



**EFFECTIVENESS OF STAKEHOLDERS' INFORMATION ON PESTICIDE  
HANDLING KNOWLEDGE AND PRACTICE OF FARMERS IN SHEBEDINO  
WOREDA, SIDAMA REGIONAL STATE, ETHIOPIA**

**MSc. THESIS**

**BY**

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A THESIS SUBMITTED TO THE  
DEPARTMENT OF BIOLOGY, HAWASSA COLLEGE OF NATURAL AND  
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**ADVISORS' APPROVAL SHEET**  
**SCHOOL OF GRADUATE STUDIES**  
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This is to certify that the thesis entitled "**Effectiveness of a stakeholders' Information on Pesticide Handling Knowledge and Practice of Farmers in Shebedino Woreda, Sidama Regional state, Ethiopia**" submitted in partial fulfillment of the requirements for the **Degree of Master's** with specialization in **Ecotoxicology and Environmental Health**, the Graduate program of the **Department of Biology** and has been carried out by **Asrat Kebede Woshe** Id.No. **GPEcEHR/0002/14**, under my supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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## **DECLARATION**

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other University, and all sources material used for this thesis have been duly acknowledged.

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## **ABBREVIATION AND ACRONMYS**

FAO	Food and Agriculture Organization
LSGH	Large-Scale Closed Green House
SSIF	Small-Scale Irrigation Farms
PPE	Personal Protective Equipment
WHO	World Health Organization
WOFED	Woreda Finance and Economic Development
HHs	Households
NGO	Non-Government Organization
FGD	Focus Group Discussion
AEW	Agricultural Extension Worker
KIS	key Informants
USEPA	United State Environmental Protection Agency

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## ABSTRACT

*Pesticides are widely used in agricultural production to control pests, diseases and maintain high product quality. Increase pesticide use has led to potentially adverse effect on human health and environment, particularly; in those where society used inadequate pesticide handling is practiced. This study aimed to assess effectiveness of a stakeholders' information on pesticide handling knowledge and practice of farmers in Shebedino Woreda, Sidama Regional state, Ethiopia. Description cross-sectional research design was employed and study kebele were selected by purposive sampling. HH were selected by systematic random techniques. A total 222 farmers participated in this study with semi-structured question interviews, focus group discussion and field observations on farm and 13 key informants involved. Majority (81.1%) of farmers in study area were without having formal education or illiterate. Thus, majority of farmers did not acknowledged that pesticides were harmful to human health and environment (94.1%) and (94.6%) respectively. Effectiveness of pesticide information significantly influenced by educational status, Farmers who attended high school and above have understood more other than those who have no formal education( $X^2=23.66$ ,  $P<0.001$ ). Farmers obtained pesticide information frequently from agricultural extension worker and labels more likely to use personal protective equipment when compared with farmers obtained pesticide information from other farmers( $X^2=42.66$ ,  $p<0.001$ ). Above half of farmers reported that they did store empty container and spraying equipment in home (54%) and (98.6%) respectively. Of farmers that have attended of training could handle more properly practice when compared with untrained and illiterate( $X^2=30.27$ ,  $P<0.01$ ). 85.1% of the farmers did not wash contaminated clothes separately. Even though farmers in the present study are increasingly using pesticides, there are numerous gaps in practice, information and knowledge. To reduce farmer pesticide exposure, government should improve farmers' education level, facilitate training and improve farmers' source of information to sustain effectiveness of pesticide information.*

**Keywords:** knowledge, pesticide, practice source of information

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. BACKGROUND

Pesticides are widely used in agriculture to control devastating pests that spoil crops (Fernandez et al, 2001). Also it is substances applied to crops either before or after harvest to protect the crop from deterioration during storage and transport (FAO, 2018). Similarly, pesticides ensure high crop yields and improve product quality by reducing physical effort, controlling different pests, and being economical (Amoatey et al., 2020). Due to this all over the world, the use of pesticides considered the most attractive method of controlling pest that involve less labor and characterize higher output per hectare of land (Dasgupta and Meisner, 2005). However, its overuse caused acute and chronic adverse effects on human, animal and environmental health (Sapbamrera & Thammachaia, 2020). One of the biggest challenges in many African countries, including Ethiopia, is the imbalance between population growth and food insecurity. In order to solve this problem; Agricultural development policies in many developing countries have increased the use of inorganic fertilizers and chemical pesticides as a means to increase agricultural production (Ngowi, 2007). Farmers in developing countries, use pesticides without full understanding of their impact on human health and the environment (Jensen et al., 2011). Ethiopia, the second populous nation in Africa with 85% of its population (currently estimated to be 120 million individuals) living in rural areas, depends on the agricultural sector for necessities and as a source of employment. The use of pesticides introduced in the 1960s in Ethiopia to smallholder farmers through agricultural extension system. Most pesticide-related poisoning in developing nations can attribute to a lack of training in their use, poor legislative control, and carelessness in protecting the body during their application (Vij, 2005).

Farmworkers are exposed to high levels of these compounds directly during all stages of handling and/or managing (mixing, loading, spraying, and cleaning of application equipment), or indirectly by re-entry tasks in pesticides treated crops or by taking home contaminated equipment or work wear. The main routes of entry of pesticides into organisms are skin (dermal absorption), respiratory system (inhalation), and mouth (ingestion) (Negatu et al., 2016) .The

Food and Agriculture Organization (FAO) and the World Health Organization (WHO) jointly developed the International Code of Conduct on Pesticide Management framework, aimed at reducing the effects of pesticide on applicators. However, public health problems have been increasing due to inappropriate handling of pesticides and disposal of its empty containers (FAO, 2015). Pesticide poisoning is a global public and occupational health problem and accounts for nearly 300,000 deaths worldwide every year, the majority of which are from developing countries (Mahmood et al., 2016). Recent studies showed that poor attitudes and practices related to pesticides application and overspray, lack of personal protective equipment (PPE), incorrect pesticides storage and leftover disposal, weather conditions during pesticides spraying, incorrect containers disposal, reuse of washed pesticide containers for food and water storage, poor source of information, not know prohibited/ banned pesticide brand, level of education, poor understanding of labels, among others, may be related to knowledge gaps and lack of training on the safe and effective use of pesticide (Gesese et al., 2016; Ndayambaje et al., 2019; Joubert et al., 2020). Similarly, clothes and contaminated personal protective equipment away from the home is keys to the health care of workers and their families (Ndayambaje et al., 2019). However, many investigations indicates farmworkers return home without changing their clothes previously. Even PPE are also stored in their homes (Mekonnen & Agonafir, 2002, Gesese et al., 2016, Bernardino-Hernández et al., 2017, Raimondo et al., 2022). Likely, the insecure and misapplication of pesticides in Ethiopia are major fears to farmers well-being and the ecosystem (Mergia et al., 2021). In order to minimize pesticide related problem, Source of information is major tools to update farmers' knowledge, attitudes, perception how they have use pesticide, dispose and follow pesticide precautions and obey pesticide rule while spraying and mixing. Agriculture extension workers (AEWs) are supposed to give advices on safe pesticide use, handling and proper disposal. But in other low income countries have indicated agriculture extension workers are not adequately trained in pesticide hazard (Negatu, 2019).

This problem could cause misapplication and handling of pesticide farmers and undermine farmer's perception on pesticide related poisons. Not only that, farmer's level of education and perception of pesticide risks played an important role in determining the use of pesticide protection devices (PPD). Then also, Education status has an important role in increasing knowledge about pesticide risks (Jensen et al., 2011). However, good pesticide management practices could help to minimize the risks of pesticide poisoning and pollution of the

environment. Some of these good management practices when working with pesticide are; follow pesticide label directions, use protective devices, avoid spills, disposal of pesticide wastes and containers properly, eliminating unnecessary application, and use of proper pesticide storage (Amera and Abate, 2008). As many studies indicated improper handling and disposing empty container, leftover and spray equipment due to inadequate knowledge, carelessness and lack of information. This misuse of pesticides also has undesirable effects on human wellbeing. They can be severely shown as headache, rashes, disorientation, shock, nausea, vomiting, respiratory failure, and even death. Since there are no formerly available studies on the investigation of the level of knowledge, the practice of pesticide use, and their association, among small-scale farmers of Shebedino woreda in Ethiopia, this study was carried out. Therefore to assess some of these problems this study investigates how pesticides are utilized in practice in small-scale farmers and effectiveness of pesticide information.

## **1.2. Statement of the problem**

Farmers cultivates tomato and cabbages in Shebedino woreda highly year to year special in those three selected kebeles (small administrate) in small-scale irrigation to progress their economy. The crop is however characterized by high pesticide use due to its vulnerability to insect pests and disease attack (Catherine, 2019). Improper management of pesticides in Ethiopia is the major challenge, including inappropriate selection, over application, fallacy at the time of application, non-targeted application, lack of monitoring of pesticide use and efficacy, poor storage practices and improper disposal of the obsolete remains (Sahilu , 2016).This could results many problem to human health and environments. By considerations of this study aimed to fill gaps by assessing and evaluating effectiveness of a stakeholders' information on pesticide handling knowledge and practice of farmers in Shebedino woreda, Sidama regional state, Ethiopia.

## **1.3 OBJECTIVES**

### **1.3.1 GENERAL OBJECTIVE**

This study was investigated effectiveness of stakeholder information on pesticide handling knowledge and practice farmers in Shebedino woreda, Sidama Regional state, Ethiopia.

### **1.3.2 SPECIFIC OBJECTIVES**

The specific objectives of the study were:-

- To identify socio-demographic determinants that affects farmers' knowledge and proper use of pesticides in study area.
- To identify farmers source of pesticide information for their activities.
- To assess determinant that influence effectiveness of pesticide information.
- To determine pattern of farmers uses of personal protective equipment in study area.
- To identify farmers pesticide use practice in study area.

### **1.4 Research Questions**

- What are demographic factor that hinders the farmer's knowledge and proper use of pesticide in study area?
- From where farmers obtain pesticide information for their activity?
- What are factors that influence effectiveness of pesticide information?
- How farmers do used pesticide and personal protective equipment?
- What do like farmers pesticide uses practice?

### **1.5 Significance of the study**

The studies provide information on effectiveness of stakeholders' information on pesticide handling knowledge and practice of farmers in Shebedino woreda, Sidama regional state, Ethiopia. This information is crucial for developing effective public health strategies to protect farmworkers and families, animals, and the environment from risks related to pesticides exposure. It also provided baseline for future research directions for those who may be interested in conduct research in the related area as well as used as primary data who are valued to do further analysis on farmers way of use pesticide and related problem which caused by miss application.

## **1.6 The scope of study**

Thematically, the research focus on farmers engaged in cultivated vegetable growing. Specifically, it focuses on effectiveness of stakeholder information on pesticide handling knowledge and practice farmers. Spatially, the research limits itself to local level study of shebedino Woreda of Sidama regional state of Ethiopia. Administratively, Shebedino Woreda is one of the Woredas of Sidama Regional states of Ethiopia. Which three kebeles was selected for the study.

## **1.7 Limitation of the study**

The study was performed on farmers' pesticide use pattern and effectiveness of pesticide information. Some extent farmers' willingness and times short were major challenges. And budget shortage also challenged researcher to go amore.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Pesticide definition**

The term pesticide is referred throughout to mean any substance used to control pests (EPA, 2011). This umbrella term includes herbicides (to control weeds and other unwanted vegetation), insecticides (to control unwanted insects), fungicides (to control fungi and pathogens), nematicides (to control worms), and rodenticides (to control rodents) (USDA, 2014). According to Cunningham (2003), pesticide as any chemical that kills, controls, drives away, or modifies the behavior of pests. Although, according to FAO a pesticide is any substance, mixture of substances intended for preventing, or controlling any pest including vectors of human or animal diseases, unwanted species of plants or animals causing harm (FAO, 1989).

#### **2.2 Pesticide uses**

The use of pesticides currently plays a major role in ensuring the world's food supply, commonly used to remove and prevent many pests and weed/herbs, especially in agriculture, and widely used in agriculture for crop protection purposes and in public health to control vector-borne disease (Damalas et al., 2016). The primary objective of using pesticides in the fields and the environment in general is to achieve a control of crop pests and disease vectors. This has been a deliberate human effort in a search for increasing agricultural yields and improving public health (Helweg, 2003). The use of pesticide reduces the incidence of harmful pests, which can severely limit yields, contribute both pre and post –harvest losses, or even directly impact human health as disease causing vectors. This also increase yield and food availability contributed in to increased incomes, decreased malnutrition, and improved human health for farming households (Cooper and Dobson, 2007).

Farmers improperly used pesticide due to many factors, these including a lack of knowledge, application equipment, and trained agricultural extension staff, as well as inappropriate agricultural infrastructure and control and pesticide resistance (Marete et al., 2021). Incorrect dosage, improper timing and targeting, poorly upheld equipment, mixing with bare hands, lack of personal protective apparatus (e.g., mask, boots, gloves, long-sleeved shirt, overalls, hat) and hygienic protections during and after spraying (e.g. Not blowing or sucking nozzle, wash body

after spraying, change clothes after spraying) can all outcome in acute pesticide poisoning. Without proper handling of pesticides, not only the health of farmers but also of their families is threatened.

### **2.3. Classification of Pesticides**

There are different types of pesticides and classification is offered according to the target organism. Based on the target organism Draggan and Miller.( 2012) classified pesticides as follows: Algacides- Control algae in lakes, Antimicrobials- Kill microorganisms (such as bacteria and viruses), Attractants- Attract pests, Fungicides- Kill fungi (including blights, mildews, molds, and rusts), Herbicides- Kill weeds and other plants that grow where they are not wanted, Insecticides- Kill insects and other arthropods, Molluscicides- Kill snails and slugs, Nematicides- Kill nematodes (microscopic, worm-like organisms that feed on plant roots), Rodenticides- Control mice and other rodents, Inorganic Pesticides- they include arsenic, copper and mercury compounds, highly toxic biocides that have the ability of remaining in the environment for extended periods of time. They are generally neurotoxins and even a single dose may cause permanent damage (Cunningham et al., 2003).

Natural Organic Pesticides- mainly plant extracts. Some examples are nicotine and nicotinoid alkaloids from tobacco, rotenone from the roots of derris and cube<sup>o</sup> plants and pyrethrum, a complex of chemicals extracted from *Chrysanthemum cineraria folium* (Cunningham et al.,2003). Inorganic pesticides include inorganic salts such as copper sulfate, ferrous sulfate and lime, and sulfur (Eddleston et al., 2007). The chemicals in inorganic pesticides tend to be simpler and are soluble in water than those of organic pesticides. Many of them work by causing stomach poisoning in insects ( Kim et al., 2017).

#### **2.3.1 WHO classification of pesticide**

Toxicity of formulated chemical product classified according to WHO hazard classes, Pesticide belonging to WHO class Ia is extremely hazardous, class Ib is highly hazardous, classII is moderately hazardous, class III is slightly hazardous and class IV is unlikely to present acute serious hazards in normal use (WHO, 2000). Nearly 90 percent of the banned pesticides fall into category Ia/ Ib/II of the WHO hazard grades.

### **2.3.2 Pesticide classification based on chemical composition**

The major classes of synthetic pesticides are organochlorines, organophosphates, carbamates, and pyrethroids.

#### **Organochlorines**

Organochlorine pesticides (also called chlorinated hydrocarbons) are organic compounds attached to five or more five chlorine atoms. They represent one of the first categories of pesticides ever synthesized and are used in agriculture. Most of them usually used as insecticides for the control of a broad range of insects and have a long-term residual effect on the environment. These insecticides may alter the proper function of the nervous system of the insects leading to disorders such as convulsions and paralysis followed by eventual death (Tano et al., 2011). Common examples of these pesticides include DDT, lindane, endosulfan, aldrin, dieldrin, heptachlor, toxaphene, and chlordane.

#### **Organophosphorus**

Organophosphorus are phosphoric acid-derived pesticides considered to be one of the wide spectrum pesticides consisting of a heterogeneous group chemical (González-Casado et al., 2005), which control a broad range of pests, weeds, or plant diseases because of their multiple functions. They are acetylcholine cholinesterase inhibitors, disturbing neurotransmitters across a synapse (Bulbuli et al., 2012). As a result, nervous impulses fail to move across the synapse causing a rapid twitching of voluntary muscles, hence, leading to paralysis, which is associated with death. Some of the widely used organophosphorus insecticides include parathion, Malathion, dichlorvos, diazinon, and glyphosate. The compounds in this group characterized by a covalent binding of carbon to phosphate (CeP) bond replaced by one of its four carbons to oxygen to phosphorus bonds of phosphate ester.

The CeP direct linkage is described to be chemically and thermally inert, making organophosphate compounds resistant to some drastic conditions such as chemical hydrolysis, photolysis compared and thermal decomposition with analogous compounds characterized with more reactive NeP, SeP, or OeP linkages. Organophosphate pesticides have contributed drastically to improved agricultural productivity as well as effective crop yields (Bolognesi, 2003). Developing countries are increasingly adapting to its use.

## **Carbamates**

Carbamates are organic pesticides derived from carbamic acid. These include carbaryl, carbofuran, and aminocarb (Tano et al., 2011). They are similar in structure to organophosphates. However, they differ from their origin. Organophosphates are derivatives of phosphoric acid, while carbamates derived from carbamic acid. The principle behind the use of carbamate pesticides is similar to that of organophosphate pesticides by affecting the transmission of nerve signals resulting in the death of the pest through poisoning (Devi et al., 2015). Sometimes, they are also use as stomach and contact poisons as well as fumigant. This pesticide easily degraded in a natural environment with minimum environmental pollution.

## **Pyrethroids**

Pyrethroids are organic compounds isolated from the naturally occurring flowers of pyrethrums (*Chrysanthemum coccineum* and *Chrysanthemum cineraria folium*) (Tano et al., 2011). The insecticidal properties of pyrethrums are due to pyrethroid acids. Pyrethroids affect the sodium channels and lead to paralysis of the organism. The most widely used synthetic pyrethroids include permethrin, cypermethrin, deltamethrin, lethrin, furethrin, fenvalerate, and alphacyperamethrin. The synthetic pyrethroids also belong to this group of pesticide, which synthesized by duplicating the structure of natural occurring pyrethrins. Relatively, they are more stable and effective than natural pyrethrins. The major active components are pyrethrin I and pyrethrin II plus smaller amounts of the related cinerins and jasmolins. Synthetic-pyrethroid pesticides are highly neurotoxic to insects and fish but less toxic to mammals and birds. Most of synthetic insecticides are non-persistent, and can be broken easily on exposure to light. They considered the safest insecticides for use in food. Modern pyrethroids slightly resemble their pyrethrin I (progenitor) and exert different mode of action from the original natural products. The commonly use synthetic-pyrethroid pesticides are cypermethrin, fenvalerate, fluvalinate, deltamethrin, lethrin, furethrin, and permethrin.

### **2.4 Route of Pesticide enter to Human**

Health effects consequential from pesticide exposure vary according to the specific pesticide involved and may be the result of exposure. Pesticides can come in the body in three ways: through the skin (contact), the mouth (ingestion), and the lungs (inhalation). A liquid or gas

product can enter the body through all three routes of entry, but solids have a lower fortuitous of entering through the lungs. However, dermal exposure is the most relevant route of exposure for pesticide applicators (MacFarlane et al., 2013). Here are four regular ways pesticides can move in the human body: dermal, oral, eye, and respiratory pathways. The fundamental courses of human introduction to pesticides are through the food chain, water, air, soil, fauna, and flora. Pesticides are distributed all through the human body through the circulatory system but can be discharged through the skin, urine, and exhaled air (Kumar et al., 2019).

## **2.5 Human health and environmental impacts of pesticide**

### **2.5.1 Environmental impacts of pesticide**

Many of the chemicals used in pesticides are persistent soil contaminants, whose impact may endure for decades and adversely affect soil conservation (Duah-Yentumi, 1986). The use of pesticides decreases the general biodiversity in the soil. Not using the chemicals results in higher soil quality, with the additional effect that more organic matter in the soil allows for higher water retention. This helps increase yields for farms in drought years when organic farms have had yields 20-40% higher than their conventional counterparts. A smaller content of organic matter in the soil increases the amount of pesticide that will leave the area of application, because organic matter binds to and helps break down pesticides (Duah-Yentumi et al., 1986). Effect on the environment could come from point-source pollution and non-point-source pollution. The former is the contamination that comes from a specific and identifiable place; including pesticide spills, wash water from cleanup sites, leaks from storage sites, and improper disposal of pesticides and their containers. The latter is the contamination that comes from a wide area, including the drift of pesticides through the air, pesticide run off into waterways, pesticide movement into ground water (Toth and Buhler, 2009).

Environmentally-sensitive areas to the pesticides are; where ground water is near surface, near the habitats of endangered species and other wildlife; near honey bees and near food crops and ornamental plants ((Toth and Buhler, 2009). Sensitive plants and animals as well as the water quality of water bodies in field margins can affected either directly or indirectly (Cessna et al., 2005). Herbicides for example can reduce vegetative cover of the ground, thus promoting soil erosion via runoff and wind. Soil erosion deforms the soil structure and therefore creates an imbalance in soil fertility. A bare land with poor soil structure and poor soil fertility cannot

support the growth of plants on it. Ecologically this land cannot support other forms of life in it and hence may lead to the collapse of the particular ecosystem (Lotter et al., 2003). Pertinent examples associated with bird's kills because of pesticides include the insecticides diazinon and carbofuran, which are well document as causing bird kills in many parts of the world (Kegley, 1999). Effect of pesticides on bees are closely watched because their importance. However, little is known about the impacts of pesticides on wild pollinators in the field. In recent study conducted in Italian agricultural area, authors monitored species richness of wild bees, bumblebees and butterflies were sampled after pesticides application. They detected decline of wild bees after repeated application of insecticide fenitrothion. Lower bumblebee and butterfly species richness was found in the more intensively farmed basin with higher pesticide loads (Brittain et al., 2010).

A major environmental impact has been the widespread mortality of fish and marine invertebrates due to the contamination of aquatic systems by pesticides. This has resulted from the agricultural contamination of waterways through fallout, drainage, or runoff erosion, and from the discharge of industrial effluents containing pesticides into waterways. Some pesticides, such as pyrethroid insecticides, are extremely toxic to most aquatic organisms. Pesticides cause major losses in global fish production (Henry, 2003). Pesticides can affect the soil organisms involved in these processes directly or indirectly hence interfering with the natural nutrient cycling in the ecosystem. Pesticides in soil hinder nitrogen fixation, which is required for the growth of higher plants. The insecticides DDT, methyl parathion, and especially pentachlorophenol have been shown to interfere with legume rhizobium chemical signaling. Reduction of these symbiotic chemical signaling results in reduced nitrogen fixation and thus reduced crop yields (Rockets, 2007).

Root nodule formation in these plants saves the world economy 10 billion in synthetic nitrogen fertilizer every year. When the natural nutrient cycling in the ecosystem is interfered in anyway by pesticides or other sources of pollution, it will lead to a decline in soil fertility and soil productivity (Fox, 2007).

### **2.5.2 Human health impacts of pesticide**

Although it is known that pesticides enhance crop production through improved control of Pests, here contributing to the overall regional and global economy, there is a great deal of

evidence for impacts of pesticides on humans and the environment, as well as unintended side effects on non-target organisms (Aktar, 2009). According to the World Bank (2008), unintentional pesticide poisoning kills 355,000 people worldwide each year. Chronic effects for which there is significant evidence of association with pesticide exposures include cancer, neurodevelopmental and behavior effects, other neurological effects, including neurodegenerative diseases, birth defects, and other adverse birth outcomes, and respiratory diseases. More recently, health-related problems have emerged with pesticides. Evidence suggests, for example, that obesity, type 2 diabetes, and metabolic disorders are becoming a global problem now (Watts et al., 2012). Pesticides are extremely hurtful to human health, especially reproductive and developmental effects, cancer, kidney and liver hurt, endocrine disruption. Pesticides are inhaled, consumed in contaminated water, or come into contact with pesticide-treated areas, exposing people to them, used as grasslands, parks, lakes, and more children are especially susceptible. Children are more likely to keep their hands on the floor and put their infected hands in their mouths and carry pesticides in homes and kindergartens as well as in schools and playgrounds. Various studies show that babies are even exposed to pesticides in the womb. Over the past three decades, the inequitable use of pesticides in agriculture has caused serious health and environmental problems in several emerging countries. Pesticides are widely used in plant, fruit, and vegetable growing areas around the world, according to various studies, raising the issue of potential health risks. Pesticides are chemicals that harm not only human health but also other ecological resources such as soil and groundwater, micro and macro-plants, and animals (Sharma et al., 2012). Because of the toxic nature of pesticides, there will always be some danger associated with their use. Farmers and their families are the most vulnerable, as pesticides can easily come into contact with them while mixing chemicals or applying them to crops.

Pesticides are accountable for hundreds of poisoning cases in the developing world, where knowledge and training on the possible negative health effects of these chemicals are often lacking. It contributes to a global public health problem that kills up to 300,000 people each year (Damalas et al., 2017). The impact may be serious in high-risk groups exposed to pesticides, like production workers, formulators, sprayers, mixers, loaders and agricultural farm workers. Although great efforts to minimize the hazards of pesticides, complete protection of the human population against pesticide exposure is very difficult.

Developing countries are prone to risks from pesticides due to lack of awareness and finances to support proper precaution measures to safely handle pesticides World Health Organization (WHO, 1990). The toxic effects of pesticides on humans can occur through direct or indirect exposure. Direct or primary exposure normally occurs when one comes into direct contact with the chemicals during application, transport or storage. Indirect or secondary exposure comes from exposure through polluted environments or the ingestion of food treated with pesticides. Pesticide exposure is associated with a wide range of human health hazards, ranging from short-term impacts like headaches and nausea to chronic impacts such as cancer, reproductive disorders, endocrine disruption, birth defects, and immune system disorders (Olaya-Contreras et al., 1998; Bouman 2004; Oesterlund, 2014; Perry et al., 2016).

## **2.6 Types of Toxicity of Pesticide with Respect to exposure**

The health effects of pesticides divide into acute poisoning and chronic effects (Koh and Jeyaratnam, 1996).

**Acute pesticide poisoning** is any illness or health effects appearing shortly after single or multiple doses of pesticide. This includes a wide range of reactions in different target organs like neurological, dermal or respiratory.

**Chronic poisoning** occurs gradually after prolonged exposure to pesticides. Increasing development of cancer and reproductive abnormalities been seen in people who have gone through long-term exposure to pesticides (Jeyaratnam et al., 1996; Maroni et al., 2006).

## **2.7 Training on pesticide practice**

Farmers desire to increase yields, improve product quality and manage pests drives them to use chemical pesticides.

However, indiscriminate use of pesticide has become a significant public health and environmental concern specifically in less developed countries. Precautionary practices in pesticide use could minimize the adverse effects of pesticide use. Some examples of the safety practices include applying a recommended dose, wearing personal protective equipment, appropriate disposal, safe storage, observing proper personal sanitation during and after pesticide application among others (Selvarajah and Thiruchelvam, 2007; Zyoud et al., 2010; Schreinemachers et al., 2016). Factors such as age, gender, education, farm income, farm size,

training and farming experience have been found to have an effect on farmers` behaviors in pesticide use (Macharia et al., 2013; Damalas and Khan, 2016; Wang et al., 2017). Previous studies (Jin et al., 2014; Khan et al., 2015; Damalas and Abdollahzadeh, 2016) have revealed that inappropriate use of pesticides has been attributed to lack of training and education in pest management and inadequate provision of extension services. Education level was found to influence the usage of pesticide labels in Pakistan. According to Damalas and Khan (2016), a solid fraction of cotton farmers in Pakistan reported that they did not read the labels.

Farmers have reported age, income, education level, training and farming experience as determinants of usage of pesticide product level. Better educated farmers tend to use pesticides judiciously and are careful to follow the recommended guidelines to the latter, unlike less educated or illiterate farmers. This might be attributed to awareness of the ill effects associated with misusing pesticides since they have access to that information. Knowledge level of pesticide use and safety was low among the majority of the farmers. For instance, farmers who failed to read labels had lower income, a low level of education and training and higher age than their counterparts. On the contrary, there was no significant relationship between farm size and reading pesticide labels (Damalas and Khan, 2016). Jin et al. (2017) found out that farmers with more experience in farming had a higher likelihood of pesticide overuse because of difficulty in reading and understanding pesticide label instructions. In contrast, Kabir and Rainis. (2012) revealed that farmers with more experience were disinclined to use more pesticide during vegetable farming. In China, farmer`s Socioeconomic characteristics were found to have a substantial influence on their precautionary behaviors (Wang et al., 2017). Farmer`s pesticide risk perception, the primary source of information on pesticide and other socio-economic characteristic play a role in influencing farmer`s behavior in pesticides use (Jin et al., 2014; Damalas and Abdollahzadeh, 2016). For example, young farmers tend to perceive pesticide overuse as risky as compared to elderly farmers (Damalas and Hashemi, 2010).

In Ethiopia, the reason of the gap on pesticide safety measure would be that training on the labels on pesticide containers might be which cannot be understood or missing (Abate.2007). The recommendations include washing hands before eating, smoking or using the restroom, wearing protective clothing to minimize skin contact with pesticide residue at work, showering and changing clothes immediately after work and washing work clothes separately. Therefore, the

knowledge level of farmers on occupational health and safety hazards and their perceived risk as well as their attitudes and behaviors towards safety, specifically play a crucial role in the safe operation of farming activities for developing countries. This study analyzes effectiveness of pesticide stakeholders' information on pesticide handling knowledge and behavior of farmers.

## **2.8 Proper pesticide application**

It is necessary to maintain carefully and continuous control over the use and handling of these chemicals during the transportation, mixing, loading, application and disposal. In addition, a care must be exercise in cleaning equipment, clothing and personal hygiene working with pesticide and check-up the preferable equipment that might be old to use and have maintenances (Dellavalle et al., 2017). Poor knowledge and understanding of safe practices in pesticide use, erroneous beliefs about the necessity of personal protective equipment, use of pesticides in excessive concentrations than those needed, and poor maintenance facilities for application equipment can seriously impair farmers' abilities to protect themselves against potential risks (Koh &Jeyaratnam, 1996). In particular, lack of personal protection equipment or failure to use it properly is a major problem during pesticide application. It is also essential that the available protective equipment is suitable for the purpose used and fits the user properly and comfortably. If it is unsuitable for the purpose used or does not fit the user well, it not be worn and apparently, it will not protect. While farmers may be aware of the necessity of using protective equipment when using pesticides, they usually prefer not to use such equipment which they consider as uncomfortable, cumbersome, or non-essential (London, 1994; Sivayoganathan et al., 1995; Clarke et al., 1997 Gomes et al., 1999; Stewart ,2001; Perry et al., 2002).

## **2.9 Safety measurements**

Numbers of strategies have been planned as critical to preventing pesticide exposure in households. These include protection against pesticides, safe practices for the effective use of PPE, understanding of labels, and properly storing and removal after using it. In Ethiopia, certain studies show that almost all households use pesticides with 98% of 45% of those purchased pesticides being from the open market and lack of training and knowledge regarding the safe use of pesticides in all farming systems (Gesesew et al., 2016). Only 30% of them read the instructions on the pesticide containers and less than 48% of the respondents did not know the type of pesticides they used (Kassahun, 2021). The use of personal protective equipment is

difficult in developing countries. In large-scale farming, labor rights are more strictly controlled, and employees are encouraged to wear personal protective equipment. However, studies undefined show that high income farmers use pesticides commonly. They also have better access to information that explains the importance of personal protective equipment (PPE) and how to make the best use of it. Nevertheless, some workers on large farms may still feel uncomfortable, so they do not wear personal protective equipment, and the employer is not responsible for making use of the workers. In small operations, farmers often do not follow the manufacturer's safety recommendations to control and implement pesticides and cannot purchase or use adequate protective clothing or equipment. They may want to avoid using PPE for cultural reasons because they are uncomfortable or unable to breastfeed properly for reuse. Employees who want to use PPE on large or small farms are strongly urged by employers to provide it. In addition, a recent study concluded that the actual effectiveness of Personal protective equipment (PPE) is essential in the prevention of chemical risks in agriculture. Personal protective equipment's includes skin and eye-protective equipment (gloves, coveralls, safety shoes, helmets, and goggles) and respiratory protective equipment (respirators). Personal protective equipment is critical to occupational safety interventions in many countries (Garrigous et al., 2020). Generally, all pesticides have the potential to be hurtful to humans, animals, alternative living organisms, and also the environment if used wrongly. The main to reducing health risks after chemical mistreatment is to constantly limit your exposure by wearing PPE and using a low-toxicity pesticide when available.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Description of the Study Area

Shebedino woreda is located in north Sidama zone in Sidama National Regional State. Geographically, Shebedino woreda is located at 6° 46'-7°45' by North latitude 39° and 40 ° East longitudes and it is located in the direction South of Hawassa by 27 km. It is neighbored by Hawela woreda in the North and Dale woreda in the South; Gorche woredas in the east and Borchha Woreda in the West. According to the Woreda Finance and Economic Development (WOFED) basic socio-economic data-based document, the total population of the woreda is 217302 of which 109318 are male and 107984 are female (WOFED,2015). The Shebedino Woreda comprises 26 Kebeles (WOFED, 2018) (Figure 1). The study took place in Shebedino woreda in sidama region, Ethiopia, which is a major vegetable growing area. Tomato, cabbage and khat are major crops in this area. In Shebedino special those three selected kebele crossed by river wamole that uses for irrigation purpose. Among kebele of taramessa and howoliso have irrigation canal which built during emperor Haile selliase. In order to maximize production and free from blemish of crop farmers often practice intensive usage of pesticide and fertilize. Vegetables produced in this cultivation work are used for local consumption and increase their income.

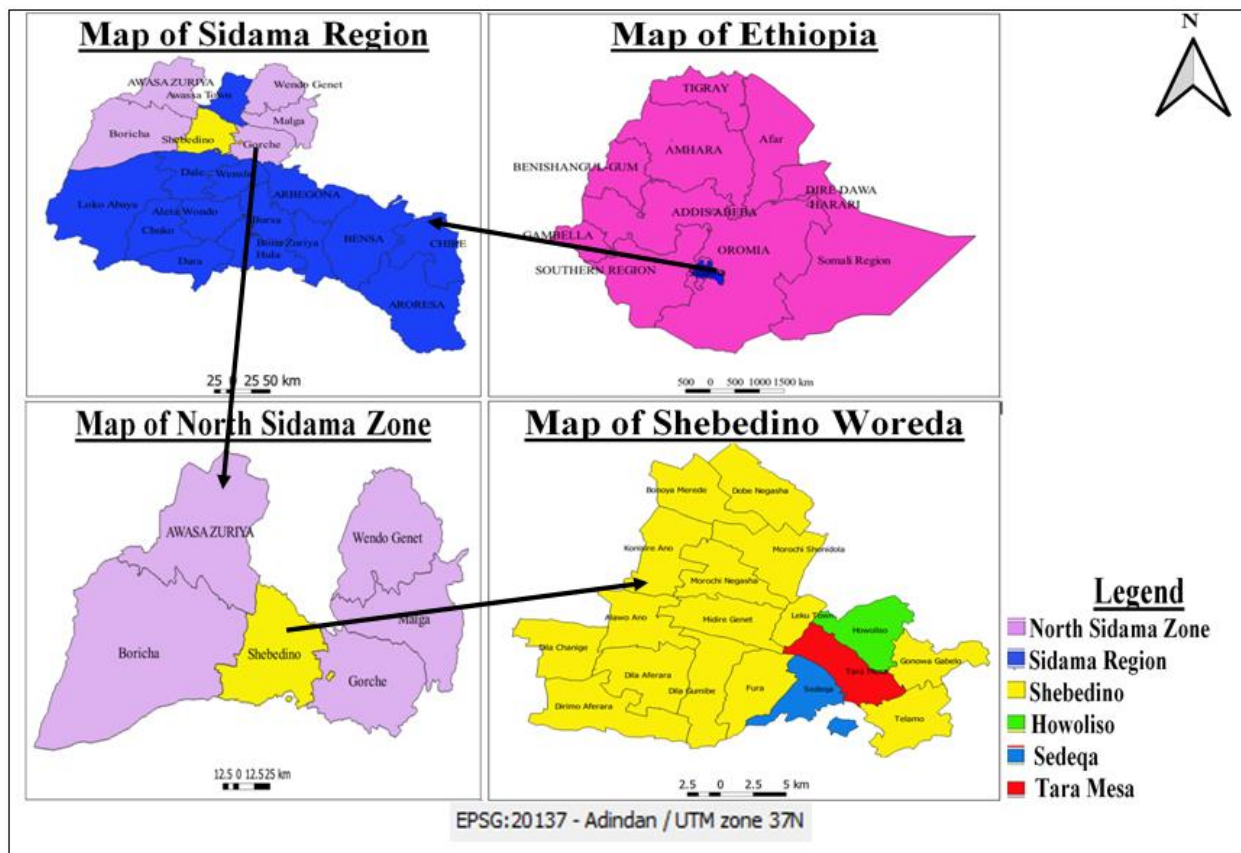


Figure 1. Map of the study area (Asrat, 2023)

### 3.2 Research Design

The research design was mixed cross sectional approach which combines both quantitative and qualitative forms of data collection and analysis. The research design heavily depends on the research objective and nature of data needed. This approach was selected as an appropriate method because it helps to legitimize the use of multiple approaches in answering the research questions, rather than restricting the researcher's choice and it rejects rigidity. In this regard, the qualitative method was designed by interpreting the data sources of interviews, focused group discussion and Key Informant's interview, whereas the quantitative method was mainly used for the data collected through questionnaire and to measure variable on the sample of the subject and to express the relationship between the variables.

### 3.3 Sampling Technique and sample Size

In this study, two stage sampling techniques were used to recruit the participant. First, among the twenty six Kebeles, three sample kebeles (Howoliso, Sadeka and Taramesa) were selected by purposive sampling technique because irrigation proceeded by cultivating cabbage and tomato year to years .Secondly, sample householders were selected based on systematic random sampling techniques. There were a total of 25197 households in the selected kebeles and list of households were acquired from their kebele administration, agricultural extension service and woreda agricultural bureau. Finally, the sample size was calculated from the total household populations by using the following formula (Taro Yamane, 1973) determine the required sample size at 95% confidence level. The sample populations per kebele were allocated via proportional to population size. 222 respondents were selected from all kebele according to household proportion in each. And the total sample HHs fractionates in to respective kebeles through proportional sampling methods.

$$n = \frac{N}{1 + N(e)^2}$$

Where n= is sample size

N=the total number of sample HHs population at Shebedino woreda  
 e =the error term with precision level of 7%. An additional 10% will be added to the sample size as contingency for non-response.

$$N=25197, \quad n = \frac{25197}{1+25197(0.07)^2} \quad n = 202+20 = 222$$

Table 1: Sample Size of Respondents for the Study

Kebeles	Total no of HHs	Sex		Total sampled HHs	Sex	
		MHH	FHH		MHH	FHH
1.Taramesa	9892	9579	313	87	84	3
2.Howoliso	8000	7680	320	70	67	3
3.Sadeka	7305	6874	431	65	61	4
Total	25197	24133	1064	222	212	10

Source: Respective kebele agricultural office

### **3.4 Data Collection**

The researcher was used different data collection instruments, such as, key informant interviews, administered questionnaires, field observation and focus group discussion. Sample gathering was done by fieldwork for all four studies firstly. Interview of farmers, key informant interviews, focused group discussion and field observations were performed. This approach helps triangulation and increases the rationality and dependability of results (Rao et al., 2003). Face-to face interviews were designed to collect responds from farmers. The questionnaire was developed in English and translated in local languages (sidaamu afoo) by researcher. The questionnaire aimed to collect data in four categories. Part one collected general information on farmer demographics, vegetable growing experience and having other occupation other than growing vegetables. The second parts include eight questions to evaluate the knowledge of farmers HHs about pesticides. Answers were recorded as “yes”, ”no” or “don’t know”. For every “correct” answer, a mark of “+1” was given. For the” wrong” answer, a mark of “-1” and for don’t know, a mark of “0” was given. A score of four or more than indicated good knowledge and fewer than four indicated poor knowledge (Mohanty MK, et al., 2013). Pesticide use and practices were included to collect information on kinds of pesticides used, pesticide source to purchase, pesticide information on dose use, advise on related to pesticide use and handling, obtain information from pesticide label and understand, use of personal protective equipment, disposal of pesticide container, effectively use of pesticide information, follow safety measure and finally symptom posed by pesticide exposure were gathered to address pesticide effects. Data related to training and advices to support farmers were obtained by interviewing pesticide vendor, agricultural office expert and agricultural extension experts. Four (4) agricultural office experts, six (6) agricultural extension experts and three (3) local pesticide vendors were interviewed to collect additional data. Key informant interviews were conducted to obtain vital information about their contribution on safe pesticide distribution, use and training of farmers (advice) to support or not. Focus discussion interviews were conducted to generate data on dynamics, source of pesticide before and now, dispose and store trends, obtain pesticide training or not, use of PPEs and take action if shown any health discomfort and four participants among each kebele. Observation check lists were used as an aid of check farmers pesticide use, disposal, storage and use of personal protective equipment.

### **3.5 Data Analysis**

Data was analyzed using descriptive statistics as well as binary logistic model and data were managed in Excel, cleaned, and entered to SPSS version 25 statistical software. The descriptive analysis was used to calculate the percentage and frequency of pesticides in the study areas. Chi-square was applied to evaluate whether variables correlated to each other. The results were presented in frequencies and percentages for specific variables and the significance levels were set at  $p \leq 0.05$

### **3.6 Ethical Consideration**

The selected kebele were contacted with researcher and letter written from the Institute (Hawassa University/ and asked for permission to continue the data collection. The study participants (householders) were selected randomly. The study participants were also asked for verbal consent. Data was collected after their full consent and their confidentiality was kept by not mentioning their names in any communications.

## **CHAPTER FOUR**

### **RESULT**

#### **4.1. The demographic characteristic of respondents.**

Tables 1 represent demographics results of farmers. From a total of 222 farmers that participated in the survey, the majority was 214(96.4%) males and only 3.6% were female. Most of farmers (44.1%) ranged between 31 and 45 years of age. 36% of farmers was between 18 and 30 years. Nearly 2.7% of the farmers were below 18 years old. In present study majority of the respondents 89.2% in the study area were married and the small 1.35% proportions of respondents' were divorced. A significant numbers (81%) of farmers had no education (illiterate), while 10.4% had attended primary (1-4), 5.4% were attended junior and 3.2% were attended high school and above. Of the study area the most respondents' family size was above 6 (45.9%), followed (43.7%) had number of family size 4-6 and 1-3 had 10.4%. In study area most of (92.8%) farmers depends on only agriculture while small proportion of farmers had another occupation beside of farming. In addition, 10.8% of farmers had one to five years of farming experience, 19.8% had six to ten years of farming experience, 23.4% had eleven to

twenty years of farming experience and 45.94% had greater than twenty years of farming experience.

**Table 2 socio-demographic character of farmers**

Variable		Frequency	Percentage (%)
Age	Below18	6	2.7
	18-30	80	36
	31-45	98	44.1
	46-60	38	17.1
Sex	Male	214	96.4
	Female	8	3.6
Marital status	Single	17	7.7
	Married	198	89.2
	Divorced	3	1.4
	Widowed	4	1.8
Educational status	Illiterate(unable write &read)	180	81.08
	Primary(1-4)	23	10.36
	Junior(5-8)	12	5.4
	High school & above	7	3.15
Family size	1-3	23	10.36
	4-6	97	43.69
	>6	102	45.9
Farming experience	1-5	24	10.8
	6-10	44	19.8
	11-20	52	23.4
	>20	102	45.94
Occupation other with farming	No	206	92.8
	Civil servant	4	1.8
	Merchant	12	5.4

#### **4.2 Types of pesticide used.**

Tables 3 represent agrochemical that used in study area. Results reveal that a wide range of pesticides are utilized by vegetable growing farmers along Shebedino woreda. A total of 16 pesticides (active ingredients) were reported in study area. Regarding to types of pesticide used in study area majority was insecticide (99%), followed by fungicide (98.19%) and herbicide (5.85%). In present study farmers reported insecticide was profit72 EC(94.59%), dimeto40%EC(90%), farrate(83.3%), Ethiodethrin2.5%EC(63%), roger (53.15%) and Ethiolathion50EC(98.65%). Types of fungicide farmers were reported they had used in farming

area, Ethiozeb(99.54%), Indom(100%), Cropzeb88wp(100%), Fungozeb(95%), Kocide101(39.19%), Cerozeb80wp(100%) and Unizeb (89.6%) and herbax and rich way granster are herbicide group of pesticide. Vegetable grow farmers reported pesticide those belonged to primary WHO class II; malathion(98.65%), profenofos72%EC(94.59%), Dimethoate(90%), karate2.5%EC(46.84%), kocide 101(39.19%), cerozeb80wp(100%), cropzeb80wp(100%) and herbax(99%)were mostly reported class of pesticide. Others belonged to toxicity class-U were; indom (100%), Ethiozeb (99.54%) and Fungozeb (95%).

Table 3 types of pesticide farmers used

INSECTICIDE					
Trade name	Ingredient and concentration	Chemical class	Frequency	Percent	WHO toxicity class
Profit72EC	Profenofos72%EC	Organophosphate	210	94.59%	II
Dimeto40%EC	Dimethoate	Organophosphate	200	90%	II
Farrate	Lambda-cyhalothrin5%	Pyrethroid	185	83.3%	II
Ethiodethrin2.5% EC	Deltamethrin25g/l	Pyrethroid	140	63%	II
Karate2.5%EC	Lambda-cyhalothrin25ml/L	Pyrethroid	104	46.84%	II
Roger	Dimethoate40%	Organophosphate	118	53.15%	II
Ethiolathion 50EC	Malathion	Organophosphate	219	98.65%	II
FUNGICIDES					
Ethiozeb	Mancozeb 80% wp	Dithiocarbamate	221	99.54%	U
Indom	Mancobez80% wp	Dithiocarbamate	222	100%	U
Cropzeb 80wp	Mancozeb wp 800g/Kg	Dithiocarbamate	222	100%	II
Fungozeb	Mancobez 80% wp	Dithiocarbamate	211	95%	U
Kocide101	Copper hydroxide	Oxime+inorganic	87	39.19%	II
Cerozeb 80wp	Mancozeb 800g/Kg	Dithiocarbamate	222	100%	II
Unizeb	Mancozeb 80% wp	Dithiocarbamate	199	89.6%	II
HERBICIDES					
Richway granster			204	91.89%	
Herbax	Propanil360g/l	Acetanile	220	99%	III
Types of pesticide used in farming	Insecticide		220	99%	
	Herbicide		13	5.85%	
	Fungicide		218	98.19%	

### **4.3 Pesticide Use Pattern of farmers**

Tables 4 represent farmer's pesticide use pattern and farmer's level of knowledge. Result to pesticide use pattern of farmers. Most of respondent had reported (97.3%) uses of pesticide always is good and only few (2.7%) of farmers had reported uses of pesticide always is not good. About 99.5% & 98.6% of farmers reported uses of pesticide are best methods to increase productivity and farmers majority were acknowledged uses of pesticide could solve pest problems respectively. And only very few (0.5%) were responded using pesticide not only increase productivity may, it cause side effects and very few (1.4%) were respond not solve pest problem. 94.6% of farmers had reported pesticide couldn't pose environmental effects. Among participant only few (1.4%) were acknowledged pesticide could have hazardous potential to environment. Similarly, most of farmers (94.1%) in study area reported pesticide are not poisonous to human and only very few farmers were revealed improperly uses of pesticide can cause poison to human health (5.9%). More than half of farmers were reported didn't knew possible route of exposure (56.3%). About 31% of farmers were reported inhalation was important way to exposure, followed this others had reported dermal (12.6%) is another way of exposure to pesticide. Result related with known pesticide in their specific name, majority (95.9%) of interviewer were reported didn't knew pesticides in their specific name. Only 4.1% of farmers had known pesticide brands in their specific name. The reason for prohibited some brand of pesticide, a significant number (45%) of farmers reported prohibition due to ineffective of pesticide, while 36.9% of farmers had reported due to expensiveness of pesticide and 16.2% farmers didn't knew the reason of banned. Nearly, 1.8% of farmers were reported prohibition due to pesticide high toxicity.

Table 4. Association between farmer's pesticide use pattern and their knowledge

Pesticide use and knowledge	Good knowledge	Poor knowledge	Total (n)	X <sup>2</sup> & p value
Uses of pesticide is always a good				
Yes	1(16.7%)	215(99.5%)	216(97.3%)	152.6
No	5(83.3%)	1(0.5%)	6(2.7%)	<0.001
Pesticide use increase productivity				
Yes	6(100%)	215(99.5%)	221(99.5%)	3.41
No	0.0	1(0.5%)	1(0.5%)	
Pesticide solve pest problem				
Yes	5(83.3%)	214(99%)	219(98.6%)	10.86
No	1(16.7%)	2(0.9%)	3(1.4%)	<0.01
Pesticide use affect environment				
Yes	2(33.3%)	10(4.6%)	12(5.4%)	9.55
No	4(66.7%)	206(95.4%)	210(94.6%)	<0.05
Pesticide are poisonous to human				
Yes	6(100%)	7(3.2%)	13(5.9%)	99.15
No	0.0	209(96.7%)	209(94.1%)	<0.02
Pesticide route of exposure				
inhalation	2(33.3%)	67(31%)	69(31%)	
dermal	3(50%)	25(11.67%)	28(12.6%)	8.61
I don't know	1(16.7%)	124(57.4%)	125(56.3%)	<0.001
Know banned pesticide brand				
Yes	5(83.3%)	0.0	5(2.35%)	184.3
No	1(16.7%)	216(100%)	217(97.7%)	<0.01
Why some pesticide are banned				
High toxicity	3(50%)	1(0.45%)	4(1.8%)	
Expensive	2(33.3%)	80(37%)	82(36.9%)	81.98
Ineffective	1(16.7%)	99(45.8%)	100(45%)	<0.32
I don't know	0.0	36(16.7%)	36(16.2%)	
Do you know pesticide in their name				
Yes	4(66.7%)	5(2.3%)	9(4.1%)	
No	2(33.3%)	211(97.7%)	213(95.9%)	62.21
overall				<0.01
poor knowledge	216(97.3%)			
Good knowledge	6(2.7%)			

#### 4.4 Farmers respond of symptom after applied pesticide.

Table 5 indicated self-reported pesticide exposure symptom. Regarding to illness or discomfort after pesticide application and taking action to mitigate pesticide effects. About 74.7% farmers were reported they had felt by pesticide during mixing and spray but they didn't understand due to pesticide. Of the 9.5% farmers were shown farmers felt by pesticide poisons after and while exposed to pesticide sometime. And 14.4% of farmers in study area reported didn't felt by pesticide exposure any of health problems after had applied pesticide. 1.4% of farmers had reported they hadn't known any discomfort after they had apply pesticide. Some of symptom shown in study area headache(95%), eye irritation(87.4%), vomiting(45.9%), skin irritation(98.6%), itchy skin(2.3%), coughing(79.7%) and poor vision(1.8%). Majority (98.6%) of farmers in study area had reported didn't taken any medical treatment to remediate pesticide related problem because they low perception to pesticide related discomfort and insignificance.

Table 5 vegetable grow farmers reported symptom after pesticide applied

symptoms shown pesticide exposure	Frequency	Percentage (%)
Do you feel discomfort/illness after pesticide application	166	74.7%
Yes	32	14.4%
No	21	9.5%
Sometime	3	1.4%
I don't know		
What do you feel?	211	95%
Headache	71	31.9%
Vomiting	194	87.4%
Eye irritation	219	98.6%
Skin irritation	5	2.3%
Itchy skin	177	79.7%
Coughing	4	1.8%
Poor vision		
Do you take action if feel those symptom	3	1.4%
Yes	219	98.6%
No		

#### **4.5 Farmers' pesticide handling practice.**

Table 6 indicates farmer's pesticide handling practice and knowledge. Checking of spraying equipment before pesticide application, majority (84.7%) of respondent never they check spraying equipment before spraying pesticide. About 13.5% of farmers in study area had reported check spraying equipment sometime and 1.8% had reported they had had check spraying equipment always. Regarding to taking shower after pesticide application, majority (89.1%) of farmers were responded never had taken shower after pesticide spray. Of the 13.5% participant reported had taken shower after pesticide sprayed sometime. 0.9% of farmers were taken shower immediately after spraying pesticide always. Among participant in study area majority (58.6%) of farmers reported had wash hands after pesticide application sometime. And 5.8% had washed always and 36% had said never wash their hands after pesticide application. Majority (85.13%) of farmers in this finding reported had never wash contaminated clothe separated from other clothes. Nearly, 13.63% of respondent had reported that they had wash contaminated clothes separately from other normal clothes sometime and very few were (1.35%) had wash always separately the contaminated clothes from other. Of respondents in study area 93.2% farmers had never wear special face mask during mixing and application of pesticide. Only about 5.85% of farmers in study area had used special face mask during mixing and application sometime and few (0.9%) farmers were used special face mask always. 76.57% farmers were transported pesticide with other good always, while 22.9% were transported with other good sometime and only, 0.45% were never transported pesticide with other goods.

Table 6 association between Farmers pesticide handling practice and knowledge

Handling practice	Good knowledge	Poor knowledge	Total response(n)	X <sup>2</sup>	P value
Checking of spraying equipment before pesticide application					
Always	1(16.6%)	3(1.38%)	4(1.8%)	35.05	<0.01
Sometime	5(83.3%)	25(11.5%)	30(13.5%)		
Never	0.0	188(87%)	188(84.7%)		
Taking shower after pesticide application					
Always	0.0	2(0.92%)	2(0.9%)	35.39	<0.05
Sometime	5(83.3%)	18(8.3%)	23(10.36%)		
Never	1(16.7%)	196(90.1%)	197(89.1%)		
Washing of hands after pesticide application					
Always	2(33.3%)	11(5.09%)	13(5.8%)	10.25	0.03
Sometime	4(66.7%)	125(57.8%)	129(58.1%)		
Never	0.0	80(37%)	80(36%)		
Washing contaminated clothes separately					
Always	1(16.7%)	2(0.9%)	3(2.7%)	18.54	<0.04
Sometime	3(50%)	27(12.5%)	30(13.6%)		
Never	2(33.3%)	187(86.57%)	189(85.1%)		
Wearing special face mask					
Always	1(16.7%)	1(0.46%)	2(0.9%)	18.73	<0.03
Sometime	1(16.7%)	12(5.6%)	13(5.8%)		
Never	4(66.7%)	203(93.9%)	207(93.2%)		
Transporting pesticide with other good such as good					
Always	0.0	170(78.7%)	170(76.6%)	50.54	<0.001
Sometime	5(83.3%)	46(21.3%)	51(22.9%)		
Never	1(16.7%)	0.0	1(0.45%)		

#### **4.6 Association between storage and disposal practice and knowledge**

Table 7 represents farmers' storage, and disposal practice of farmers. Result indicated about farmers pesticide purchase, dispose and storage practice in study area. Regarding to source of purchasing of pesticide, majority of farmers (73.87%) were purchase from open market, followed by purchase from agricultural store (4.5%) and others were from unlicensed local vendor (22%). Most of farmers in study they had stored empty container anywhere in home (54% ),by followed this they had reported leave it on farm land after it finished (30.7%). Of the farmers in study area also they had reported, used for water fetch and food store (15.37%). Related with storage place of pesticide equipment, majority of respondent had stored general in home (98.6%) and very few farmers were reported store pesticide spraying equipment in equipment store (1.4%). Of the respondent showed most of them store pesticide after they bought in home anywhere (68%) due to fear of thief, followed this they had stored on open field (30.18%) and fewer (1.8%)were stored separated open shed just for pesticide. And practice with rinse or clean pesticide container before it dispose, present study indicated most of farmers in study area didn't clean container before it disposed(98.2%) and very fewer were reported had clean before they disposed(1.8%). Finding indicates farmers in study area majority were dump leftover pesticide on open farm and canal (52.7%). 40.5% farmers in present study reported had dumped leftover pesticide in toilet. And only very few (2.3%) farmers were reported had bought and mixed only needed amount of pesticide. A significant number (91.9%) of farmers were stored contaminated clothe with other clothes. However, 8.1% of farmers in present study were stored in separated area. Above the half of the respondent have reported thrown mixing stick in anywhere (64.9%) and some of them thrown it in farm (31.1%).Only few farmers where reported they had burnt it stick (4%).

Table 7 associations between storage and dispose practice and knowledge

Purchase and storage practice	Good knowledge	Poor knowledge	Total respond(n)	X <sup>2</sup>	P value
Source of purchase pesticide					
From agricultural store	2(50%)	8(3.6%)	10(4.5%)	27.44	<0.001
From open market	1(25%)	163(74.4%)	164(73.87%)		
From local vendor	1(25%)	48(21.9%)	49(22%)		
Where dispose empty container					
Leave it on farm land	3(75%)	65(29.8%)	68(30.6%)	46.88	
Anywhere in home	1(25%)	119(54.3%)	120(54%)		<0.001
Use it for water/food sore	0.0	34(15.5%)	34(15.3%)		
Where store spraying equipment		217(99.09%)	219(98.6%)	35.86	
General store in home	2(50%)	2(0.9%)	4(1.35%)		
Equipment store	2(50%)				<0.02
Where do you store pesticide		67(30.87%)	67(30.18%)		
Open field	0.0	1(0.46%)	4(1.8%)	98.38	
Open shed for pesticide	3(75%)	149(68.6%)	150(68%)		
Anywhere in home	1(25%)				<0.001
clean empty container before dispose				22.4	
Yes	3(75%)	4(1.8%)	5(2.3%)		<0.01
No	1(25%)	216(99.19%)	217(97.7)		
What do you it leftover pesticide				30.27	
Dump/dispose in toilet	0.0	90(41.3%)	90(41.3%)		
Apply on other crop	2(50%)	8(3.67%)	10(4.6%)		
Mixed only needed pesticide	1(25%)	4(1.8%)	5(2.3%)		
dump in canal	1(25%)	116(53.2%)	117(52.7%)	24.81	<0.01
where do you put working clothe					
put with other clothe	1(25%)	203(93.1%)	204(91.9%)		
store in separated area	3(75%)	15(6.9%)	18(8.1%)		<0.05
Where do you put mixing stick					
Throw in farm	1(25%)	68(31.2%)	69(31.1%)	54.01	
Throw anywhere	0	144(66%)	144(64.9%)		<0.01
Burning it	3(75%)	6(2.8%)	9(4%)		

#### **4.7 Pesticide information and farmers knowledge**

Table 8 indicate farmers source of pesticide information. Regarding to source of pesticide and pesticide information for purchase, dose use, apply, prohibited brand of pesticide, mix and uses of PPEs. Present study indicate farmers in study area obtain pesticide information majority were from other farmers (63.9%), followed this they had obtained pesticide information for from local dealer (30.6%) and some were reported for purchase from governmental agricultural extension (5.4%). The training to use of pesticide, majority of farmers had reported didn't train (93.7%) and only (6.3%) had reported they had trained how to apply and practice. This finding indicated majority of farmers hadn't trained on pesticide but they still now using pesticide. About 52.3% of farmers reported that they had informed pesticide dose use information from other farmer's through oral communication in study area, followed this they had reported they had informed from local pesticide dealer (44.1%). In present study only very few respondents reported they obtained pesticide dose use information from reading labels (3.6%). Pesticide related advice farmers in study are majority obtained from other farmers (59%), follow this from local retailer (36%) but only very few farmers obtain from AEs (5%). Most of farmers obtained information of some pesticide brand that are prohibited to / banned from others farmers (92.3%) and only few farmers obtained from AES (5.8%). In addition to importance of uses of personal protective equipment in order to minimize pesticide hazards majority obtained from other farmers (93.7%). However, small number of farmers frequently obtained from AES (6.4%). Farmers in study area obtain pesticide information how have mixed in safe ways were obtain from other farmers (92.8%) and very few farmers reported they had informed from agricultural extension workers (7.2%). Then also only few farmers informed way to store before and after spray from agriculture extension workers (5.4%) and majority were informed from other farmers (94.6%) in present study. Likely, farmers obtain pesticide information from others farmers majority (91.4%) were not known pesticide in their specific name and farmers (8.6%) frequently acquired pesticide information from AEW understood pesticide in their specific name.

Table 8 Source of pesticide and information farmers' knowledge

Pesticide information	Good knowledge	Poor knowledge	Total(n)	X <sup>2</sup> & p value
pesticide information for purchase				
Pesticide dealers	1(16.7%)	67(31%)	68(30.6%)	
Agricultural experts(AES)	4(66.7%)	8(3.7%)	12(5.4%)	70.85
Others farmers	1(16.7%)	141(65.3%)	142(63.9%)	<0.001
Do you train with application of pesticide				
Yes	2(33.3%)	12(5.6%)	14(6.3%)	28.70
No	4(66.7%)	204(94.4%)	208(93.7%)	<0.01
pesticide dose use information				
Local retailers	0.0	98(45.4%)	98(44.1%)	
Label	1(16.7%)	7(3.2%)	8(3.6%)	25.30
Others farmers	5(83.3%)	111(51.4%)	116(52.3%)	<0.01
From whom do you taken pesticide related advise				
Pesticide vendor	1(16.7%)	79(36.6%)	80(36%)	
AES	5(83.3%)	6(2.8%)	11(5%)	42.66
Others farmers	0.0	131(60.6%)	131(59%)	<0.001
informed restricted brand of pesticide				
AES	4(66.7%)	6(2.8%)	10(4.5%)	
Other farmers	2(33.3%)	201(93%)	203(91.4%)	70.07
Mass media	0.0	9(4.2%)	9(4.1%)	<0.03
obtain information of use PPEs				
AES	5(83.3%)	9(4.2%)	14(6.3%)	32.4
Other farmers	1(16.7%)	207(95.8%)	208(93.7%)	<0.05
information ways to mix pesticide				
AES	4(66.7%)	12(5.6%)	16(7.2%)	10.79
Other farmers	2(33.3%)	204(94.4%)	206(92.8%)	<0.01
Information way to store pesticide				
Agriculture extension workers	6(100%)	4(1.9%)	12(5.4%)	103.67
Other farmers	0	212(98.1%)	210(94.6%)	<0.01
Information about pesticide in their name				
AEW	4(66.7%)	15(6.9%)	19(8.6%)	26.6
Other farmer	2(33.3%)	201(93.1%)	203(91.4%)	<0.05

#### 4.8 The relationship between pesticide information and uses of PPEs

Table 9 represents a farmer's pattern of uses personal protective equipment in study area. Personal protective equipment and safety measures during and after pesticide sprays are unique ways to protect oneself from pesticide posing health problems. But farmers in study area majority (96.8%) had never used personal protective equipment during pesticide mixing and praying. About 3.2% of farmers had used personal protective equipment during and after pesticide sprays as well as during mixing. Most of farmers used personal protective equipment's, such as; boots 173(77.9%), hat 213(95.9%), gloves 216 (97.3%), eyeglass 209(94.1%), special face mask 214(96.4%) and full-length trouser 193(86.9%).

Table 9 farmer's PPEs use pattern and source of information.

Uses of PPEs	Obtain information AEW+labels	Obtain information other farmers	Total respond(n)	X <sup>2</sup> & p value
Do you wear boots				
Yes	5(71.4%)	44(20.5%)	49(22%)	10.23
No	2(28.5%)	171(79.5%)	173(77.9%)	<0.01
Do you wear hats				
Yes	2(28.5%)	7(3.3%)	9(4%)	
No	5(71.4%)	208(96.7%)	213(96%)	11.17
Do you use glove				
Yes	4(57.1%)	2(0.93%)	6(2.7%)	
No	3(42.9%)	213(99.07%)	216(97.3%)	81.54
Do you wear eye glasses				
Yes	7(100%)	4(1.8%)	11(4.9%)	
No	0.0	211(98.2%)	211(95.1%)	138.65
Do you use face mask				
Yes	6(85.7%)	2(0.93%)	8(3.6%)	140.42
No	1(14.3%)	213(99.07%)	214(96.4%)	<0.01
You wear full-length trouser				
Yes	2(28.5%)	0.0	2(0.9%)	62.04
No	5(71.4%)	215(100%)	220(99.1%)	<0.01
Not wear PPEs				
Not available	3(42.9%)	17(7.9%)	20(9%)	61.06
Uncomfortable	4(57.1%)	38(17.67%)	42(18%)	<0.01
Not have awareness	0	160(74.4%)	160(72%)	

#### **4.9 Key informant responds in study area.**

Key informant interview indicates in present study, usage of pesticide at woreda level they confirmed increased in each years and they sometime had given advice but farmers didn't followed. They had raised educational status of farmers was major challenges to acquire and frequently follow up pesticide precaution. Related with source of pesticide they said most farmers were bought from markets and non-licensed trader. And they promised to give advice to farmers. Interviewed importer had no knowledge of adequate guideline for use, safety and toxicity of pesticide, storage facilities and handling of pesticides. None of importer had received training from manufacturer, NGOs and state agencies on safety and storage; due to this they were unable to training farmers. Finding showed that the lack of technical knowledge among vendor, expert and extension dealing with pesticide at the local level, this is major challenges for safeguarding the pesticide distribution system and use in the study area. In present study focus group discussion were happened and they have raised ideas in following manner, During the focus group discussion, the majority had little or no knowledge on the nature of pesticide, toxicity level and how to disposal of empty containers. They had no information about brands, product specification and handling precaution. Due to this they apply and mix without use special personal protective equipment's. They also rise on focus; they are not taken pesticide training effectively. Of the farmers in our discussion they reported didn't knew prohibited reason of pesticide and banned brand of pesticide.

#### **4.10 Focus group discussion in study area.**

During our discussion respondent had revealed hadn't gone to medication to mitigate pesticide posed problem. Pesticide dose use information most of participant rise obtain from others farmers. Due to this they have low risk perception on pesticide. But at the time of the focus group discussion they had learnt and exchanged information. Even though today have some improvement from previously they raise lack of knowledge of personal protective equipment use and they had bought pesticide most time from open market and vendor. But during our focus group discussion they had learnt the uses of PPEs and necessity of bought from agricultural office. Participant had reported they had used small bag, pocket, animal back and other means to transport, this also have its own contribution for pesticide exposure. During our discussion they have informed never to use such kinds of means of transportation. Likely, respondent raise they

have trend of dispose empty container in farm, anywhere in home, some of them respond use to as means of storage. But the time of our discussion we have exchanged how have to dispose empty container. Almost none of participant rise about surely negative effects of pesticide for human health and environment, they have raised many positive effects of pesticide chemicals. This situation indicates about farmers need to take pesticide related advice from expert of pesticide related discipline in generally. In addition, observation could happen to magnify triangulation. During my observation, almost of farmers never they wears gloves and/or closed boots, enhancing direct contact of hands and feet with pesticides even they have reported during interview. But only few numbered were they have used personal protective equipment. Although they didn't take shower after pesticide application most of them .This result also confirm majority participant respond in interview. They had also stored pesticide anywhere in their house. This is so serious and harmful acts. Majority of farmers could only know pesticide but not know pesticide in specific name and their nature as well as negative impacts and toxicity level. Farmers in study area have a low risk perception to uses of pesticide due to this they handle carelessly. This practice could also maximize the possibility of exposure to pesticide hazards. Most of farmers in study area obtain pesticide information for purchase from others farmers and most of them hadn't gate pesticide advice. Majority of farmers not take any action if they had felt by pesticide effects. Lifeway's they had disposed leftover pesticide on open farm and irrigation canals. In addition, participant shown some of them reused pesticide container for water fetch and store foods. General in my observation farmers in study area have inadequate knowledge and poor safety measure as well as have gap between pesticide information. Almost of all need special support to upgrade farmers understand, the nature of pesticide, negative effects of pesticide, farmers knowledge, uses of PPEs and safety measure because, farmers in study area most are illiterate. Therefore, governments and NGOs agent should have provided training on pesticide use and safety practice.

## CHAPTER FIVE

### 5. DISCUSSION

#### 4.1 The socio-demographic characteristics of farmers.

In present study, farming activities dominantly done by males headed(96.4%).Similarly, Ndayambaje et al(2019) in Rwanda, Awrajaw et al (2020), Kasahun et al.(2021),Mergia et al.(2021) and Gesesew et al.(2016) in Ethiopia reported that farming activities was performed by male. In addition, investigation by Raimondo et al.(2022)reported that (100%) farming practice performed by men in western Catamarca province in Argentina. This finding indicated that, mostly male headed households are more vulnerable to pesticides risks than female headed households. The possible reason for this is males are usually involved in pesticide application than females. Most of the vegetable growing farmers in present study were illiterate (unable to read and write) (81.1%) (Table2). Illiteracy has its own influence on, safety measure, proper disposal, storage, read labels and properly uses pesticide. Due to this farmers neither read nor write. This study agreed with investigation was reported by Bernardino-Hernández et al. (2017) who found high percentages of respondents responsible for agricultural activities in rural and indigenous communities in Mexico could neither read nor write. Unlike present study investigation reported by Raimondo et al.(2022) all farmworkers in Singuil town completed primary education, so they are literate. The age of farmers one of variable that influence the farmers knowledge to proper handling and application of pesticide during mixing and spraying of pesticide as well as disposal of empty container. Most of farmers (44.44%) ranged between 31 and 45 years of age, similar to that observed by Bernardino-Hernández et al. (2017). Of the study area the most respondents' family size was above 6,( 45.9%). This indicates the family planning in study area was poor. This may invite farmers HHs use agrochemical to increase food supply.

Farming experience also one of variable which influence farmers knowledge to follow safety measures, obey precaution and proper dispose. In present study farming experience were significantly associated with farmers knowledge with follow safety measures, indeed, young farmers likely have good knowledge while comparing with older farmers( $X^2=19.71$ ,  $P<0.01$ ) (Table 1). This study lined with study conducted by Damalas and Hashemi. (2010) found that

young producers in Greece showed higher levels of perception of risk to adverse effects of pesticides on their health and higher levels of adoption of integrated pest management practices than the oldest producers. On the contrary, Bernardino-Hernández et al. (2017) revealed that the age of the workers in Mexico is one of the factors influencing the perception of technological and economic benefits, with younger farmworkers prioritizing technological and economic benefits over health care and older more prioritized health care over benefits.

#### **4.2 Types of pesticide used in study area.**

A total of 16 pesticides (active ingredients) were reported in study area. Those pesticides are present in WHO classification and chemical class as well as toxicity level. Toxicity class as classified by the World Health Organization, where Ia ; extremely hazardous, Ib, highly hazardous, II, moderately hazardous, III, slightly hazardous, U, unlikely to present acute hazard in normal use; unk, unknown their toxicity(WHO, 2005). The most of pesticides (75%) used in study area belonged to the WHO toxicity class II (moderately hazardous), followed this belonged to class-U (unlikely to present acute hazardous in normal use and few of belonged to class III slightly hazardous). The present investigation vegetable growing farmers used pesticide categorized under class II toxicity level to WHO classification and none of reported pesticide categorized under Ia and Ib in study area. This study lined with study reported by Mergia et al.et al.(2021) and disagreed with study reported by Mengistie et al. (2015) pesticide such as aldicarb class Ia. Insecticide and fungicides were dominated agrochemicals in present study area (99%, 98.9% and 5.85%) respectively (Table2). But very few proportion vegetable growing farmers were reported used herbicide because farmers mostly remove weeds using in human labor. Mancozeb (Ethiozeb) are systemic fungicides belonging to the dithiocarbamate. Mancozeb is used on a wide variety of food/feed crops, including fruit trees, vegetables, grapes, ornamental plants, and grasses. Since these compounds are classified by the WHO as classes III (slightly hazardous) and U (unlikely to present an acute hazard in normal use) (WHO, 2019), their use is not restricted. However, it was reported that there is a long-term risk for cancer development and endocrine disruption resulting from farmer's exposure to fungicides containing mancozeb (Novikova et al., 2003).

### **4.3 Pesticide use pattern of farmers.**

In present study most of respondent had reported a (97.3%)(Table 4) use of pesticide always is good but farmers who had attended high school and above were reported uses of pesticide always is not good. The present study revealed almost farmers in study area could have positive attitude for about pesticide uses without considering negative effects of pesticide on soil, living organism as well as environments. Variable of educational status has significantly associated with farmers pesticide used knowledge. Farmers in present study have poor knowledge on understand adverse effects of pesticide on environment ( $X^2=152.6$ ,  $p<0.001$ ) (Table4). This finding is similar with that reported from six districts of North Showa zone, Amhara regional state (Hiluf and Ayalew, 2015). Most of farmers in study area also reported pesticide are not poisonous to human (94.1%) and only very few farmers were revealed improperly uses of pesticide can cause poison to human health (5.9%) (Table4). Some pesticides are banned or restricted to use due to their toxicity levels in worlds. But most of farmers in study area didn't know banned or restricted pesticide brands (97.7%) (Table4). In overall farmers in study area had poor knowledge related with known prohibited brand of farmers. Regarding to the reason of some brand of pesticides are prohibited or restricted to use, most of farmers had reported some brand of pesticide banned due to their expensiveness (36.9%) and others were reported due to ineffectiveness (Table 4).Only, 1.8% of farmers had acknowledged pesticide prohibited due their toxicity level. 16.2% of farmers were don't knew why it have banned. Likely, most (95.9%) (Table 3) of farmers in study area not knew pesticide in their specific name, this due to farmers in study area were unable to write and read, but respondent who have profile attended high school and above would understood pesticide in their specific name. This report agreed with study reported by Gesesew et al.(2016) and disagreed with investigation conducted by Mergia et al.(2021)a significant proportion of participants knew pesticides by name in Ethiopia. The major difference was educational status of farmer's. Only a small proportion of farmers recommended of pesticide exposure include; inhalation, dermal and ingestion. This study contradicts report of (Negatu et al., 2016 and Ngowi et al., 2014). Farmers attended high school and above acknowledge possible exposure route while farmers who have no formal educational profile.

Knowledge about understand pesticide exposure in study area significantly associated with level of farmers educational status( $X^2=8.61$ ,  $P<0.001$ )(Table 4).

#### **4.4 Farmers respond of symptom after applied pesticide.**

Farmers in present study reported pesticide exposure related health problems includes, headache(95%), vomiting(31.9%), eye irritation(87.4%), skin irritation(98.6%), skin itchy(2.3%), coughing(79.7%) and poor vision(1.8%)(Table5). This finding consistence with study conducted by (Maumbe and Swinton, 2003 Lawal et al., 2005, Tajjian, 2006, Sosan et al., 2008)reported pesticide potentially contributed to range of short term symptoms such as headache, general weakness, diarrhea, vomiting, abdominal cramps, excess sweating and nausea. In fact no profile of farmers has taken action for mitigate pesticide related poison through medication (100%). May this have serious problem for farmers.

#### **4.5 Farmers pesticide handling practice.**

Proper handling is advisable practice to minimize pesticide exposure problem. Likely, before and after spray pesticide checking of pesticide equipment could have its significance in control pesticide exposure. However, in present study vegetable growing farmer's majority (84.7%) (Table6) were never check spraying equipment before and after spraying. In addition, vegetable growing farmers' majorities (89.1%) were never taken immediately shower after spray pesticide in study area. This finding lined with study conducted by Mergia et al. (2021) and results of two Studies conducted in Greece and in Gaza (Damalas et al., 2008 and Yassin et at., 2002). On other disagreed with finding conducted in western Catamarca province in Argentina by Raimondo et al.(2022) and Nigussie Kurcho (2019) they had reported majority of farmers had taken shower after spray pesticide. Proper handling practice of farmers in present study was influenced by educational level, likely proper handling significantly associated with farmers level of their educational level( $X^2=35.39$ , $p<0.05$ ). 85.1% (Table6) of farmers in present study farmers wash work cloth with other clothe. This practice could have high possibility to pose pesticide poison their families.

#### **4.6 Association between storage, disposal practice and knowledge.**

Improper storage of pesticides and disposal of empty containers is also a major source of exposure to toxicity of these chemicals to humans, animals, and the environment (Ndayambaje et

al., 2019). The storage place for pesticides, including the proper signposting of the installations, ordered shelves with adequate separation of products, and fire extinguishers must guarantee the effectiveness of the products and the health of workers. Farmers with good knowledge could have good storage practice. But present study most (98.2%)(Table7) of vegetable growing farmers were stored pesticide anywhere in home. This finding agreed with finding conducted by (Ohayo-Mitoko, 1997, Zhang and Lu, 2007, Ndayambaje et al., 2019, Gesesew et al., 2016) more than half of the interviewed farmers stored pesticides in places like under the bed, granary, and kitchens. Also a study in Tanzania reported storage of pesticides with in residential home, often in rooms used by a number of family members by 81% of the respondents (Lekei et al., 2014). This finding disagreed with finding conducted in western Catamarca province in Argentina by Raimondo et al.(2022). The improper disposal/use of empty pesticides containers might expose poison to humans, animals and environment. In present study, over half (54%) (Table7) of farmers stored empty container anywhere in home and some of farmers also reported had leave it on open farmers. Unlike, this study reported by Raimondo et al. (2022) most surveyed farmworkers store pesticides in simple depots until these compounds are fully used in agricultural activities. A farmer attended high school and above likely, shown advanced storing practice. This indicated farmers storing practice was significantly associated with educational status( $X^2=46.88$ ,  $p<0.001$ ). The results in study area indicated farmers have poor knowledge on disposal practice. Farmers in study area had used empty container for water fetch and some time to place foods (15.4%) (Table7). Likely, many finding indicates farmers reused empty containers for domestic purpose (Nadja et al., 2011, Jallow et al., 2017, Benjamin et al., 2019 and Mergia et al., 2021). Keeping work clothing and PPE away from the home is keys to the health care of workers and their families (Ndayambaje et al., 2019). Majorities (91.9%) (Table7) of farmers in study area never wash and store contaminated clothe separately from other clothe. This situation could have its contribution to maximize pesticide exposure to families' members. The proper store practice of farmers was influenced by training. Interviewers who had attendance of training in present study shown good knowledge on proper store practice when compared with no have attendance of training( $X^2=30.27$ , $p<0.05$ ). In addition to this farmers (52.7%) in study area were reported they had dumped leftover pesticide in to toilet and irrigation canal. Farmers who attended above high school and obtain frequently pesticide information could have a good knowledge of proper handling of pesticide and dispose as well as storage. Since acquire of

pesticide information of its brand name, specification, precaution, toxicity, safety ,handling, disposal and how it apply and distribute could have major advantages to minimize impacts of pesticide to vegetable growing farmers in the world. Example, In China, a safety education program decreased pesticide poisoning prevalence from 1.05% to 0.25% in one village taken as a leading experience (Fukuzono et al., 2006).

#### **4.7 Pesticide information and knowledge.**

Agricultural extension workers and retailers are supposed to give advises on pesticides hazards (Negatu, 2019). But many of the farmers in present study had received pesticide information from others farmers other than agricultural extension service and labels. This result agreed with finding conducted in Malaysia by (Siti Hajar Sabran and Azlan Abaset al., 2021). Most (93.7%) (Table 8) of farmers didn't trained pesticide related issues in present study. Similarly, studies in developing countries have indicated comparable poor attendance of pesticide-related trainings; for instance only 16% of surveyed female farmers in South Africa attained any formal training (Naidoo et al., 2010) and almost all (98%) of the respondents of a survey in Egypt indicated they did not receive any training (Ibitayo, 2006). In some developing countries, such as Nicaragua and Puerto Rico, undertake an action-oriented approach to farmworkers' education: teaching farm workers about the hazards and safe use of pesticides and empowering them to take preventive and protective actions gave a positive result (Chen S et al., 1998). However, farmers who have attended training had good knowledge while compare with who hadn't trained on proper handling, this implies farmers knowledge significantly associated with source of information like training( $X^2=28.7$ ,  $p<0.01$ ). Training farmers alone may not be sufficient to reduce the risk posed by pesticide. Interventions that provide farmers with information and increase knowledge of pesticide safety should be complemented with other strategies. Greater priority must be given to enforcing existing pesticide laws and regulations at the retail and at farm level, through surveillance and monitoring activities (Mustapha et al., 2017). Majorities (51.4%) (Table8) of vegetable growing farmers purchased from open markets and obtain pesticide dose use information from other farmers and retailers. Only very few (1.4%) farmers bought pesticide from agricultural store and labels. Mostly, those farmers bought pesticide from open market and unlicensed vendor couldn't respect pesticide dose standard while compared with farmers acquired information from AEW and bought from agriculture store. Likely, those

farmers who obtained pesticide information from other farmers and bought pesticide from open market could have poor knowledge to understand prohibited/ banned brand of pesticide while compared with farmers obtained information frequently from AEW. This implies farmers knowledge to understand prohibited pesticide brand significantly associated with source of pesticide( $X^2=70.07$ ,  $p<0.03$ ) (Table8). A farmer frequently acquired pesticide information from agricultural expert and who read and understands labels could have good knowledge to identify pesticide in their names and obeys pesticide precaution. Participation in training programs leads to increased knowledge about safety precautions while handling pesticides (Jones et al., 2009). Indeed, farmers in present study who have attendance of training and advise from expert have positive result with properly handling; this implies farmers practice also significantly correlated with farmers training. In overall the government must develop adequate training programs on pesticide safety, and the hazards of pesticide exposure must address gaps in farmers' knowledge.

#### **4.8 The relationship between pesticide information and uses of PPEs.**

Application of safe practices and the use of appropriate PPE during pesticides handling reduce significantly the risks associated with exposure to toxic chemical compounds (YarpuzBozdogan, 2018). In 2015, both FAO and WHO announced the International Code of Conduct on Pesticide Management, which establishes guidelines for pest control (FAO, 2015). Additionally, the United States Environmental Protection Agency (US EPA) announced revised Worker Protection Standards regarding pesticides application, detailing guidelines that owners and employees should be aware of during their activities, e.g., the mandatory use of PPE by pesticide applicators that must be provided by its employers (USEPA, 2015). PPE required during pest control operations include face shields or full-face respirators, clean long-sleeved coveralls, washable hats, and eye and face protection, chemical resistant boots, aprons, and gloves. Generally, the required PPE are described on the label of each product, according to pesticide toxicity to guarantee their safe use. In present study majority (96.8%) (Table 9) vegetable growing farmers never used personal protective equipment during pesticide application and mixing. This finding agrees with Sosan et al.(2008), Sosan and Akingbohunge(2009), Mengistie et al.(2015), Kahun Kebede (2019), Yirdaw (2021). Other studies in developing countries reported similar results, no personal protection use by more than half of the farmers during mixing or application of pesticides in Tanzania (Stadlinger et al., 2011). This disagreed with study conducted floriculture

farmers in Bahirdar Ethiopia by Mastewal, Mulat and Dessie et al.(2020). However, very few (3.2%) farmers enable to read and obtain frequently pesticide information from agriculture extension workers had used personal protective equipment in present study. Pesticide source of information influence farmer's uses of personal protective equipment. Uses of personal protective equipment could significantly associated with source of pesticide information( $X^2=153.88, P<0.001$ )(Table9), farmers who obtain frequently pesticide information from agriculture extension workers likely more used PPEs when compared with farmers obtain pesticide information from other farmers and other.

## **CHAPTER SIX**

### **6. CONCLUSION AND RECOMMENDATIONS**

#### **6.1 CONCLUSION**

The farmers in Shebedino woreda did not use appropriate safety precaution with regarding to pesticide application. Majority of farmers were not uses personal protective equipment. Likely, farmers have poor knowledge of storing and disposal practice. Most of farmers received pesticide information from other farmers, but only few were obtained frequently from agriculture extension workers. Effectiveness of pesticide information had influenced by source of information, knowledge and work experience. Farmers obtained pesticide information frequently from agriculture extension worker likely has good knowledge while compared with obtained from other farmers. Majority of farmers unable to read pesticide label and training program on pesticide use was very poor in study area.

#### **6.2 RECOMMENDATIONS**

Based on the finding of this study the following are recommendations, are:-

- The Ministry of Agriculture extension agents, NGOs and international organizations agents should provide regular training for farmers on pesticide use and PPEs
- There should be focus on the awareness rising of farmers on proper pesticide management, appropriate safety precautions with regard to pesticide formulation and application and risk perception on human health and the environment.
- Farmers, agricultural office and agricultural extension expert should work together to minimize pesticide misuse and related problems.
- Personal protective equipment should be providing to farmers with balanced price and increase farmers level of knowledge to use PPEs. Because farmers uses normal cloth.
- Agriculture extension workers should have to train farmer's uses of properly pesticide and follow up pesticide rule.
- Farmers should have to bought pesticide and obtain pesticide information only from agricultural store and agriculture experts.

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## APPENDICES

### Appendix I. Questionnaire for Farmers

This questionnaire is prepared for educational research purpose in order to partially full fills the MSc study in Hawassa University, faculty of computational science, Department of Biology and its aim is to assess pesticide handling behavior of farmers and the effectiveness of pesticide information on pesticide handling knowledge and use of PPE among farmers in Shebedino woreda of north zone, Sidama region state, Ethiopia

Please feel free that the information collected is only for academic purpose. Hence, any part of the information being secured from you will be kept confidential. Therefore, you are kindly requested to respond straightforward, honestly and responsibly. Circle your response and also write your suggestion and/or additional information if required.

**N.B: You may have more than one response for a single or one questions, If so, circle all numbers of your response and also you can write down additional information.**

#### Part 1. Socio-demographic background of (HHs).

**Instruction:** Please, do not write your name. Circle your response and also write your additional information if required.

Name of kebele \_\_\_\_\_

- 1 . Sex: A. Male B. Female
2. Marital status: A. Single B. Married C. Divorce D. Widowed
3. Age: A. below18 B.18-30 C. 31-45 D.46-60
4. Educational status of households.  
A. unable to read & write (illiterate) B. Primary (1-4) C. Primary (5-8)  
D. secondary school E. higher School
5. Family size A. 1-3 B. 4-6 C. above 6
6. Do you have an occupation other than farming?  
A. I don't have any B. Civil Servant C. trader D. Other (Specify) -----
7. Farming experience (years). A. 1-5 B. 6-10 C.11-20 D. >20

#### Part 3. Pesticide use pattern and knowledge.

1. The uses of pesticide always are good?  
A. yes B. no
2. The uses of pesticide could increase productivity?  
A. yes B. no

3. Pesticide could solve pest problem?

A. yes B.no

4.use of pesticide could affects environment?

A. yes B. no

5.pesticide could cause poisonous to human?

A. Yes B. No

6. What are exposure route of pesticide?

A. inhalation B. Dermal C. Don't know

7. Do you know prohibited/banned brand of pesticide?

A. yes B. no

8. Do you know why some brands of pesticide are prohibited?

A. high toxicity B. expensive C. ineffective D. i don't know

9. Do you know pesticide in their name? A. Yes B. No

**Part 4.pattern of farmers reported symptom after application of pesticide.**

1. Do you feel discomfort/illness after pesticide application?

A. yes B.no C. sometime D. I don't know

2.what do you felt after application?

A. headache B. vomiting C. eye irritation D. skin irritation

E. itchy skin F. coughing G. poor vision

3. Do you take action if felt those symptom?

A. yes B. No

**Part 5.pesticide handling practice of farmers.**

1. Do you check of spraying equipment before pesticide application?

A. always B. sometimes C. never

2.do you take shower after pesticide application? A. always B. sometime C. never

3. Do you wash contaminated clothes separately? A. always B. sometime C. never

4. Do you wash hands after pesticide application? A. always B. sometime C. never

5. Do you wear special face mask? A. always B. sometime C. never

6. Do you transport pesticide with other goods? A. always B. sometime C. never

7. Do you handle pesticide with use PPEs? A. yes B.no

8. Do you spray pesticide with use PPEs? A. yes B. no

**Part 6.information related with farmers storage practice.**

1. Where do you purchase pesticide?

A. from agriculture store B. from open market C. vendor

2. Where do you dispose empty container?

A. leaves it on farm land B. anywhere in home C. use it for water/food store

3. Where do you store pesticide? A. open field B. open shed for pesticide C. anywhere in home

4.where do you store spraying equipment?

A. general in home B. Equipment store

5.do you put leftover pesticide? A. dump/dispose in toilet B. apply on other crop C. mixed only needed pesticide D. dump in canal

6. Where do you put working clothes?

A. put together with other clothe B. store in separated area

7. Where do you put mixing stick? If it used A. throw in farm B. anywhere C. burning

**Part 7.farmers pattern of source of pesticide information.**

1. Where do you obtain pesticide information for purchase?

A. pesticide dealer B. agriculture extension worker C. other farmers

2.do you trained issue with pesticide how it use? A. yes B.no

3. Where do you obtain dose use information? A. local retailer B. labels C. other farmers

4. Where do you take pesticide related advice?

A. agriculture extension worker B. other farmers C. vendor

5. Where do you obtain information to use PPEs?

A. agriculture extension worker B. other farmers

6. Where do you inform banned/restricted brand of pesticide?

A. agriculture extension worker B. other farmers C. mass media

7. Where do you inform ways to mix pesticide? A. agriculture extension worker B. other farmer

8. Where do you obtain information of how it store pesticide? A. AES B. other farmers

**Part 8.farmers pattern of uses of PPEs.**

1. Do you use personal protective equipment? A. yes B.no C. sometime

2. Do you wear boots? A. Yes B. No

3. Do you wear hats? A. yes B.no

4. Do you wear glove? A. yes B.no

5. Do you wear face mask? A. yes B.no

6. Do you wear full-length trouser A. yes B.no

7. Do you wear eye glass? A. yes B.no

8. Why not wear personal protective equipment? A. yes B.no

**Appendix II Checklist for focus group discussion (FGD)**

This questionnaire is prepared for educational research purpose in order to partially full fills the MSc study in Hawassa University, faculty of computational science, Department of Biology and its aim is to assess pesticide handling behavior of farmers and the effectiveness of pesticide information on pesticide handling knowledge and use of PPE among farmers in Shebedino woreda of north zone, Sidama Region state, Ethiopia.

Please feel free that the information collected is only for academic purpose. Hence, any part of the information being secured from you will be kept confidential. Therefore, you are kindly requested to respond straightforward, honestly and responsibly. Circle your response and also write your suggestion and/or additional information if required.

1. Have you ever attend any workshop or training regarding safety measure and use of pesticides?
2. What personal protective equipment do you use during application of pesticide?
3. How do you transport and storage pesticides?
4. For what purpose do you do with pesticides containers?
5. What do you think about positive and negative effects of pesticides to the human healthy and to the environment?
6. From where do ever obtain pesticide information to use and handling of pesticide

### **Appendix III Checklist for field observation**

This questionnaire is prepared for educational research purpose in order to partially full fills the MSc study in Hawassa University, faculty of computational science, Department of Biology and its aim is to assess pesticide handling behavior of farmers and the effectiveness of pesticide information on pesticide handling knowledge and use of PPE among farmers in Shebedino woreda of north zone, Sidama Region state, Ethiopia.

Please feel free that the information collected is only for academic purpose. Hence, any part of the information being secured from you will be kept confidential. Therefore, you are kindly requested to respond straightforward, honestly and responsibly. Circle your response and also write your suggestion and/or additional information if required.

Do farmers follow the instructions given on the label?

Do farmers properly transport pesticide?

Did the farmers use PPEs properly?

Did the farmers spray when it is windy?

Did pesticide containers properly disposed?

Did the pesticide stored in separated room?

Do farmers obtain pesticide information from AEW or other?

Do farmers handle pesticide properly?

Do farmers disposed leftover pesticide properly?

Do farmers rinse empty container before dispose?

## **Appendix IV Key informant interview questionnaires (KIIQs)**

Which include experts from agricultural offices, agricultural extension workers/DA chairman and pesticide vendors.

### **Dear respondents;**

This questionnaire is prepared for educational research purpose in order to partially full fills the MSc study in Hawassa University, faculty of computational science, Department of Biology and its aim is to assess pesticide handling behavior of farmers and the effectiveness of pesticide information on pesticide handling knowledge and use of PPE among farmers in Shebedino woreda of north zone, Sidama Region state, Ethiopia.

Please feel free that the information collected is only for academic purpose. Hence, any part of the information being secured from you will be kept confidential. Therefore, you are kindly requested to respond straightforward, honestly and responsibly. Circle your response and also write your suggestion and/or additional information if required

THANK YOU FOR YOUR SUPPORT

### **Part I. Background of key informant.**

**Instruction:** Please, circle your response and also write your additional information if required.

1. Sex: A. Male B. Female
2. Age: A. 18- 30 B. 31-45 C. 46-60 D. >60
3. Educational level A. College diploma B. First degree Second degree C. Third degree
4. Occupation A. Farmers B. Civil servant C. Self-Employee
5. Years of experience on the job A. 1-5 B. 6-10 C. >11
6. Marital status: A. Single B. Married C. Divorced D. Widowed

### **Part II. Pesticide use and safety measure, practice and awareness:**

7. Do you advise farmers to use recommended personal protection equipment (PPE) while preparing and spraying pesticides?

- A. Yes, always B. Yes, sometimes C. No/Never

8. Did your office give training to farmers on pesticide issues in the past? A. Yes B. No
9. If yes to question 8. What were the farmers trained on (trained topics of) pesticides?
- A. How to use pesticides B. Health & safety issues C. Application technology  
 D. Disposal of leftover pesticides & containers E. Environmental effects of pesticides  
 F. Integrated pest management (IPM) G. Others, please specify-----
10. What do you think about positive and negative effects of pesticides to human health & to the environment? -----
11. What means does your office use to transport pesticides? -----
12. from where farmers get pesticides? A) Buy from licensed sealer,  
 B. Buy from unlicensed illegal sealer C. Buy from open market,  
 D. Buy from government office E. other place, please specify \_\_\_\_\_
13. When you sell pesticides to farmers, do you advise them about safe handling & use?
- A. Yes, always B. No/never
14. When you advise farmers, what is your source of pesticide handling instructions?
- A. Labels on the container B. pesticide dealers C. agricultural extension workers,  
 D. Other farmers, E. other persons, please specify \_\_\_\_\_
15. Mention the types of personal protection equipment available for farmers in your office?
- A. head dress/ hat B. eye and face protection glasses & goggles  
 C. reparatory / noise protection D. Hand protection glove E. Body protective long coat/cloth (tuta)  
 F. protective foot wear/shoes G. others, please specify \_\_\_
16. is there personal protection equipment easily available for farmers to buy & use?
- A. Yes but small extent B, no
17. Illnesses felt by farmers after application & exposure: A. Head ache, B. nausea,  
 C. Vomiting, D. skin irritation, E. eye irritation F. Other discomforts specify \_\_\_\_
18. Do you think there is a possibility of harmful effects of pesticide use on your local environment? A. Yes B. No