot of energy

Response choices	Score
All of the time	5
Most of the time	4
Some of the time	3
A little of the time	2
None of the time	1

6. Social Functioning:

How much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)

Response choices	Score
All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

7. Role Emotional:

Do you accomplish less than you would like

Did you do your work or other activities less carefully than usual

Response choices	Score
All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

8. Mental Health:

Have you felt calm and peaceful

Have you felt downhearted and depressed

Response choices	Score
All of the time	1
Most of the time	2
Some of the time	3
A little of the time	4
None of the time	5

Constraints to the use of safe practice for pesticide application among vegetable farmers:

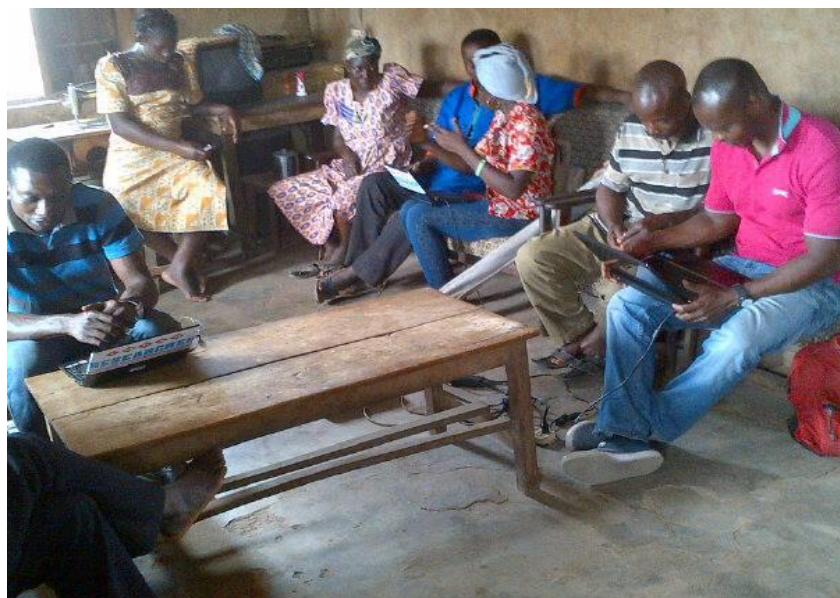
The following are constraints to the use of safe practices in pesticide application. Please tick as applicable.

Constraints to the usage of safe practices among vegetable farmers when handling pesticide	Very severe (%)	Severe (%)	Less severe (%)	Not severe (%)
Poor access to pesticides/equipment				
Poor knowledge on pesticide misuse				
Wrong information on dosage of pesticide				
Lack of government intervention				
Lack of training on safety measures				
Financial problem				
Handling and maintenance of equipment				
Literacy and Numeracy problem				
Poor extension services				
Lack of public awareness on pesticide classification by hazard				
Lack of understanding of instruction manual				
Cultural beliefs				
Superstition				

PICTURES



Picture showing woman working on her vegetable farm as enumerator collects data



Picture showing enumerators working with a group of vegetable farmers during the data collection process



Cross section of participants during a focus group discussion



Picture showing a farmer eating cucumber while working on his recently sprayed vegetable farm



Picture showing process of seeking consent before taking pictures of vegetable farmers



Picture showing unsafe disposal of empty pesticide container



Picture showing woman mixing pesticide with bare hands



Picture showing woman applying pesticide on vegetable farm without recommended protective wear



Picture showing an okro field sprayed with insecticide