Health symptoms associated with pesticides exposure among flower and onion pesticide applicators in Arusha region

Suten Geofrey Mwabulambo

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HEALTH SYMPTOMS ASSOCIATED WITH PESTICIDES EXPOSURE AMONG FLOWER AND ONION PESTICIDE APPLICATORS IN ARUSHA REGION

By

Suten Geofrey Mwabulambo

A Dissertation/ Thesis Submitted in (partial) Fulfillment of the Requirements for the Degree of Master of Science (Environmental and Occupational Health)
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CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***Health Symptoms Associated with Pesticides Exposure among Flower and Onion Pesticide Applicators in Arusha Region,*** in partial fulfillment of the requirements for the degree of Master of Science (Environmental and Occupational Health) of Muhimbili University of Health and Allied Sciences.

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Dr. Ezra J. Mrema

(Supervisor)

Date_____

DECLARATION
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I, **Suten Geofrey Mwabulambo,** declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature……..…… Date……..…

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DEDICATION

This work is dedicated to my beloved wife Grace Adamson Ngoo, my children Bright and Charity, my father Mr. Geofrey Mwabulambo and my mother Sifa Anusa for their prayers, patience and inspiration during the period of my study.

ABSTRACT

Background: Pesticides are extensively used in agriculture to control harmful pests and prevent crop yield losses or product damage. In Tanzania several studies have been conducted on health symptoms of pesticides to agricultural workers. However there are few studies on neurological health symptoms associated with pesticide exposure in flower and onion farms.

Objective: The study focused on health symptoms associated with pesticides exposure among flower and onion pesticide applicators in Arusha region.

Material and Methods: The study used cross sectional study design with quantitative approach, it employed the use of interview based questionnaires, observation checklist and laboratory analysis of 140 cholinesterase test at flowers and onion farms. A multistage sampling technique with probability methods was used to select study area (districts, wards and villages). A simple random sampling was used to select study participants. Data analysis was done using SPSS software version 20.

Results: About 98% of pesticide used was organophosphate and only 2% was carbamate used in the area to protect crops from the effect of diseases, pests and weeds. The prevalence of neurological health symptoms reported more to onion farms, with higher body weakness (91.1%) pain in part of the body (64.3%) but the situation differ from flower farms were reported in excessive sweating followed by body weakness. More than 39% of the study participants from onion and 19% from flower farms had Acetylcholinesterase levels below the normal range. The mean average of participants from onion farms was 27.882 ± 3.829 U/g Hgb of cholinesterase test level whereas participants from flower farms was 25.146 ± 3.9607 U/g Hgb of cholinesterase test level which was lower by 2.736 U/g Hgb compared to those of onion farms. About 39.3% and 19% of participants from onion and flower farms had cholinesterase level below the limit level respectively. Study shows that only 60% of pesticide applicator use personal protective equipment when exposed to pesticide

Conclusion: High proportion of neurological health symptoms and cholinesterase test depression was noted among pesticide applicators in both farms. There is a need to conduct further studies to ascertain causal to such high neurological health symptoms

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LIST OF ABREVIATIONS

AChE	Acetylcholinesterase
CNS	Central Nervous System
FAO	Food and Agriculture Organization of the United Nations
MUHAS	Muhimbili University of Health and Allied Sciences
OP	Organophosphate
PPE	Person Protective Equipment
SPSS	Statistical Package for Social Sciences
TPRI	Tropical Pesticides Research Institute
UNDP	United Nations Environment Programme
US	United States
WHO	World Health Organization

DEFINATION OF TERMS

Hazard: - Means the inherent property of a substance, agent or situation having the potential to cause undesirable consequences (e.g. properties that can cause adverse effects or damage to human and animal health, the environment or property

Organophosphate: - Any organic compound whose molecule contains one or more phosphate ester groups, especially a pesticide of this kind. Used as insecticides, medications, and nerve agents

Neurological disorders: Is any disorder of the nervous system. Structural, biochemical or electrical abnormalities in the brain, spinal cord or other nerves can result in a range of symptoms. Physical symptoms of health problems may include the following: Partial or complete paralysis, Muscle weakness, partial or complete loss of sensation, seizures, difficulty reading and writing, poor cognitive abilities, unexplained pain, decreased alertness, itching, headache, vomiting, diarrhea and nausea.

Pesticide:- Defined by TPRI Act No. 18 of 1979 as "any matter description (including acaricides, arboricides, herbicides, insecticides, fungicides, mollucides, nematicides, hormonal sprays and defoliants) used or intended to be used, either alone or together with other material substances – a) For the control of weeds, pest and disease; or b) for the control of external vectors of veterinary or medical disease and external parasites of man or domestic animals or c) for the protection of any food intended for human or animal consumption."

Pesticide applicator means a person who: Is spraying or applying pesticides for others or is authorize to do work for and is employed by a specific pesticide operator or is in direct charge of or supervises the spraying or application of pesticides or operates uses, drives or physically directs propulsion of equipment, apparatus or machinery, either on the ground or by aircraft in such activity.

Pesticide spraying: - This refers to practical way in which pesticides; (including herbicides, fungicides, insecticides, or nematode control agents) are delivered to their biological targets (e.g. pest organism, crop or other plant

CHAPTER ONE

INTRODUCTION

1.1 Background

Pesticides are substances meant for attracting, seducing, destroying and exterminate a target living organism by inhibiting certain vital functions (Damalas & Eleftherohorinos 2011). They were applied predominantly to kill or at least control weeds, insect pests, nematodes and fungi in agricultural, forestry, and livestock production (Berry 1991). Pesticides have also important role in public health efforts to control vectors that spread diseases like malaria, leishmaniasis, sleeping sickness, dengue fever, and chagas disease.

Globally approximately five billion pounds of pesticides were used per annum among which organophosphate and carbamate insecticides (34%), dithiocarbamate fungicides (18%) and phenoxyl herbicides (12%) are the most commonly used (Ye et al. 2013). It was estimated that 18% of pesticides used in public health sector while 81% used in livestock and agricultural sectors and 1% for protecting buildings from damage caused by insect pests (Kapeleka et al. 2016).

The spreading concern about global food security has led to various approaches to improve food production systems such as utilization of chemical to reduce agricultural loss due to presence of pests (Perez et al. 2015). This resulted to increase of toxic chemicals in the environment. Globally 2,267,961.85 metric tons of pesticides are used per annum. Studies on pesticides use among farmers in developing countries reported that the pesticide use raised up to 35% because of horizontal and vertical expansion of agricultural sector (Perez et al. 2015).

Developing countries are known to consume less than 20% of the world production of agrochemicals including pesticide. Africa consumes about 4% of the total world produced pesticides. The annual imports of pesticides in Africa countries like Sudan were approximately 5000 metric tons of pesticides which are used in cotton (47%), vegetables (26%), sugarcane (15%), pests (7%) and public health sector (2%) of pesticide used per annum (Azhari Omer Abdelbagi & Ali 2013).

Developing countries seen to have higher incidence of pesticides poisoning due to poor regulation, lack of surveillance systems, poor enforcement, lack of training, inadequate access to information systems, poorly maintained or non-available personal protective equipment (PPE), and large agriculturally-based populations (Thundiyil Stober and Besbelli, 2008).

In Tanzania traditional cultivation methods such as use of hand hoes, crop rotation, shift cultivation, intercropping, and manure are practiced in production. Due to globalization and local population growth, demand for food and raw materials led to shift to commercial agriculture in 1980s which required to use hazardous chemicals like synthetic fertilizers and pesticides (Ngowi et al. 2016). In 2014/15 agricultural sector grew by 3.4% compared to 3.2% reported in 2013/14 (Tanzania Ministry of Agriculture 2015).

According to World Health Organization (WHO) and the United Nations Environment Programme (UNEP) each year three million workers employed in agriculture in the developing world are estimated to experience severe poisoning from pesticides (Miller 2004). It was estimated that pesticides cause 14% of all known occupational injuries in agriculture and 10% of all fatal injuries in the world (Maden et al. 2014). About, 99% cases of pesticide poisoning fatalities occur in developing countries only, although these countries consume 20 to 25 % of pesticides (De Jong et al. 2014).

Despite extensive use of pesticides more concerns are on health risks due to the exposure of farmers when handling, mixing and applying pesticides or working in sprayed fields. Small scale pesticide applicators come in contact with pesticides in field during pesticides application, weeding, pruning, harvesting and reentry to collect fire wood and vegetables (Mekonnen & Agonafir 2002). Farmers face great risks of exposure to toxic pesticides that were banned or restricted and or due to incorrect application techniques, poorly maintained or totally inappropriate spraying equipment, inadequate storage practices, and often reuse of old pesticide containers for food and water storage (Perry 2008).

Agrochemical poisons find their own way into blood systems of human beings through mouth, nose, intact skin and the eyes (Damalas & Koutroubas 2016). Several adverse health effects such as temporary acute effects like irritation of eyes and excessive salivation may result from exposure to pesticides. Effects on the central nervous system (CNS) like restlessness, loss of

memory, convulsions and coma are also common. Effects on parasympathetic and sympathetic nervous system such as respiratory paralysis have been widely reported (Mhauka et al., 2014).

Pesticide uses in agriculture activities expose large number of populations of applicators to risk factors for neurological health symptoms. To my knowledge, little has been conducted in the country on neurological health symptoms to applicators in agricultural sector or on the risk factors associated with pesticide exposure to applicators. Finally, this study will identify health symptoms associated with exposure to flower and onion pesticide applicators that will create foundation for better pesticides management in the country.

1.2 Problem statement

Like in other countries, in Tanzania pesticides are increasingly widely used in agriculture to control the harmful pests and prevent lose in crop yields or product damage. They are also used in other settings such as households, schools, airplanes and boats. Arusha region in Tanzania is known to be leading in pesticide trading and utilization because of intensification of horticulture. The climatic conditions of this region favor the growth of horticulture crops such as vegetables, fruits, seeds (vegetables and flowers cuttings).

The use of pesticides has lead to an increase in human exposure which may result to adverse health effects. Farmers have reported to fall sick after routine application of pesticides. Moreover, health symptoms including skin problems and neurological symptoms have been reported by previous studies conducted in Tanzania (Lekei et al., 2014, Ngowi et al. 2007). Studies done in Kenya showed the increase in prevalence of neurologic symptoms and changes in neurobehavioral performance reflecting cognitive and psychomotor dysfunction after exposure to pesticide (Kipsengeret et al., 2016).

The misuse of pesticides such as mishandling of pesticides, over and under dosing, mixing of different pesticides, dangerous storage of pesticides, poor spraying equipment and poor use of personal protection reported among farm workers in Tanzania (Lekei et al., 2014) suggest a high potential for human exposure with the highest risk of occupational exposure among pesticide applicators and other agricultural workers. However, limited studies have been conducted to assess the health symptoms such as neurological symptoms associated with this exposure. It is therefore necessary to conduct this study to add to the body of knowledge on neurological health symptoms experienced by the pesticide applicators working in onion and flower farms. The neurological health symptoms reported by the study will be useful in establishing national magnitude of the problem and hence benchmark national efforts to reduce the burden.

1.3 Problem analysis diagram

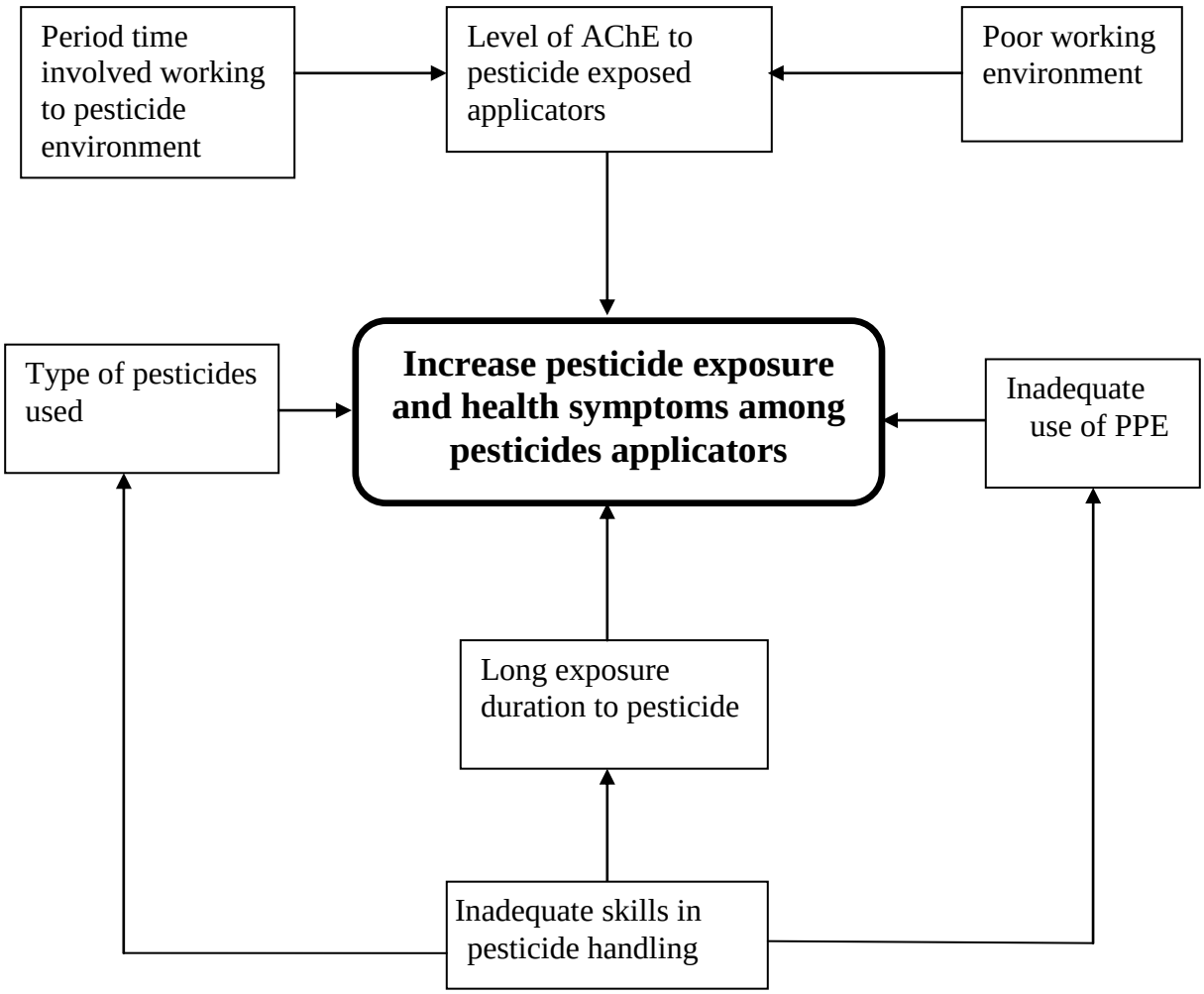

Figure: 1. Problem analysis diagram on neurological health symptoms associated with pesticide exposure among flower and onion pesticides applicators.

The problem analysis diagram (Figure 1.1) presents the factors that may lead to neurological health symptoms among flower and onion pesticide applicators. Extensive pesticides application in farms for crops protection from pests and diseases, expose pesticide applicator into pesticides poisons.

Occupational exposure to organophosphate (OP) among pesticide applicators is usually through skin absorption and inhalation as many OP applicators do not use protective devices and time taken to be exposed to pesticide. Most OP pesticides exert toxicity on the target and non target organs through inhibition of Acetylcholinesterase (AChE) activity in the nerve and muscle tissues. Hence, determination of blood serum AChE activity has been the standard biomarker of OP exposure. Organophosphates bind with cholinesterase enzyme and inhibit the activity of the enzyme by irreversible phosphorylation. This results in elevated levels of acetylcholine thus stimulating the muscarinic and nicotinic receptors resulting in consequent toxicity.

The exposure may results into a number of neurological health symptoms such as irritation, itching, headache, vomiting, diarrhea and nausea. Pesticide exposure is usually caused by several factors generally categorized into individual, environmental exposure to pesticides, and social demographic factors.

Social demographic factors such as age, education and economic status in sense that pesticide applicators have high exposure which can affect risk perception and working practice, are inter alia increasing exposure level to pesticides.

1.4 Rationale of the study

Tanzanian economy heavily depends on agriculture for the provision of food, employment and creation of wealth. The contribution of the agricultural sector to the economic growth and the development of Tanzanians have continued to increase. Currently agricultural sector contributed 29% of the GDP. Agriculture is the largest employer in the country. The study aims to address the magnitude of the neurological symptoms due to pesticide exposure among pesticide applicators. Information that will be obtained from this study will explore the magnitude of the problem that will initiate both national and local methods of pesticide application for improvement of agriculture sector in the country. This is also helped raising awareness to agricultural pesticide applicators as a vital to encouraging establishment of controls in the workplace. It also helped to inform relevant authorities and interested parties of the existing problems and provide opportunities for further research acting to provide baseline information for policy makers.

Therefore this study focused on development of practical management strategy for the investigation of health symptoms associated with the pesticides exposure among flower and onion pesticide applicators, control of exposure to pesticide, prevention of people from pesticide exposure from pesticide. Understanding this information is an effective tool to policy and decision makers in addressing burden of neurological health symptoms in agricultural sector.

1.5. Research Questions

1.5.1 Main Question

What is health symptoms associated with pesticide exposure among flower and onion pesticide applicators in Arusha region?

1.5.2 Research Questions

1. What are the common pesticides used in flower and onion farms in Arusha region?
2. What is neurological health symptoms associated with pesticide exposure among flower and onion pesticide applicators?
3. What are the cholinesterase concentration levels among flower and onion pesticide applicators?
4. At what extent does pesticide applicator use PPE's when exposed to pesticides?

1.6. Objectives

1.6.1 Broad objective

To assess health symptoms associated with pesticide exposure among flower and onion pesticide applicators in Arusha region.

1.6.2 Specific objectives

1. To identify commonly pesticide used in onion and flower farms in Arusha Region
2. To assess neurological health symptoms associated with pesticide exposure among flower and onion pesticide applicators
3. To determine cholinesterase concentration level among flower and onion pesticide applicators in Arusha
4. To assess the extent of PPE use among flower and onion pesticide applicators in Arusha Region.

CHAPTER TWO

2.0 LITERATURE REVIEW

The Food and Agriculture Organization (FAO) of the United Nations (1996) defines a pesticide as any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies Pesticides are widely used throughout the world in agriculture to protect crops and in public health to control diseases. Nevertheless, exposure to pesticide can represent a potential risks to humans. Pesticides manufacturing workers, pesticides applicators at home and at farms are prone to possible occupational pesticide exposure. In Tanzania, Tropical Pesticides Research Institute (TPRI) and National Environmental Management Commission (NEMC) have given mandate to manage the production, importation and exportation of agrochemicals in the country because of their toxicological risks to people, animals, crops and the environment.

2.1 Pesticide commonly used in agriculture

Common pesticides used in the World are classified according to the use and to chemical composition. The classification includes insecticides, herbicides, fungicides, rodenticides, avicides. Others are chemically classified as organophosphates, carbamates, organochlorines and pyrethrins and pyrethroids and arsenals compounds (Kariathi et al., 2016). The world used approximately 2.4 megaton's (5.3×10^9 lb) of pesticides, with herbicides constituting the biggest part of the world pesticide use at 40%, followed by insecticides (17%) and fungicides (10%) (Williamson et al. 2008). Most pesticides are imported from developed to developing countries where they arrive pre-formulated or in raw form and are then formulated locally (Mrema E.J., Ngowi A.V., Kishinhi S.S. 2017).

Consumption increased substantially over time, for example, in the USA, the use of pesticides doubled from 1960 to 1980, but total use has since remained stable or fallen (Sulle, 2016). Use of pesticide has risen in developing countries and the fastest growing markets in Africa, Asia, South and Central America, Eastern Mediterranean (Lahr et al., 2016).

Bangladesh and Thailand have quadrupled their pesticide use since the early 1990s, while Ghana, Ethiopia, and Burkina Faso, countries newer to the pesticide game, have seen a tenfold increase over the same period according to the Food and Agriculture Organization of the United Nations

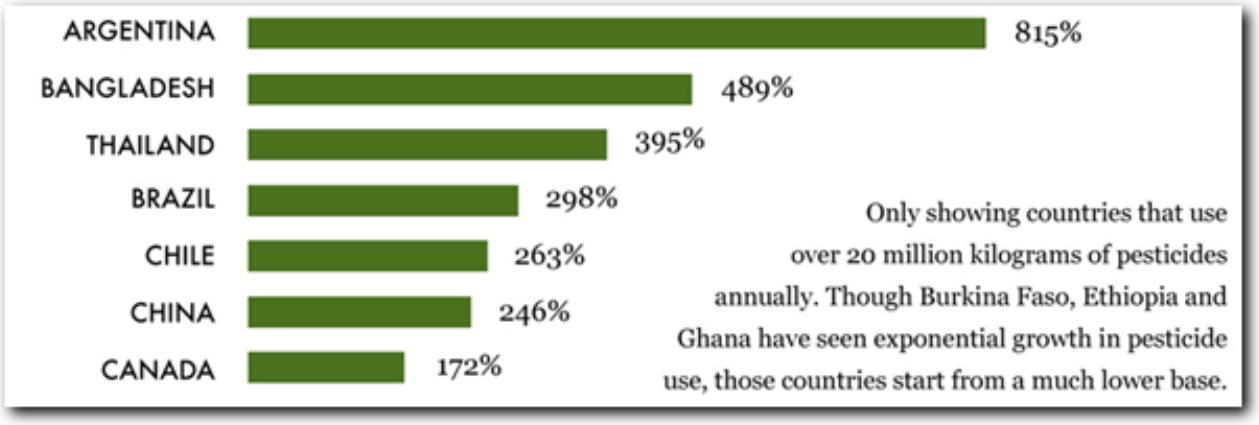

Figure: 2. Increase of Pesticide use in some countries in the world from 1990 to 2017. (Source Food and Agriculture of the United National report 2017)

As in any intensive agriculture, pesticides are used in flower and onion farms in wide range to control diseases and pests, which can damage production and marketability (Lahr et al. 2016). Globally two million metric tons of pesticides are used per annum in flower and vegetable (onion and tomato) (Perez et al. 2015).

Organophosphate, carbamate, organochlorine and pyrethroids are potentially hazardous pesticides that are widely used in various parts of East Africa. The study done on trends in pesticide use and drivers for safer pest management in four African countries shows that a total of 47 different pesticide active ingredients were reported by farmers in vegetable (onion, tomato, cabbage etc) growth (26 insecticides; 10 herbicides; 5 fungicides; 1 acaricide; 1 nematicide; 1 fumigant; 1 rodenticide; 1 biopesticide and 1 plant growth. The most commonly encountered

active ingredients were the insecticides endosulfan, dimethoate, cypermethrin, chlorpyrifos, fenitrothion, malathion, profenofos and deltamethrin and the herbicide glyphosate (Williamson et al. 2008).

More than 1000 active ingredients are marketed as pesticides and developing countries use 25% of the annual global consumption. In Tanzania, a total of 300 active ingredients were registered and used by 2006, including endosulfan, which is restricted by the Stockholm Convention due to its environmental persistence and the documented toxic potential (Med et al. 2015).

In response to huge demand for Tanzanian agricultural products, there has been a great increase in horticultural production for both export and domestic use. This has led to intensified cultivation, a reduction in the use of traditional methods of pest management, and an increase in the use of synthetic pesticides (Ngowi et al. 2016). Insecticides, fungicides, herbicides and rodenticides were common types of pesticides used by onion farmers in the Tanzania. In addition, despite the ban to use Lindane is used to treat scabies despite of its discouragement (Sulle 2016).

The study done in Northern party of Tanzania on pesticides use by smallholder farmers in vegetable production shows that types of pesticides used by the farmers were insecticides (59%), fungicides (29%) and herbicides (10%) with the remaining 2% being rodenticides. Also the study shows that fifty three percent of the farmers reported that the trend of pesticide use in vegetable production was increasing (Ngowi et al. 2007).

2.1.1 Human Exposure to Pesticides

The pesticide and agricultural chemical industry is a large and important aspect of farming in Tanzania. The work environment is one among the factor which involves pest control activity, personal hygiene habits (frequency of changing clothes, washing body), personal protection equipment that have been shown to influence workers exposure to pesticide (Grimbuhler et al., 2014).

Human exposure to pesticides may occur through occupational exposure in the case of agricultural workers in open fields and greenhouses, workers in the pesticide industry, and exterminators of house pests (De Jong et al., 2014). Adverse effects on non-target organisms

(e.g., reduction of beneficial species populations), water contamination from mobile pesticides or from pesticide drift, air pollution from volatile pesticides, injury on non-target plants from herbicide drift, injury to rotational crops from herbicide residues remained in the field, crop injury due to high application rates, wrong application timing or unfavorable environmental conditions at and after pesticide application (Perez et al., 2015).

Workers who mix, load, transport and apply formulated pesticides are normally considered to be the group that receives the greatest exposure because of the nature of their work. They are therefore at the highest risk of acute intoxications (Damalas & Eleftherohorinos 2011). The exposure of workers increases in the case of not paying attention to the instructions on how to use the pesticides and particularly when they ignore basic safety guidelines on the use of PPE and fundamental sanitation practices such as washing hands after pesticide handling or before eating (Lu et al., 2006).

Dermal absorption may occur as a result of splashes and spills when handling (mixing, loading or disposing of) pesticides. The degree of hazard by dermal absorption depends on the duration of the exposure, the pesticide formulation, and the body part contaminated. Contrary to liquid pesticides, powders, dusts, and granular pesticides are not absorbed easily through the skin and other body tissues. Liquid pesticides which contain solvents (e.g., organic solvents) and oil based pesticides usually are absorbed more quickly than dry pesticides (Damalas & Koutroubas, 2016).

The study done in Ethiopia shows that insecticides (37.6%), fungicides (17.8%) and herbicides (31.5%) are the highly common used pesticides, the remaining 3.1% are rodenticides. The study also showed that 94.3 % of the farmers use chemical pesticides at different levels regularly or occasionally and 5.7% do not use chemical pesticides for crop production. About 93% of farmers who use chemical pesticides indicated to use them for weed control, 89.9% for insect pest control, 37.5% for fungi/molds/rust control, 13.5% for rodent control, 24.3% for veterinary uses and 1.7% for other purposes (Ayalew, 2014).

2.2 Neurological Health Symptoms

Pesticide poisoning is very common in developing countries particularly in rural areas where pesticides application is highly practiced (Perez et al. 2015). The WHO estimates that 3 million people are poisoned by pesticides every year, most of them in developing countries. Exposure to pesticides can affect the reproductive system, causing infertility, early pregnancy loss, spontaneous abortions and foetal deaths. Many pesticides are known to cause cancer. The impact on health and environment depends as much on the type of pesticides as the level of exposure. However, little is known about the health effects of pesticides on those who use or handle these chemicals, especially informal workers on small-scale farms in developing countries who are underrepresented in population-based studies of pesticides and health (Manyilizu et al. 2016).

Neurological disorders are diseases that affect brain and the central and autonomic nervous systems. The signs of neurological disorders can vary significantly, depending upon the type of disorder as well as the specific area of the body that is affected. In some instances, you might experience emotional symptoms while in other cases physical symptoms may be the result Sleeuwenhoek et al. 2007). Risk assessment of pesticide impact on human health is not an easy and accurate process because of differences in the periods of pesticide exposure and the levels of exposure, type of pesticides (regarding toxicity), mixtures used in the field, and the geographic and meteorological characteristics of the agricultural areas where pesticides are applied. Such differences refer mainly to the people who prepare the mixtures in the field, the pesticide applicators, and also the population that lives near the sprayed areas, pesticide storage facilities, greenhouses, or open fields (Lekei et al. 2014).

Considering that human health risk is a function of pesticide toxicity and exposure, a greater risk is expected to arise from high exposure to a moderately toxic pesticide than from little exposure to a highly toxic pesticide. However, whether or not dietary exposure of the general population to pesticide residues found on food and drinking water consists of a potential threat to human health, is still the subject of great scientific controversy (Damalas & Eleftherohorinos 2011).

The cross sectional study done in Córdoba Province, Argentina that aimed to describe the health conditions of terrestrial pesticide applicators reported a high prevalence of occasional or frequent

symptoms: 47.4% had symptoms of irritation, 35.5% fatigue, 40.4% headache and 27.6% nervousness or depression (Butinof et al. 2015).

Studies have shown exposure to pesticides has been associated to adverse neurological disorders, respiratory symptoms, hormonal disturbances and reproductive abnormalities (Kumar & Panneerselvam 2008). The numerous case reports and case registries indicated that 4-9% of individuals with acute pesticide poisoning experience delayed or persistent neurological effects, including depression, weakness, nervousness, irritability, fatigue, insomnia, forget fullness, confusion and depressive reactions when exposed to pesticides (Ugwu et al., 2015).

A descriptive analytical study conducted on pesticide exposure and health conditions of terrestrial pesticide applicators in Córdoba province, Argentina reported a high prevalence of occasional or frequent symptoms whereby 47.4% had irritation symptoms, 35.5% fatigue, 40.4% headache and 27.6% nervousness or depression (Butinof et al., 2015).

The study done in Ethiopia on assessment of pesticide use, practice and environmental effects showed that 85.94% of farm workers felt discomfort during application of pesticides, 28.13% indicated a head ache, 6.77% indicated nausea, 13.02% indicated vomiting, 32.99% indicated skin irritation, 26.91% indicated eye irritation and 2.26% indicated discomforts after pesticide application. It was also found that 95% farm workers did not practice safety precautions during pesticide formulation and application. Moreover, the study showed that more than 22.2 % respondents heard pesticide poisoning incidents in their communities and environment and only 10.9% reported it to agriculture office (Ayalew. 2014).

The study done in Kwekwe district, Zimbabwe on health effects of agrochemicals reported that 45.1% of farm workers in commercial farms reported to suffer headache (66.7%), cold/flu (62.2%), weakness (45.9%), dizziness (41.1%) and skin irritation (39.0%) (Magauzi, 2011).

2.2.1 Sixteen (Q16) neurological health symptoms

The 16 questions were commonly used to study prevalence of neurotoxic symptoms among workers exposed to organic solvents. It has also been recommended that exposed workers reporting more than six symptoms referred for further examination of possible chronic toxic

encephalopathy. The symptom questionnaires are commonly used to monitor workers who are occupationally or environmentally exposed to, for example, neurotoxicants, shift work, and the like (Rastogi et al. 2010).

2.3 Cholinesterase test

Cholinesterase is an enzyme produced by the body that is needed for the central nervous system to function properly. Absence of cholinesterase or excess acetylcholine leads to confusion of the body's nervous system which can result to health symptoms within a minute to hours. The carbamate and organophosphate pesticides are main chemicals inhibitors that affect the function of cholinesterase in the body (Mambo et al. 2013). The primary biological role of AChE is the rapid hydrolysis of acetylcholine at the cholinergic synapses in the central and peripheral nervous systems and at neuromuscular junctions. The inhibition of AChE by certain xenobiotic chemicals (e.g., organophosphate pesticides) within synaptic clefts results in the dysfunction of nerve transmission by preventing the inactivation of ChE; this leads to excessive stimulation of the CNS/PNS. The measurement of blood AChE activity in individuals is a non-invasive biomarker method to monitor poisoning or exposure to organophosphate and carbamate insecticides (Hinson et al. 2017).

The study done in Arusha on self reported health effects among short and long term pesticide applicators shows that respiratory disease symptoms were the most frequently reported (29.3%) followed by skin (17.2%), and sight (15.3%) due to exposure to organophosphates, carbamate, dithiocarbamate and pyrethroids applied frequently in the farms (Med et al. 2015).

The study done by Ngowi et al on acute health effects of organophosphorus pesticides among small-scale coffee growers showed comparable results on AChE activities during spraying and non spraying period (the mean values; 32.0, SD 7.8 versa 33.0, SD 8.7 U/g HgB; $p = 0.26$). The study showed that the prevalence of cough, headache, abdominal pain, excessive sweating, nausea, excessive salivation, diarrhea, and vomiting did not differ significantly between spraying and non spraying periods (Ngowi et al. 2001).

2.4. Personal protective equipment (PPE)

This refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by PPE include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. The study on protection against the risk of pesticide shows that pesticide applicators use engineering controls and PPE but PPE was highly used, with chemical resistant gloves showing to have the highest level of compliance. Majority of respondents did not wear PPE because they do use engineering controls (Coffman et al. 2009).

A cross-sectional study conducted among the farmers of Kangralli village in Belgaum district in India showed that majority of farmers had knowledge regarding PPE, 100% used mask, 16.3% used apron, 14% used gloves, 8.1% used goggles and only 3.5% used special boots during spraying pesticides in the field (Ranjan et al. 2014).

A study in Tanzania on the impact of pesticide on human health among farmers found that 42% of the respondents reported using some kind of PPE such as respirators, boots, gloves and aprons while applying pesticides and about 94% took precaution when eating, drinking and smoking by washing hands and avoiding smoking while spraying (Ngowi et al. 2001).

The study done in Ghana on pesticides exposure and the use of PPE among farmers shows that majority of the farmers were aware of the negative effects of pesticides on their health and the environment if not well handled. Despite the awareness, most farmers did not handle pesticides with care and did not adhere to the use of PPE, hence, increasing their risks to danger of exposure to pesticides. Storage of pesticides in bedrooms was reported by 22.5 % of farmers; an indication of a high risk of pesticides exposure through direct inhalation (Okoffo et al. 2016).

According to the study conducted on pesticide knowledge and safety practices among farm workers in Kuwait come up with the results that shows majority of the farmers acknowledged that pesticides were harmful to their health (71%) and the environment (65%). However, farmers' level of knowledge of pesticide safety is insufficient. Over 70% of the farmers did not read or follow pesticide label instructions, and 58% did not use any PPE when handling pesticides (Jallow et al., 2017).

CHAPTER THREE

3.0 METHODOLODY

3.1 Study design

This was a cross-sectional study carried out to flowers and onion farms in three districts (Arusha, Meru and Karatu) in Arusha region. The quantitative approach was used to assess health symptoms associated with exposure to pesticides among flower and onion pesticide applicators in Arusha region.

3.2 Study area

The study was conducted in Arusha region which is one of 30 administrative regions in Tanzania. The area was the leading on flower and onion growers in Tanzania. The region has seven administrative districts namely Arusha city, Arusha rural, Meru, Monduli, Karatu, Ngorongoro and Longindo. It lies below the equator between latitudes 2^{o} and 6^{o}. Longitudinally the region is situated between 35^{o} and 38^{o} east of Greenwich. The region is bordered by Kenya to the north, Kilimanjaro region to the east, Manyara and Singida regions to the south, and Mara and Simiyu regions to the west. The region has a total land area of 34,526 km^2 of which 2.7% is covered by water bodies of lakes Eyasi, Manyara and Natron. According to census of 2012 the region had a population of 1,694,310. Agriculture is the main economic activity of which contributes more than 45% of regional GDP and accounts for more than 75% of export earnings(Tanzania Ministry of Agriculture 2015). Moreover, both agriculture and livestock sectors employ more than 65% of the rural population in the region.

3.3 Study Population

The study population was made up of male pesticide applicators from the study areas who were involved in application of pesticides in onion and flower farms. This group was chosen because of their nature of the activity they were doing daily that expose them to different kind of pesticides and health effect they suffer after exposed to pesticide

3.4 Sample size estimation

The formula adopted from Kothari (2004) was used to estimate the sample size where a total minimum of 140 pesticide applicators were involved. The formula provided a simple way of estimating sample that was required for the study. This formula was presented as follows:

$$n = \frac{Z^2 P (1-P)}{\varepsilon^2}$$

Where:

Z = confidence interval at 95%

ε = Margin of error which is 5% or 0.05

n = Minimum sample size

P = Proportion of the study assumed to be 9% from the study conducted on Health effects to pesticides use among farm workers in farming sector by Bwititi, et al. (1987)

$$n = \frac{1.96^2 \times 9(100-9)}{5^2}$$

$$n = 126$$

This sample size was adjusted for 10% non response rate:

$$N = \frac{126 \times 1}{R}$$ where R was the Response Rate = 90%

$$N = \frac{126 \times 1}{0.9}$$

$$= 140$$

The minimum sample size of respondents to participate in the study was 140 pesticide applicators

3.5 Sampling Design and Techniques

3.5.1. Area and Participants sampling

Probability sampling technique was used by employing multistage sampling techniques to select 140 through the following stages:

First stage: Simple random sampling was used to select the study area. Through lottery method was used to select three districts from the respective list of the district in the region.

Second stage: From each district two wards and one village from each ward was selected using simple random sampling method therefore the total number of six wards and six villages was selected to involve in the study

Third stage: The systematic random sampling was used to select farms from each village. Whereby random starting point between one and fixed periodic interval was used to select farms from the list. Seven farms were selected from five villages.

Fourth stage: Simple random sampling method was used to obtain study subject for neurological health symptoms. List of pesticide applicators were solicited from farm managers to obtain a sampling frame and performed simple random sampling to select the study subjects. A total of 20 pesticide applicators were selected from each farms. Therefore, a total of 140 study participants from list of contractual (216) from flower farms and casual (182) from onion farms were sampled to involve in the study.

3.6. Inclusion Criteria

Employed pesticide applicators with a minimum of one month working duration in farms involving in spraying of pesticides were agreed to participate.

3.7 Data Collection Technique and tools

Data were collected by using questionnaire which comprised of closed and open ended questions which were administered to the participants. The information on demography (age, sex, and residence), types of pesticide, health effects of the pesticides, period used to spray per day was collected. The respondents were also asked whether use PPE such as masks, gloves, boots and coveralls. The observation checklist also was used to collect information on how PPE worn, quality of PPE if have holes that allow pesticide to penetrate to reach skin, hazards from pesticide spill, preparation process of pesticide before spraying, storage and disposal of pesticide empty storage facilities and body cleanliness after spraying. Visual media collection was done to collect information on PPE's uses, pesticide handling and spraying process. About 10 µL of blood from the tip of index finger was taken from each study participant using Test-mate™ that was used for the cholinesterase test. The blood sample was collected from each pesticide applicators for AChE activity testing within four minutes after collection.

The data collected during pre testing were not included with those collected from the study sites in Arusha during analysis.

3.8 Recruitment and training of research assistants

Data collection was conducted by the author and the two trained research assistants. These included an intern second year student from Department of Health Safety and Environment of University of Bordeaux, France and Laboratory technologist from TPRI. They were trained for two days to acquaint them with the research topic, objectives of the study and data collection strategies such as visual media collection (video and photographs), observation checklist and questionnaires. Trainees did trials on data collection to demonstrate their understanding of the instructions and further trials done on pretesting data instrument in the field areas. The data collection was conducted from 22nd April, 2017 to 15th May, 2017 of the farming period and spraying activities being done.

3.9 Pretesting

Prior data collection, the questionnaires were pre tested in Dar es Salaam region at Kariakoo ward among 10 pesticide applicators working in vegetables gardens along Msimbazi river basin. Pretesting was done by using Kiswahili questionnaire. After pretesting the tools were improved accordingly. Thus unclear questions were rephrased and time to administer the entire instrument was determined and thus questions were adjusted to fit the standard time. The questionnaire was given to statistician for evaluation and comment prior to it being use.

3.10 Data collection procedure

Structured questionnaire was adapted from a biological monitoring of pesticide exposures conducted by Sleeuwenhoek et al. (2007). The questionnaire was prepared in English and translated to Swahili and then back to English to verify the translation. It was administered by a trained research assistant to collect the data which are reported in this dissertation. On the days of data collection prior to interview, the research team was introduced themselves and the purpose of the study. Questionnaire was having the following parts: socio demographic, occupation, pesticide exposure, common type of pesticide used in the area and sixteen modified neurological

health symptoms (Q16). The Q16 questionnaire is a self administered questionnaire on neuropsychiatric symptoms that has been used in several studies of populations exposed to neurotoxicants. Q16 was useful to know whether symptoms reported in the questionnaire also reflect impairment of similar functions measured with main objective or specific objective methods in a formerly highly exposed group.

Intensity determination of pesticide exposure and field analysis of cholinesterase activities were performed by a well trained laboratory technologist from Tropical Pesticide Research Institute (TPRI) toxicology laboratory. WHO approved field spectrophotometric kit, Test-mate Model 400 device (EQM Research Inc., Cincinnati, OH, USA) with a photometric sensor was used to measure blood cholinesterase levels. In brief, fingers were washed with alcohol and dried for few seconds. Ten micro liter capillary blood was drawn using a finger prick sterile lancing device and placed into the assay tube. AChE erythrocyte cholinesterase reagent was then dissolved in distilled water and inserted into the analyzer. The analyzer provided the measurements of haemoglobin, the level of AChE and haemoglobin adjusted erythrocyte acetylcholinesterase activity.

The observation checklist was used to collect information on how PPE were worn; quality of PPE; hazards from pesticide spills; pesticide preparation process before spraying; storage and disposal of pesticide empty containers; and personal hygiene after spraying. Visual media collection using camera was done to collect information on PPE's uses, pesticide handling and spraying process. Data analysis was done to compare neurological symptoms and AChE activity in both large and small-scale farms.

3.11 Data Management

For maintaining quality of data, the principal investigator was responsible for regular supervision of the assistant researchers to meet the criteria; also was counterchecked the return forms for completeness and taking steps to retrieve missing information, and assigning identification (ID) numbers. A closed-ended question was post coded into categories for data entry purposes. Coded

data was entered onto a computer using SPSS for analysis to run frequencies, then verified and cleaned to ensure there is no missing information.

3.12 Data Analysis

Data analysis was done by Statistical Package for Social Sciences (SPSS) version 20 for descriptive analysis. Descriptive statistics was then done to obtain frequence distribution for all the variables, proportions for categorical data and mean for continous data.

The Q16 questionnaire contains 16 questions that was answered by either “yes” or “no”. All 16 questions were included in the analysis. The participants were interviewed and the questions asked focused on education, occupational history, duration of working per day, year involved in spraying activities and preventive measure taken by pesticide applicator from direct exposure to pesticide. Logistic regression was used to describe the relationship between neurological health symptoms and predictor variables. Cross tabulation between independent and dependent variables was constructed. Chi - square tests were used to assess the statistical significance of the association between dependent and independent variables (Fisher’s exact test was used when any expected number was less than five). The p - value of 0.05 was used to determine the level of significance. The significance level of p - value < 0.05 was considered statistically significant with a confidence interval (CI) of 95%. Binary logistic regression analysis was done to determine the odds ratio of different predictors of neurological health symptoms, while controlling for potential confounding factors of neurological health symptoms.

3.13 Variables

3.13.1 Dependent Variable

The dependent variables of this study were the neurological health symptoms among flower and onion pesticide applicators

3.13.2 Independent Variables

Socio-demographic variables: Sex, age, educational level and working experience of pesticide applicator

Pesticide Exposure variable: hours worked per day, number of years on job, workplace supervision, and type of pesticide, health and safety training, chemical handling, housekeeping.

Behavioural variables: Use of personal protective equipment and adherence to standard operating procedures.

3.14 Ethical issues and consideration

The study was approved by Muhimbili University of Health and Allied Sciences Directorate of Research and Publications Committee. The permission to conduct this study was also obtained from all government authorities concerned from the district, ward to village authorities to conduct the study at their administrative areas.

Study subjects informed about the study aims, purpose and rationale of the study. They also informed on how the findings of this study will be used. Their written consent was sought after being sure that they understood the study and agreed to participate. The consent forms were thereafter signed by the consented subjects.

Confidentiality was guaranteed by ensuring anonymity and only numbers was used to identify subjects instead of names. Subject's rights such as freedom to withdraw from the study, freedom from not answering some questions and other rights was addressed and observed

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents major findings of the study conducted to assess neurological health symptoms associated with pesticide exposure among flower and onion pesticide applicators in Arusha region. The chapter composes of five main sections namely socio-demographic characteristics of participants, neurological health symptoms associated with pesticide exposure, personal protective equipments use among pesticide applicators and cholinesterase test results. It also presents the relationship between pesticide preparation, duration of exposure, PPE uses, pesticide dermal contact, and the identified neurological health symptoms.

4.2 Common Pesticides used for crops protection

Organophosphates were the most common type of pesticides used accounting for 98%. Carbamate account for 2% of total pesticide use (Table 1 and 2). Majority of pesticides (75%) belonged to Organochlorine group, 25 % were pyrethroid used in flower farms. 81 percent of pesticides used in onion farms belong to organochline but only 19% use pyrethroid for pest control to onion. The result shows that 54.1% of pesticides were moderately hazardous (II), 21.6. % was slightly hazardous (III) and 24.3% were unlikely to represent any acute hazard (IV) in normal use according to WHO criteria.

Flower farms had shown to follow procedure of pesticide management as per direction of the manufacturer but the interviewed pesticide applicator in onion farms shows different way of pesticide applicators whereas 1% stored pesticides that was easily accessible by children, 11% stored pesticide in closed containers, 54 stored pesticides in their farmhouse, 9% stored pesticides in the kitchen, 15% stored pesticides in the sleeping room. (Table 1 and 2)

Table: 1. The list of pesticides used in flowers fields

Trade name of pesticide	Name of the active substance(s)	Class	Type of Pesticide	Approved uses	Reference on health effects
Amsac	Indoxacarb 14.50%	II	Insecticide	For the control of African boll worm on vegetable	US EPA
Merpan	Captan 50%	III	Fungicide	For the control of Powdery mildew on flowers.	Strivastava and Kesavachandran
Golan	Acetamiprid50%	II	Insecticide	For the control of aphids, thrips, leaf minor & flea beetle on flowers	US EPA
Ippon	Iprodione 50%	III	Fungicide	For the control of botrytis on flowers.	US EPA
Impulse	Spiroxamine 50%	II	Fungicide	For the control of powdery mildew on flowers.	US EPA
Ortiva	Azoxystrobin 35%	IV	Fungicide	For the control of rust, botrytis & downy mildew on flowers.	Strivastava and Kesavachandran
Previcur energy	Fosetyl-aluminium + propamocarb 310g/l	III	Fungicide	For the control of botrytis, pythium & phytophthora on flowers.	Strivastava and Kesavachandran
Previcur N	Propamocarb hydrochloride 722g/l	III	Fungicide	For the control of downy mildew on flowers.	Strivastava and Kesavachandran

Trade name of pesticide	Name of the active substance(s)	Class	Type of Pesticide	Approved uses	Reference on health effects
Proplant SL	Propamocarb hydrochloride 722g/l	III	Fungicide	For the control of downy mildew on flowers.	Strivastava and Kesavachandran
Ridomil Gold	Mancozeb 64%+ Metalaxil 4%	IV	Fungicide	For the control of downy mildew on grape.	Strivastava and Kesavachandran
Tracer 480 SC	Spinosad 480%	III	Insecticide	For the control of thrips and leaf miners on flowers	US EPA
Round-up	Glyphosate 420g/l	IV	Herbicide	For the control of annual & perennial weeds	
Teldor	Fenhexamid 50%	III	Fungicide	For the control of Botrytis on flowers.	Strivastava and Kesavachandran
Scala SC	Pyrimethanil 400g/l	IV	Fungicide	For the control of Botrytis on flowers.	Strivastava and Kesavachandran
Ridomil MZ	Metalaxyl 5%	III	Fungicide	For the control of downy mildew on grape.	Strivastava and Kesavachandran
Collis	Kresoxim-methyl + Boscalid 100g/l	II	Fungicide	For the control of Powdery mildew on flowers.	Strivastava and Kesavachandran
Nimrod 25EC	Bupirimate 250g/l	III	Fungicide	For the control of powdery mildew	Strivastava and

Trade name of pesticide	Name of the active substance(s)	Class	Type of Pesticide	Approved uses	Reference on health effects
				on pepper.	Kesavachandran
Poller/infinito	Propamocarb hydrochloride 722g/l	III	Fungicide	For the control of Powdery mildew on flowers.	Strivastava and Kesavachandran
Polar	Polyoxin 50%	IV	Fungicide	For the control of powdery mildew on straw berry	Strivastava and Kesavachandran
Proven 1,9EC	Emamectin + Benzoate 1.90%	III	Insecticide	For the control of stalk borer	US EPA

Key reference: US EPA: United State Environmental Protection Agency, (Reregistration eligibility decision for triforine)(Edwards 2005)، (Mrema E.J., Ngowi A.V., Kishinhi S.S. 2017)، (Ministry of 2017)

Table: 2. The list of pesticides used in onion fields

Trade name of pesticide	Active ingredient	Class	Type of pesticide	Approved uses	Reference on health effects
Supercron 500EC	Profenofos 500g/lEC	II	Insecticide	For the control of aphids (Acyrtosiphon pisum)	US EPA
Snowcron 500EC	Profenofos 500g/lEC	II	Insecticide	For the control of aphids (Acyrtosiphon pisum)	US EPA
Wilcron Profenos 500EC	Profenofos 500g/lEC	II	Insecticide	For the control of fruit worm	US EPA
Bicron 500EC	Profenofos 500g/lEC	II	Insecticide	For the control of Onion thrips	US EPA
Select Plus	Profenofos 300g/lt + Lambdacylothrine 5g/lt	II	Insecticide	For the control of onion thrips (thrips tabaci in onion)	US EPA
Dudumectin	Emamectin 4.8% + Acetameprid 6.4%	II	Insecticide	For the control of green aphids	US EPA
Protrin 60 EC	Chloropyrifos 500g/lt+	II	Insecticide	For the control of tuber moth (PTM) and African boll worm (ABW)	US EPA

Trade name of pesticide	Active ingredient	Class	Type of pesticide	Approved uses	Reference on health effects
	Cypermethrin 100g/lt				
Prosper 720EC	Profenofos 600g/lt + Cypermethrin 120g/lt	III	Insecticide	For the control of onion thrips on onion.	US EPA
Snowsoldier 240EC	Carbonsulfan 240g/lt	II	Insecticide	For the control of locust and grasshoppers.	US EPA
Marshal 240EC	Carbosulfan	II	Insecticide	For the control of locust and grasshoppers.	US EPA
Lamdex 5EC	Lambda-Cyhalothrin 5% EC	II	Insecticide	For the control of stalk	US EPA
Ninja plus 5EC	Lambda cylothrin (Pyrethroid) 50g/lt	II	Insecticide	For the control of stalk	US EPA
Sumo 5EC	Lambda cylothrin (Pyrethroid) 50g/lt	II	Insecticide	For the control of stalk	US EPA
Trigger 5EC	Lambda cylothrin (Pyrethroid) 50g/lt	II	Insecticide	For the control of stalk	US EPA
Duduthrin	Lambda cylothrin	II	Insecticide	For the control of stalk	US EPA

Trade name of pesticide	Active ingredient	Class	Type of pesticide	Approved uses	Reference on health effects
	(Pyrethroid) 50g/lt				
Duduba 450EC	Cypermethrin 10g/lt +Chloropyrifos 35g/lt	II	Insecticide	For the control of tuber moth (PTM) and African boll worm (ABW)	US EPA
Duduall 450EC	Cypermethrin 150g/lt +Chloropyrifos 300g/lt	II	Insecticide	For the control of tuber moth (PTM) and African boll worm (ABW)	US EPA

Key reference: US EPA: United State Environmental Protection Agency, (Preregistrations eligibility decision for triforine) (Edwards 2005)', (Mrema E.J., Ngowi A.V., Kishinhi S.S. 2017)', (Ministry of 2017)

4.3 Social demographic characteristics of participants

Majority of participants in onion farms (62.5%) were below 30 years old with 5.4% children (below 18 years). Onion farms were dominated by casual workers (94.6%) with one third having work experience of less than a year and no training on pesticide safety or management (Table 3). Majority of workers (52.1%) in onion farms also work for more than eight hours.

Table 3: General characteristics of the study participants in flower and onion farms, Arusha Region, April – May 2017

Characteristics	Flower Farms % (n=84)	Onion Farms % (n=56)
Age (in years)		
18 and below	0	5.4
19 - 28	36.9	57.1
29 - 38	52.4	26.8
39 and above	10.7	10.7
Level of education		
No formal education	7.1	5.4
Primary education	78.6	83.9
Secondary education	14.3	10.7
Employment		
On Contract	95.2	1.8
Casual	4.8	94.6
Self employed	0	3.6
Attended training on pesticide		
Yes	86.9	0
No	13..1	100

Characteristics	Flower Farms % (n=84)	Onion Farms % (n=56)
Working duration experience (in years)		
<1	3.6	33.9
1 – 5	77.4	50.1
6 – 10	16.7	7.1
> 11	2.4	8.9
Working duration (hours per day)		
<8	100	42.9
>8	0	57.1

4.4 Comparison of neurological health symptoms between flower and onion pesticide applicators

The result below gives the comparison of the prevalence of neurological health symptoms between the flower and onion farms of the pesticide applicators. The occurrence of each of the symptoms, except for excessive sweating symptom in flower farms the body weakness, abnormal tiredness of the body, headache, pain in part of the body, poor appetite, depression, irritation, nervousness or shakiness inside, nausea, dizziness, ringing in ears and trouble to falling asleep were significantly higher in the onion farm pesticide applicators than those who work in flower farms (Table 4)

Table 4: Prevalence of neurological health symptoms among study participants in Flower and Onion Farms

Neurological Health Symptoms	Flower farms % (n=84)	Onion Farms % (n=56)
Excessive sweating	46.4	32.1
Body weakness	34.5	91.1
Abnormal tiredness of the body	28.6	55.4
Headache	27.4	58.9
Pain in part of the body	21.4	64.3
Poor appetite	17.9	46.4
Depression	15.5	17.9
Irritation	13.1	46.4
Nervousness or shakiness inside	11.9	23.2
Nausea	8.3	39.3
Dizziness	7.1	53.6
Ringing in ears	7.1	30.4
Trouble to falling asleep	7.1	14.3
Feel hot or cold	7.1	23.2
Vomiting	3.6	28.6
Loss of concentration	4.8	17.9

4.5 Relationship between risk factors and the occurrence of Neurological Health Symptoms

The independent Those pesticide applicators reported highest proportion of symptoms potentially related to pesticide exposure. Results of bivariate correlation of all symptoms and specific risk factors on the flower and onion farms are presented in Table 5. There was a significant positive correlation for each of the following symptoms: Nausea, vomiting, dizziness, loss of concentration irritation painful part of the body. ($p < 0.05$). (Table 5)

Table 5: Relation between risk factor and the occurrence of Neurological health symptoms

Neurological Health Symptoms	Risk factor to pesticide sprayers (n=140)							
	Preparation of pesticide		Duration of exposure		PPE's use		Pesticide spill	
	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value
Abnormal of the body	0.338	0.561	2.695	0.101	10.1	0.323	1.859	0.115
Painful part of the body	2.088	0.148	13.53	0.000*	26.04	0.000*	16.77	0.000*
Irritation	4.124	0.042*	19.57	0.000*	19.2	0.000*	10.012	0.002*
Depression	7.525	0.006	6.678	0.168	19.33	0.000*	8.294	0.004*
Loss of concentration	3.464	0.063	9.722	0.002*	6.402	0.011*	6.238	0.013*
Excessive sweating	17.87	0.000*	0.24	0.624	2.841	0.092	0.022	0.881
Headache	2.104	0.147	2.333	0.127	13.93	0.000*	6.558	0.01*
Nervousness or shakiness inside	0.206	0.068	10.53	0.001*	3.13	0.077	4.9	0.027
Dizziness	9.05	0.003*	21.03	0.000*	37.91	0.000*	17.95	0.000*
Poor appetite	0.782	0.377	1.82	0.177	13.24	0.000*	19.46	0.000*
Vomiting	8.515	0.004*	9.262	0.002*	17.9	0.000*	6.98	0.008
Ringing in ears	0.828	0.363	14	0.000*	13.18	0.000*	7.203	0.007

Neurological Health Symptoms	Risk factor to pesticide sprayers (n=140)							
	Preparation of pesticide		Duration of exposure		PPE's use		Pesticide spill	
	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value
Nausea	6.531	0.011*	9.6	0.002*	19.6	0.000*	9.003	0.003*
Trouble to falling asleep	0.076	0.782	6.22	0.013*	3.339	0.049	10.7	0.001*
Feel hot or cold	0.888	0.346	1.97	0.16	7.399	0.007	6.98	0.008
Body weakness	1.364	0.243	11.9	0.001*	0.97	0.325	0.177	0.674

Key: * Statistical significance (p value < 0.05), χ^2 = Chi square value

4.6 Cholinesterase Test

About 39% of the study participants from onion and 19% from flower farms had acetylcholinesterase levels below the normal range (above 24.5 U/g Hgb). The study participants from onion farms shows to have mean of 27.882 ± 3.829 U/g Hgb of cholinesterase test level whereas that from flower farms the mean was 25.146 ± 3.9607 U/g Hgb of cholinesterase test level which was lower by 2.736 U/g Hgb compared to those of onion farms. Majority of study participants 60.7% from onion farms had cholinesterase level above the limit level and about 81% participant from flower farms had cholinesterase level above the standard limits whereas 39.3% and 19% respectively found to be below the limits level of the cholinesterase test.

The relationship between AChE and symptoms was significant for depression in onion farms. There was significant difference between irritation and cholinesterase level among pesticide applicators in onion farms ($p<0.05$) (Table 6).

Table 6: Reported neurological health symptoms among pesticide applicators in relation to cholinesterase test (N=56) in Onion Farm

Neurological health symptoms	**AChE Below Normal range (N=22)** n (%)	**AChE Within Normal range (N=34)** n (%)	**Total** n (%)	**Chi sq.**	**p-value**
Abnormal tiredness	13(59.1)	18(52.9)	31(55.4)	0.204	0.785
Painful part of the body	13(59.1)	23(67.6)	36(64.3)	0.426	0.575
Irritation	6(27.3)	20(58.8)	26(46.4)	5.346	0.029*
Depression	11(50.0)	17(50.0)	28(50.0)	0.000	1.000
Loss of concentration	5(22.7)	5(14.7)	10(17.9)	0.586	0.448
Excessive sweating	4(18.2)	14(41.2)	18(32.1)	3.238	0.087
Headache	15(68.2)	18(52.9)	33(58.9)	1.282	0.282
Dizziness	12(54.5)	18(52.9)	30(53.6)	0.014	1.000
Heart or chest pain	4(18.2)	6(17.6)	10(17.9)	0.003	1.000
Poor appetite	10(45.5)	16(47.1)	26(46.4)	0.014	1.000
Vomiting	9(40.9)	7(20.6)	16(28.6)	2.703	0.134
Ringing in ears	6(27.3)	11(32.4)	17(30.4)	0.163	0.772
Nausea	10(45.5)	12(35.3)	22(39.3)	0.578	0.577
Trouble to falling asleep	6(27.3)	6(17.6)	12(21.4)	0.735	0.508
Feel hot or cold	7(31.8)	6(17.6)	13(23.2)	1.505	0.332
Body weakness	21(95.5)	30(88.2)	51(91.1)	0.856	0.340
Feel hot or cold	7(31.8)	6(17.6)	13(23.2)	1.505	0.332
Body weakness	21(95.5)	30(88.2)	51(91.1)	0.856	0.340

Keys: * Statistical significance (p value < 0.05), Chi square value

The relationship between AChE and symptoms was significant for depression in flower farms. Results show that there was a significant difference in between those who have depression and cholinesterase level ($p<0.05$; Table 7).

Table 7: Reported neurological health symptoms among pesticide applicators in relation to cholinesterase test (N=84) in flower Farms

Neurological health symptoms	AChE Below Normal range (N=16) n (%)	AChE Within Normal range (N=68) n (%)	Total n (%)	Chi sq.	p-value
Abnormal tiredness	20(83.3)	4(16.7)	24(28.6)	0.124	1.0000
Painful part of the body	14(20.6)	4(25.0)	18(21.4)	0.15	0.7390
Irritation	9(13.2)	2(12.55)	11(13.1)	0.06	1.0000
Depression	9(13.2)	4(25.0)	11(15.5)	1.37	0.260*
Loss of concentration	4(5.9)	0(0.0)	4(4.8)	0.988	1.0000
Excessive sweating	31(45.6)	8(50.0)	39(46.4)	0.101	0.7870
Headache	18(26.5)	5(31.2)	23(27.4)	0.149	0.7580
Dizziness	5(7.4)	1(6.2)	6(7.1)	0.024	1.0000
Heart or chest pain	7(10.3)	1(6.2)	8(9.5)	0.246	1.0000
Poor appetite	13(19.1)	2(12.5)	15(17.9)	0.387	0.7250
Vomiting	3(4.4)	0(0.0)	3(3.6)	0.732	1.0000
Ringing in ears	6(8.8)	0(0.0)	6(7.1)	1.52	0.5900
Nausea	7(10)	0(0)	7(8.3)	0.246	1.0000
Trouble to falling asleep	7(10)	1(6.2)	8(9.5)	0.246	1.0000

Neurological health symptoms	AChE Below Normal range (N=16) n (%)	AChE Within Normal range (N=68) n (%)	Total n (%)	Chi sq.	p-value
Feel hot or cold	6(8.8	0(0.0)	6(7.1)	1.52	0.5900
Body weakness	25(36.8)	4(25.0)	29(34.5)	0.793	0.5600

Keys: * Statistical significance (p value < 0.05), X^2 = Odd ratio, Chi square value

4.7 Hazardous practices and PPE use among pesticide applicators

The study showed that among pesticide applicators, 83.9% do spraying only and 16.1% carry out both spraying and pesticide preparation (mixing and loading). Pesticide applicators in onion farms were observed to wear no PPE but were observed to wear only shirts or T-shirts, shorts or trouser and slippers or no shoes (Figure 3).

Figure: 3. Pesticide applicators handling pesticides without body protection measure

The situation was vice versa in the flower farms where pesticide applicators use PPE (100%) (boots, gloves, full and a half face masks, and coveralls) that protect them direct exposure to pesticides (Figures: 4).

Figure: 4. Pesticide applicator displaying full PPE used in flower

It was observed that 62.7% of pesticide applicators spilled pesticides on their body when they did spraying (Figure 5 & 6).

Figure: 5. Pesticide applicator spilled with pesticide on body and cloth onion at onion farms

Figure 6: Pesticide spill on PPE of pesticide applicator at flower farm

The equipment used to spray pesticide. Mobile motorized tanks with pipes and spray guns were used in flowers whereby most of them had leakage and spilled pesticide on the ground that exposed applicators to the risk whereas manual knapsack equipments were used in onions farms which left pesticide applicator to high exposure to pesticide because of leakages (Figure:7).

Figure: 7. Motorized mobile pesticide sprayer in flower

Manual knapsack was the most equipment being used in onion farm for spraying of pesticide to field (Figure 8)

Figure: 8. Manual Knapsack equipment used in onion farms

Empty pesticide containers were thrown in the field; river and home refuse collection pits in onion farms (Figure 9 & 10)

Figure: 9. Empty pesticide containers disposed to the environment in the onion farm

However in flowers farms empty pesticide containers were collected into plastic bags and then transported to the distraction unit identified by TPRI then transport for distraction (Figure 10)

Figure 10: Empty pesticides stored in bags in flower farms

No table of figures entries found.The finding shows that 95% of participants reported to experience dermal contact with pesticide. From reported findings 62.1% of dermal absorption occurs as the result of a splash, spill when spraying, cleaning and or repairing equipment. Also noted that (60%) of pesticide sprayers exposed to pesticide when take bath and washed their body by tap water, (15.7%) using bucket, (12.9%) bath in rivers and (11.4%) does not wash their body. Also study shows that 60% of participants exposed when wash clothes and equipments after spraying.

The results for PPE use shows that only 60% of pesticide applicators of the total study participant use boots face masks, coverall and gloves. However results of percentage distribution of farmers (86 %) from flower farms present to wear full body cover PPE during the time of pesticides application. (Table 8)

Table: 8. PPE use among participants (n = 140)

Protective measures and gears	Frequency (n)	Percentage (%)
Boots		
Use	84	60
Not use	56	40
Face cover (full or a half face cover)		
Use	84	60
Not use	56	40
Coverall		
Use	84	60
Not use	56	40
Gloves		
Use	84	60
Not use	56	40

CHAPTER FIVE

5.0 DISCUSSION

This study demonstrate significantly high proportion of neurological health symptoms to onion pesticide applicators than flower farms pesticide applicator with greater risk of pesticide exposure because lack of person protective equipments to onion farms than flower farms that pose great risk of cholinesterase inhibition and neurological health symptoms to pesticide applicators. The results of this study can be compared with the results of other similar studies. This study aimed to assess neurological health symptoms associated with pesticide exposure among flower and onion pesticide applicators.

The study come up with the results that shows more than 98% of pesticide used in the study area by farmers were organophosphates and the least was carbamate. This results was similar with the study done in Gazoué and Savè townships, in central republic of Benin on risk factors of pesticide poisoning and pesticide users' cholinesterase levels among farmers which found that 72.96% of pesticide used were organophosphates and pyrethroids constituted the group of pesticides more frequently used by 88% of the farmers (Hinson et al., 2017). In addition, it is necessary to note that among the problems mentioned by pesticide applicator was lack of knowledge on handling of pesticides. Their presence reveals the existence of sources for the informal provision of pesticides, opening the door to increased risks of poisoning. The predominance of the organophosphates in this study showed the importance of monitoring cholinesterase activity, as the main test of poisoning with pesticides.

The study provides insights into pesticide application and related health symptoms among flower and onion pesticide applicators in Arusha. Majority of pesticide applicators (75%) in the studied region suffered one or more forms of pesticide related health symptoms. This result was supported with the findings from the study done in Nigeria on pesticide use practices and safety issues reported that about 80% of both farm workers indicated that they experience discomforts such as headaches, tiredness vomiting, nausea, and skin problems (itching and skin burn) after spraying (Tijani, 2016).

A group of pesticide applicators from onion farms with high level of exposure to pesticide was found to have higher prevalence whereas body weakness (91.1%), headache (58.9%), dizziness (53.6%), irritation (46.4%) and cold or hot of the body (23.2%) compared with flower farms come up with the prevalence of body weakness (91.1%), headache (27.4%), dizziness (7.1%), irritation (13.1%) and cold or hot of the body (7.1%) of pesticide applicators. These findings were similar with the study done in Zimbabwe at Kwekwe district on health effects of agrochemicals where headache (66.7%), cold/flu (62.2%), weakness (45.9%), dizziness (41.1%) and skin irritation (39.0%) were reported among farm workers in commercial farms (Magauzi 2011).

The statistically significant depletion in AChE activity clearly exhibits the exposure to organophosphate (OP) and carbamate pesticides among pesticide applicators. In the present study, mean average of AChE level among pesticide applicators in onion farms was greater by 2.736 U/g Hgb as compared to those of flower farms which had the mean concentration of 25.146 ± 3.9607 U/g Hgb. The findings were in agreements with a study done in Tanzania on acute health effects of organophosphorus pesticides on Tanzanian whereby mean average 32.0 U/ g Hgb (Ngowi et al., 2001).

Studies have shown that the blood AChE level must be depressed to less than 20% of its normal value before symptoms of systemic poisoning appear (Jensen et al., 2011). In the present study, there was no indication of such depression, which explains relationship between symptoms and AChE even if the proportion of depressed participant observed to be higher than those who were above limit.

The failure of farmers to use PPE during pesticides application presents potential risks to pesticides exposure. Results indicated that 100 % of the onion farms pesticide applicators in the study area there were no any form of PPE used during pesticide application but in flower farms was vice versa where pesticide applicators put on full PPE during pesticide application. Forty percent (40 %) of farmers apply pesticides with no PPE while majority of farmers (60 %) put on PPE during pesticides application from the total pesticide applicators involved in the study. Wearing or putting on full PPE during pesticides application in this study was defined as wearing a nose mask, hand rubber glove, overall, long coat, facemask and boot

(rubber boot) at the time of application. Alternatively, applying pesticides without PPE connotes when a farmer uses casual farming cloths without any of the listed PPE's. The findings in this study are in line with study done in Cambodian farmers that shows a reduction of risk of acute pesticide poisoning by 55% among more highly educated farmers who adopted extra personal protective measures (Jensen et al. 2011). The study on community based intervention to reduce pesticide exposure to farm workers and potential take-home exposure to their families showed the importance of wearing protective gloves in reducing pesticide exposures among strawberry harvesters (Bradman et al. 2009). The study done in Ghana to farmer perceptions and pesticide use practices in vegetable production showed that pesticide poisoning occurred more often among farmers who generally did not wear protective clothing during spraying of pesticide (Ntow et al. 2006). In addition, a study of farmers who used pesticides in rural Indonesia, showed that those who wore no mask/respirator, wet clothing or short-sleeves, had greater skin contact with pesticides (Sekiyama 2007).

Based on sufficient evidence from this study, pesticide applicators were exposed to pesticide above the acceptable level. Those who did not used PPE were more likely to develop neurological health symptoms compared to those who used. Therefore the use of PPE is unavoidable and should always be encouraged during application of pesticides.

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5.1 Strengths and Limitations of the study

This was a cross sectional, descriptive study that gave a snap shot of the existing situation in pesticide application in Tanzania. Due to this design, it was not possible at the time to establish causal – effect relationship and comparison between exposed and control groups. However, the study was able to identify toxicity of pesticide and neurological health symptoms together with the proportional of PPE use among flower and onion pesticide applicators. This information is useful for pesticide applicators, regulatory authorities, policy makers and researchers when addressing issues related to pesticide applicator's health.

The study could not allow the assessment of the cause and effect; data were collected by questionnaire, observation and laboratory analysis. It was based on self reported alone and

may therefore be prone to under or over reporting of the neurological health symptoms and associated factors. This was reduced by probing during interview and all laboratory procedure being followed as well assuring confidentiality to the study participants so that they could produce honest response.

Another limitation is criteria used for the selection of participants. Pesticides applicators that were involved in spraying for more than one month were selected for the study. This is considered the risk of applicators as they have been exposed for enough time to show the acute neurological health symptoms of interest.

The neurological health symptoms are reported to have a lot of confounders. In this study, control for confounders was done so as to rule out non-spraying related factors that were associated with neurological health symptoms. A multiple regression analysis was done, where preparation of pesticide, duration of exposure PPE use and pesticide spill that can expose to pesticide were controlled.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The study showed that pesticides were widely applied in flower and onion farms in Arusha region. Pesticide applicators had poor knowledge regarding health impacts of pesticide. Organophosphate exposures were observed in depressed AChE to pesticide applicators. The prevalence of neurological symptoms was found to be high. Large number of pesticide applicators from onion farms applied traditional technique of pesticide management rather than Integrated Pest Management technique. There is an urgent need to develop the proper mechanism to monitor pesticide management to reduce the health impact of pesticide among pesticide applicators.

Our study revealed that pesticide applicators from onion farms were not using any kind of PPE during pesticide application. This exposed them to pesticide directly thus increases the potential pesticide exposure, which have serious health implications to pesticide applicator.

The factors like, use of PPE included farming experience, age of farmer, access to extension service, availability of a chemical shop, farm size and educational level also influence exposure of pesticide applicators to pesticides. The influence of extension service on the use of PPE is indicative that extension systems must be strengthened to increase farmers' knowledge and understanding of the effects of applying pesticides without PPE. Regular training of farmers on safe use of pesticides and safe disposal of empty pesticide containers is required.

Neurological health symptoms from pesticides are based on dermal exposure pathways. Pesticide applicators contacted with pesticides during preparation and the spraying period increase the probability to health problem. It is important to know that occupational exposure provides almost certainly the primary source of pesticide exposure among the pesticide applicators at the area.

6.1 Recommendations

Implementation of proper pesticide management in the agricultural activities has the potential of reducing the incidences of neurological health symptoms. Base on the findings of this study, it is recommended that:

1. Pesticide applicators have poor knowledge on understanding health symptoms associated with the exposure to pesticide that were poor choice of pesticides, poor pesticide application in relation to the environmental condition (wind direction to onion farms) and low skill on which time of the day was safe for pesticide applicator to expose to pesticides. Therefore health promotion to pesticide applicators in flower and onion farms was important as the means of protection from the effect of pesticide.
2. In both farms pesticide applicators suffered adverse neurological health symptoms effects while applying pesticides that included effects on skin and eyes and general effects like headaches and dizziness. The frequent cholinesterase test is needed to avoid excessive concentration of pesticide residue to the pesticide applicators that will be followed with the strict follow up of the recommended and correct ways of using pesticides.
3. The use of PPE should be encouraged as the last option after other hazard controls being considered and found not to work. This will help to minimize risk of pesticide toxicity and adverse neurological health symptoms to pesticide applicators.
4. Practices of pesticides handling (storage and disposal of empty containers) in onion farms were inappropriate whereas majority store them in their rooms where they use to sleep and dispose empty containers to the environment. Therefore training about pesticide safety management is important. Training should offer education on appropriate methods that are necessary to prevent or reduce pesticide exposure.

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DATA COLLECTION TOOLS (ENGLISH)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

Department of Environmental and Occupational Health

APPENDICES

Appendix 1 - English questionnaire

HEALTH SYMPTOMS ASSOCIATED WITH PESTICIDES EXPOSURE AMONG FLOWER AND ONION PESTICIDE APPLICATORS IN ARUSHA REGION

Instructions: For the questions with options, please circle or tick to the appropriate number corresponding to the response, for example (a) or (√). For questions requiring writing the response, write in the spaces provided

Questionnaire number: …….....

District……..

Division…….……Ward……Village……..

Type of farm: ……..…….....Service: …..…….

Date of interview: .....Name of Interviewer: ……..

Section A: Socio-demographic characteristics

1. Age in year: .....Years

2. Sex (a). Male (b). Female

3. Education

(a) No formal Education (b) Primary education

(c.) Secondary education (d) Tertiary Education

4. Have you attended any seminars, workshop or training on safe and effective use of pesticides?

(a) Yes (b) No

Section B: Occupational history

5. Employment condition:

(a) Permanent employed (b) Temporary employed

(c) Self employed (d) other (Please specify)…….……

Section C: Exposure to pesticides

6.. For how long have you been engaged in pesticide application?

Month(s) ….…… Year(s)……..

7. Do you prepare pesticides before application?

(a) Yes (b) No

8. Do you know the names of pesticides you used to spray?

(a) Yes (b) No

9. If yes in question (8) Name type of pesticide……

10. How do you prepare pesticides for application ……..…….

11. Where do you prepare pesticide before spraying?

(a) At home (b) At farm (c) Along the river (d) others……

12. Who does the mixing of pesticides before spraying?

(a). Myself (b). Other person

13. If answer (a) in question (12), how do you mix pesticides?

(a). With hands (b.). With mixer machine

14. How many minute/hours do you spend per day spraying pesticides per day?

Minutes…… Hour(s)……..

15. Do you use Personal Protective Equipment (PPE) when spraying pesticide?

(a) Yes (b) No

16. If yes in question 15 above, which type of PPE do you use?.....

17. What type of equipment do you use when spraying pesticide?

(a) Bush twigs tied together for sprinkling (b) Improvised plastic spray cans.

(c.) Knapsack sprayer ` (d) Motorized mobile sprayer (gun pipe)

18. Do you spill pesticide on your clothes when spraying pesticide? (a) Yes (b) No

19. If yes in question 18 after what time do you change your clothes? Minute(s) …hour(s)…

20. After spraying pesticides, what time do you usually change into clean clothes?

Minute(s) …… hour(s)…….

21. After spraying pesticides to crops, where do you usually wash up your body or shower?

Tap water (b) River water (c) Water from bucket (d) Am not washing

22. Do you wash pesticide equipment after use? (a) Yes (b) No

23. If the answer is yes in question (18) above, where do you wash pesticide equipment?

(a) At home (b) In the river (c) At farm

24. If the answer is yes in question (18) above, where do you wash pesticide equipment?

(a) At home (b) in the river water (c.) At farm

(d.) At the specific building in the farm (e) No wash done

26. If it is (a), how do you wash them?

(a) Mix with family clothes (b) Washing separate with family clothes

(c.) No wash

Section D: Neurological Health Symptoms (Q16)

26	Are you abnormally tired?	Yes /No
27	Do you often have painful tingling in some part of your body?	Yes /No
28	Do you often feel irritated without any particular reason?	Yes /No
29	Do you often feel depressed without any particular reason?	Yes /No
30	Do you often have problems concentrating?	Yes /No
31	Do you often perspire without any particular reason?	Yes /No
32	Do you have a headache at least once a week?	Yes /No
33	Do you often feel faintness or dizziness?	Yes /No
34	Do feel pains in heart or chest?	Yes /No
35	Do you often have poor appetite?	Yes /No
36	Do you often feel nausea or upset stomach?	Yes /No
37	Did you often have feeling of vomiting?	Yes /No
38	Do youoften feel ringing of the ears?	Yes /No

39	Do you often have nausea?	Yes /No
40	Do you have trouble falling aspleep?	Yes /No
41	Do you have feeling weakness in part of your body	Yes /No

42. What remedial measures do you encounter to neurological health problem?

Drinking fresh milk b. Drinking concentration of charcoal

c. Sought medical assistance. d. No action taken

e Washed body

Appendix II: Observation checklist

OBSERVATION CHECKLIST

Age……

Area…… ID No…..…….

Job category: Sprayer ( ) Mixer ( ) Supervisor ( )

Observe way cloth worn when spraying pesticide:

Undershirt ( ) Turban ( ) Loin cloth ( ) Shirt ( ) Full Sleeves ( )

Half Sleeves ( )

Observe parts of body of pesticide applicator contacted with the pesticide when applying?

(a) Hands (b) Back, stomach and chest (c) Legs (d) Head

Observation Checklist

No.	**Question**	**Type**	**Worn**		**Condition**		**Remarks**
			Yes	**No**	**Good**	**Poor**	
3	Do boots worn during spraying pesticide?	PVC					
		Leather					
		None					
4	Do worker cover face while spraying pesticide?	Full Face shield					
		Part face shield					
		Not shield					
5	Do worker wear coveralls while spraying?	PVC/nylon					
		Cotton					
6	Do worker wear apron to protect coverall when handling pesticides?	PVC apron					
		Cotton apron					

No.	Question	Type	Worn		Condition		Remarks
			Yes	No	Good	Poor	
		No apron worn					
7	Do worker worn coveralls over boots?	Coverall					
8	Do worker worn gloves over sleeves?	Gloves					
9	Do worker wear gloves while spraying pesticides?	Nitrite rubber					
		latex/natural rubber					
10	Does sprayer have leakage? (Observe if shirt is wet)	Wet					

What type of pesticides used during time of spraying of pesticide?

SN	Type of pesticides	Active Ingredient
1		
2		
3		
4		

DODOSO LA KISWAHILI

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

Idara ya Mazingira na Afya Mahala pa kazi

DODOSO KWA AJILI YA UTAMBUZI WA DALILI ZA MAGONJWA KWA WATUMIAJI WA VIUATIRIFU KATIKA MASHAMBA YA MAUA NA VITUNGUU MKOA WA ARUSHA

Appendix IV: Swahili version questionnaire

Namba ya dodoso: …….....

Wilaya……

Tarafa…….….Kata……..…Kijiji……..

Aina ya Shamba: ……..……..... Shughuli.……..……..

Tarehe ya Kudodosa: .....Jina la Mdodosaji:... ……..

MAELEKEZO; Katika maswali yenye majibu ya kuchagua, tafadhali zungushia au weke alama ya tiki namba yenye jibu sahihi, mfano (1) na (√) .Kwa maswali yanayohitaji maelezo, tafadhali andika maelezo yako katika nafasi iliyoachwa wazi.

Sehemu A: Taarifa za kijamii na Kidemografia

1. Una umri wa miaka mingapi? Miaka……

2. Jinsia (a) Me ( ) (b) Ke ( )

3. Unakiwango gani cha elimu?

(a) Sijasoma (b) Elimu ya msingi (c.) Elimu ya secondary (d) Elimu ya juu

4. Je umewahi hudhulia semina, kikao cha kazi au mafunzo ya usalama na matumizi sahihi ya viatilifu?

(a) Ndio (b) Hapana

Sehemu B: Historia ya Kazi

5 Hali ya ajira

(a) Ajira ya kudumu (b) Ajira ya muda

(c.) Nimejiajiri (d) Nyingine (Taja)……..

Sehemu C: Mazingira ya viuatirifu

6. Je, kwa muda gani umejihusisha na viuatirifu? (a). Miezi…… (b).Miaka……

7. Je, huandaa viuatirifu kabla ya matumizi? (a). (a) Ndio (b). Hapana

8. Je unalijua jina la kiuatilifu unachotumia? (a) Ndio (b) Hapana

9. Kama jibu (a) swali namba 8. Taja jina la kiuatilifu utumiacho……

10. Je, ni jinsi gani huandaa viuatilifu kabla ya matumizi?.....

11. Je, ni wapi huandalia viuatilifu kabla ya matumizi?

(a) Nyumbani (b) Shambani (c) Mtoni (d) Kwingine (Taja)……

12. Je, nina huchanganya viuatilifu kabla ya matumizi? (a) Mwenyewe (b) Mwingine

13. Kama jibu ni (a) kwa swali namba 12, Je, huchanganyaje viuatilifu?

(a) Kwa mikono (b) Kwa mashine ya kuchanyanyia

14. Je, muda gani unatumia kupulizia viuatilifu kwa siku? Saa (jaza) ……..

15. Je, unatumia vikinga mwili utumiapo viuatilifu? (a) Ndio (b) Hapana

16. Kama jibu ni ndio swali 15, aina gani ya kikinga mwili hutumia? Taja……...

17. Je, vifaa gani unatumia kupulizia viuatirifu?

(a). Majani ya miti yaliyofungwa pamoja (b). Geli keni ya plastiki

18. Je, humwagikiwa na viuatilifu nguoni umwagiliapo? (a) Ndio (b) Hapana

19. Kama jibu ni (a) swali (18) je baada ya muda gani unabadili mavazi?

(a) Dakika…… (b) Masaa……..

20. Je, baada ya muda gani hubadili mavazi baada ya kumaliza kazi ya upuliziaji viuatilifu?

(a) Baada ya dakika…… (b)Baada ya masaa……

21. Je, baada ya kumaliza kazi ya upuliziaji wapi huosha mwili wako?

(a) Kwa maji ya bomba (b) Mtoni

(c.)Maji ya kwenye Ndoo (d) Huwa sioshi

22. Je, husafisha vifaa baada ya kumaliza matumizi? (a) Ndio (b) Hapana

23. Kama jibu ni (a) kwa swali (22) Je, ni wapi huwa unaosha vifaa?

(a) Nyumbani (b) Mtoni (c) Shambani

24. Kama jibu ni ndio kwa swali (22) je, wapi huwa unaoshea vifaa vyako?

(a) Nyumbani (b) Mtoni (c). Shambani (d) Eneo maalum (e). Huwasioshi

25. Kama jibu ni (a) kwa swali 24, je unaziosha kwa utaratibu upi?

(a) Nachanganya na nguo zingine za familia (b) Naziosha peke yake (c) Huwa sioshi

Sehemu D: Dilili za kiafya za mfumo wa fahamu

26	Je, wajihisi uchovu usio wa kawaida?	Ndio/Hapana
27	Je, unapata hali ya mapigo ya moyo kwa kasi sana?	Ndio/Hapana
28	Je, una maumivu ya kuchomachoma mahali popote katika mwili wako?	Ndio/Hapana
29	Je, unapatwa na msongo wa mawazo bila sababu maalam?	Ndio/Hapana
30	Je, unatatizo katika kuwa makini mara kwa mara?	Ndio/Hapana
31	Je, unatokwa na jasho bila sababu yoyote ya msingi?	Ndio/Hapana
32	Je, unapata maumivu ya kichwa walau mara moja kwa wiki?	Ndio/Hapana
33	Je, unahisi kuzimia au kizunguzungu?	Ndio/Hapana
34	Je, unapata maumivu katika kifu chako?	Ndio/Hapana
35	Je unakosa hamu ya kula?	Ndio/Hapana
36	Je, unajihisi kuwa na kichefuchefu au mvurugiko wa tumbo?	Ndio/Hapana
37	Je, unapata hisi za kutapika?	Ndio/Hapana
38	Je, unahisi makelele kwenye masikio?	Ndio/Hapana
39	Je, unajihisi kuwa na kichefuchefu au mvurugiko wa tumbo?	Ndio/Hapana
40	Je, unapata tabu kupata usingizi?	Ndio/Hapana
41	Je, unahisi udhaifu kwenye sehemu za mwili wako?	Ndio/Hapana

42. Je, hatua gani huchukua upatwapo na moja ya tatizo upuliziapo viuatilifu?

(a).Nakunywa maziwa (b) Nakunywa maji ya mkaa

(c.)Natafuta msaada wa mtaalamu wa afya (d) Hakuna hatua yoyote niliyofanya

Appendix VIII: Informed Consent – English Version

Consent form

Title: Assessment of health symptoms associated with pesticides exposure among flower and onion pesticide application in Arusha Region

Consent to Participate In the Study

Greeting! My name is Suten Geofrey Mwabulambo a resident from Muhimbili University of Health and Allied Sciences (MUHAS). I am currently conducting a study titled "Assessment of health symptoms associated with exposure to pesticides among flower and onion pesticides applicators in farms in Arusha Region".

Purpose of the Study

The study is intended to assess health symptoms associated with exposure to pesticides among agricultural pesticides spraying in farms. The results obtained will determine extent, magnitude and way forward to deal with the observed situation among the pesticide applicators in different farms in the country.

Benefits of the Study

The results from this study will be an important source of information to policy makers and reviewers, farms owners and other stakeholders on the burden of exposures to pesticides and neurological health symptoms. The information will also raise awareness to farms workers on how they should behave while applying pesticide to get rid or reduce the levels of exposures.

What participation Involves

We ask for your participation in the study because you are among the pesticide applicators and you are regarded as a group at risk of exposures as a result of your job. If you agree to participate in the study you will be interviewed on your previous exposure status, your age experience and other relevant information inherent in your current job in this pesticide application.

Confidentiality

All information obtained from you will be treated as confidential and will be used only for the intended purposes of this research. The research team will compile a report that will contain information about all pesticides application interviewed while maintaining confidentiality.

Potential Risks

We do not expect any harm to you as a result of your participation in the study.

Right to withdraw

You have the right to participate or not to participate in the study without giving any reason for your decision. When you have decided to participate you are also free to terminate your participation at any time in the course of the study.

Contacts

If you have any questions about this study you are free to contact, the principal investigator, Suten Geofrey Mwabulambo (0784-790675) or sumwa19@gmail.com.

If you have any questions/concerns about your rights as a participant you may contact Chairman of MUHAS Research and Publications Committee. P.O.BOX 65001 Dar es Salaam. Telephone number: 2150302-6 and Dr. Dr. Ezra Mrema 0683-649461.

If you agree to this interview, please sign this consent form.

I …… have read and understood the contents of the consent form and my questions have been answered adequately. I therefore consent for the interview regarding the study.

Signature of the interviewee ……..... Date ……

Signature of the interviewer ……....……. Date ……

Appendix IX: Informed Consent – Swahili Version

FOMU YA RIDHAA

Utafiti: Dalili za magonjwa ya mfumo wa fahamu kwa watumiaji wa viuatirifu mashambani katika mkoa wa Arusha.

Ridhaa ya kushiriki kwenye utafiti

Habari! Jina langu ni Suten Geofrey Mwabulambo, mtafiti kutoka chuo cha afya na sayansi shirikishi Muhimbili. Kwa sasa nafanya utafiti ili kutambua dalili za magonjwa ya mfumo wa fahamu zinazohusiana na matumizi ya viuatirifu miongoni mwa wafanyakazi katika mashamba yanayotumia viuatirifu mashambani..

Lengo la utafiti

Matokeo ya utafiti huu yatakuwa ni rasilimali muhimu sana kwa watunga sera,waboresha sera, wamiliki wa mashamba na wadau wengine kwa sababu matokeo haya yatatoa picha halisi juu ya ukubwa wa tatizo na sababu mbalimbali zinazopelekea matatizo haya kuwepo kwa wafanyakazi mashambani wanaohusika na upuliziaji wa viuatirifu.

Faida za kushiriki katika utafiti

Taarifa hizi zitaongeza uelewa kwa wafanyakazi wenyewe juu ya jinsi gani wajikinge na madhara ya kutumia viuatirifu bilakufuata utaratibu wa matumizi yake na hatimaye kupunguza tatizo au kulimaliza kabisa. Wizara ya Afya na Ustawi wa Jamii, Wizara ya Kirimo, Umwagiliaji na Mifugo na Mamlaka ya Usalama na Afya Mahala pa kazi wanatazamiwa kutumia matokeo haya kuandaa mikakati thabiti kwa ajili ya kudhibiti tatizo hili kwa matumiaji wa viuatirifu.

Ushiriki

Tunaomba ushiriki wako katika utafiti huu maana wewe ni mmojawapo wa watumiaji wa viuatirifu na kuwa ni katika kundi ambalo linalotambuliwa kuwa katika hatari ya kupata athari wakati ukiendelea kujiweka katika mazingira ya matumizi ya viuatirifu. Ukikubali kushiriki utaulizwa maswali kuhusu hali ya athari za matumizi ya viuatirifu. Utaulizwa pia kuhusu umri wako na muda ambao umekuwa ukifanya kazi pamoja na taarifa nyingine kuhusiana na k azi yako.

Usiri

Taarifa zote utakazotoa zitakuwa siri na hazitatumika kwa matumizi mengine mbali na utafiti huu. Timu ya utafiti itachambua taarifa hizi na kutoa taarifa ambayo haitatoa siri yoyote kuhusu wewe kwa kuwa majina au taarifa inayomlenga mtu binafsi haitakusanywa katika utafiti huu.

Athari

Katika utafiti huu hatutegemei madhara yoyote kwa mhojiwa kwa kipindi chote cha utafiti au hata baada ya utafiti huu.

Haki ya kujitoa na mambo mbadala

Unao uhuru wa kushiriki katika utafiti huu au kutokushiriki pasipo kutoa sababu yoyote juu ya hatua utakayokuwa umechukua.Ukishakubali kushiriki katika utafiti huu na ukaona kwamba huwezi kuendelea unao uhuru wa kusitisha ushiriki wako muda wowote wa utafiti.

Mawasiliano

Kama utakuwa na swali lolote kuhusu utafiti huu unaweza kuwasiliana na kiongozi wa utafiti huu ambaye ni Suten Geofrey Mwabulambo - 07784790675 au barua pepe-sumwa19@gmail.com. Kama utakuwa na swali juu ya haki yako kama mshiriki unaweza kuwasiliana na, Mwenyekiti wa kamati ya utafiti na machapisho ya chuo cha afya Muhimbili kwa anuani S.L.P 65001 Dar es Salaam. Simu ya mezani: 2150302-6, pamoja na Dr. Ezra Mrema 0683-649461.

Kama umekubali kuhojiwa, tafadhali saini hapa:

Mimi……..,……mesoma na kuelewa kilichoelezwa kwenye fomu hii na maswali yangu yamejibiwa kiufasaha. Hivyo ninakubali kuhojiwa kwa ajili ya utafiti huu.

Sahihi ya mhojiwa …….. Tarehe ……..

Sahihi ya mhoji……..…… ……. Tarehe……