FARMERS DECISION MAKING PROCESSES REGARDING PESTICIDES USE: A CASE STUDY OF SMALLHOLDER CROP FARMERS OF AJUMADOR, A RURAL FARMING COMMUNITY IN THE NINGO-PRAMPRAM DISTRICT OF THE GREATER ACCRA REGION OF GHANA

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BY

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Dedication

To God be all the glory, now and forever. I dedicate this research project to my son, Caleb Kelvin Owura-Martey, my wife, Mrs. Emelia Adobea Martey, also to Mr. Moses K. Martey, Madam Mary Larweh and my parents, Mr., and Mrs. A.N.A. Clottey, for the love and support shown me during the period of my study

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MoFA	Ministry of Food and Agriculture
DoA…	Department of Agriculture
AEA	Agricultural Extension Agent
NiPDA	Ningo-Prampram District Assembly
WHO	World Health Organisation
FAO	Food and Agricultural Organisation
DDT	Dichlorodiphenyltrichloroethane
KII	Key Informant Interview
FGD	Focused Group Discussion
IDI	In-Depth Interview
CSD	Crop Services Department
EPA	Environmental Protection Agency
PPRSD	Plant Protection and Regulatory Services Directorate
MSLC	Middle school Leaving Certificate
FFS	Farmer Field School

ABSTRACT

The use of pesticides by farmers to protect crops against pests has gained global attention due to the potential negative impact it could pose to humans and the environment. This demands that, farmers and all those who use it, make appropriate decisions, backed by credible sources of information to ensure its safe and sound use. This study attempts to understand the complexity of the decision making processes of smallholder crop farmers with regards to pesticides use in four dimensions, economic, social, environmental and technological, using Ajumador, a farming community in the Ningo-Prampram district of the greater Accra region of Ghana as a case study. A critical understanding of the decision-making process of the farmers with regards to pesticides will enable the researcher to make appropriate recommendations to the problem owner, the Department of Agriculture (DoA), Ningo-Prampram District Assembly (NiPDA) to: tailor its extension services to farmers in the community in this regard, for safe sound and effective practices of pesticides use. A qualitative research method was used to gather primary data using tools and instruments such as semi-structure in-depth interview (IDI), key informant interview (KII) and focus group discussion (FGD) alongside participant observation. Respondents included individual farmers, farmers in cooperative (group), a pesticides retailer, traditional leaders and government officials. Data gathered were analysed based on the objectives.

Pesticides retailers, agricultural extension agents (AEAs), and farmers colleagues were found to be the sources of pesticides information available to the farmers, with pesticide retailers being the major source. Agricultural extension services provided by the local government, aimed at providing information and knowledge on pesticides use to farmers were found to be inadequate. Farmers therefore depend heavily on pesticides retailers for information for decision making concerning pesticides. Information provided by the pesticide retailers appear to be misleading the farmers, as most of them are untrained, inconsistent in their information, and not specific with their recommendation and this is causing confusion among the farmers, therefore, farmers trust and prefer them less. As businesspeople, they had conflict of interest in advising, recommending and at the same time selling pesticides to the farmers. Male and female farmers alike, involved in crop production made decisions with regards to pesticides ad its use. Farmers in cooperative (groups) were found to source and utilise pesticides information better than farmers who were not in groups. They grew similar crops, requiring similar information. Educated farmers in the groups assisted in reading of label information, there was sharing of knowledge acquired during trainings, they checked each other's activities to ensure everyone is on track. Farmers in the study area, were found to lack proper understanding of pesticides label information leading to some unsafe pesticides use and practices. The cost of pesticides and pest management were the most important economic decision the farmers made before using pesticide, but they did not observe ETL/EIL of pest management. Farmers perceived and formed both positive and negative opinions about pesticides with respect to health, the environment, crop protection and their beliefs. Older farmers knew and practiced other options of pest management other than chemical pesticides better than relatively younger farmers who lacked knowledge of the use of other options of pest management other than chemical pesticides.

Based on the findings in this study, the researcher recommends for DoA-NiPDA to:

- Register and have a strong database of all pesticides retailers in the district, licencing them to undergo compulsory training to address their knowledge gap, laying emphasis on trust, this will improve their role to provide quality services to farmers concerning pesticides use.

- Facilitate the establishment of viable and sustainable farmer groups (cooperatives), spearheaded by the farmers themselves, to serve as a platform for DoA-NiPDA and other stakeholders to reach out to farmers with pesticides knowledge and information for effective and safe pesticides use practices.

- Conduct Farmer Field School involving farmers and AEAs as an intervention to support farmers to manage pest in crops (through scouting and critical observation) and also tackle the issue of disposal of empty pesticides containers, right use of PPEs, proper observation of PHI and REI, correct measurement of pesticides dosage and safe storage of pesticides in the custody of farmers.

- Promote the use of other options of pest management other than chemical pesticides and make it attractive to young farmers in Ajumador community and other communities in the district.

- Include women in all pesticides training programme and such trainings should be geared towards empowering them to make independent decisions with regards to pesticides and its use.

CHAPTER ONE.

1.1 INTRODUCTION AND BACKGROUND

Globally ‘‘Pesticides have been an essential part of agriculture to protect crops and livestock from pest infestations and yield reduction for many decades. Despite their usefulness, pesticides could pose potential risks to food safety and the environment as well as human health’’(Zhang et al., 2015) and these associated risks could be worsened by lack of adequate knowledge and information about the safe use of pesticides.

Throughout the world, one major constraint common to the production of vegetables and other crops among smallholder farmers is pest and diseases which limits farmers in obtaining maximum crop yield to ensure food security, thus allowing smallholder farmers to adopt the use of chemicals (pesticides) to manage these pests and diseases in the production of vegetable and other crop (Phophi, and Mafongoya, 2017).

Agriculture remains the main economic stay of Ghana. It employs over 50% of the labour force and contributes above 20% to the GDP (Mattah, Mattah, and Futagbi, 2015). Despite this, agricultural practices in Ghana remain undeveloped, resulting in low yields and productivity. As a way of improving crop yields and productivity, farmers resort to the use of pesticides. In Ghana, pesticides are used by farmers for farming activities. While many farmers lack adequate information about the hazards associated with handling and use of pesticides, several reports discussed the effects of pesticides on the environment and on the health of farmers (Mattah, Mattah, and Futagbi, 2015).

Out of desperation and the yearning of farmers to eliminate all insect pests to produce crops without visible signs of pest damage, farmers in developing countries often end up spraying higher doses of poisonous chemical pesticides on their crops. The sprayings of pesticides on crops are done on weekly basis or less by farmers and some of these pesticides are meant for perennial (tree) crops (Amoabeng et al., 2017).

According to FAOSTAT (2015), cited by Donkor et al. (2016), in the early part of the year 2000, ‘‘the total pesticide consumption in Ghana was 131.6 tonnes, this rose to 8,729.04 tonnes in the year 2004, several other magnitudes higher, peaking at 14,701.55 tonnes in the year 2009’’. This suggests that, year after year, the total quantity of pesticides imported and used in Ghana is on the increase, as confirmed by the Ministry of Food and Agriculture (MoFA) Ghana; this increase includes the different number of pesticides as well as their quantities. The increase (pesticides importation and use) is attributed to increase in area of crop cultivation and the need to protect crops from pest to meet the ever-increasing demand for food (MoFA 2003, cited by Kwakye et al., 2019).

The decision-making process of farmers regarding pesticide use is therefore very important to ensure safe use of pesticide in agriculture and to ensure food safety, and this must be supported with credible sources of information.

In the Greater Accra region of Ghana and for that matter the Ningo-Prampram District, much efforts have been geared towards training the small holder farmer to protect his crops with pesticides (Mattah, Mattah, and Futagbi, (2015), Achiri, Akotsen-Mensa, and Afreh-Nuamah, 2017). While pesticides are generally considered a panacea for farmers’ pest concerns, not much is known about the farmers decision making processes with regards to pesticides use (Ntow et al., 2006).

The acceptance of pesticides usage to improve crop yield in Ghana has led to its misuse. Considering horticultural crops grown in Ghana for local consumption such as tomatoes, garden eggs, okra, cabbage etc, farmers use considerably higher volumes of pesticides, frequently abusing and misusing it (Donkor et al., 2016). ‘‘Instances of overuse and misuse on crops have been reported with accompanying negative effects on productivity’’ (Gerkan et al., 2001, Amoako et al., 2012 and Dinham 2003, cited by Kwakye et al., 2019). For this reason, several vegetables and fruits produced and marketed in and around the Greater Accra region

are contaminated with high levels of pesticides (Blankson, et al. 2016 and Donkor, et al., 2016). This raises lots of food and nutrition security concerns.

1.2 PROBLEM STATEMENT

''Information about pesticide use and perceptions of their risks among farmers (which guides their decision making process) is vital for identifying problems associated with pest-control decisions and developing appropriate management practices in given crops'' (Hashemi et al., 2012 cited by Damalas, and Koutroubas, 2014). ''Compared to decision-making processes in other economic activities, decision-making processes in crop protection have received little attention''. A better understanding of the decision-making process is necessary given the increased complexity of the decision farmers make in integrated pest management. (Rossi, Caffi, and Salinari, 2012.)

Ajumador is a farming community in the Ningo-Prampram district of the Greater Accra region of Ghana, predominantly smallholder crop farmers. Crop production such as maize, okra, pepper, tomato, onion, cabbage, garden eggs, cucumber, cowpea (beans) and watermelon, is a major source of livelihood for members of the community. A major challenge of the community is pest and disease situations affecting crop production. Lately, farmers have resorted to the use of pesticide to protect their crops, in order to optimise yield and to improve their source of livelihood.

The Department of Agriculture (DoA), Ningo-Prampram District Assembly (NiPDA) provides agricultural extension services to these farmers but lack adequate knowledge of the decision-making processes of farmers in the community with regards to pesticides use , this is however very vital in in developing interventions in pest management practices in given crops to meet the extension service needs of the farmers in the community to ensure safe use of pesticides.

1.3 OBJECTIVE

This study therefore seeks to have a better understanding of the decision-making processes of smallholder crop farmers in Ajumador community with regards to pesticides use. This will help the researcher to provide knowledge and information in this regards, which can be useful to the Department of Agriculture (DoA), Ningo-Prampram District Assembly (NiPDA) through recommendations, to tailor its extension services to farmers in the community in this regard for safe sound and effective practices of pesticides use.

The study focused on the decision making process of farmers regarding four (4) pesticides (insecticides, weedicides, fungicides and nematicides) usage in the production of ten (10) commonly grown crops (maize, cowpea beans, okra, pepper tomatoes, onion, cabbage, garden eggs, cucumber and water melon) among smallholder crop farmers of Ajumador, a rural farming community in the Ningo-Prampram district of the greater Accra region of Ghana.

1.4 Research Question

What are the different factors influencing the decision-making processes of small holder crop farmers of Ajumador with regards to pesticide use?

1.4.1 Sub questions

a) What sources of information regarding pesticide use are available to smallholder crop farmers of Ajumador?
b) What are the challenges (problems) that farmers in Ajumador face with pesticide label information when using pesticides?
c) What economic considerations do farmers in Ajumador make before using pesticides?
d) What are the local (indigenous), environmentally safe cultural farming practices that farmers in Ajumador use to manage pest other than chemical pesticides?
e) What are the beliefs and perceptions of farmers of Ajumador concerning pesticides?

CHAPTER TWO.

THEORETICAL BACKGROUND OF SMALL HOLDER CROP FARMER DECISION MAKING PROCESSES REGARDING PESTICIDES USE

2.1 Introduction

This chapter provides the review of literature on pesticides use and decision-making concerning pesticides in crop production. The theoretical background consists of the theories used as well as the key concept and words of the study and their relationship. Review of the literature involves the systematic identification, location and analysis of documentations containing relevant information in line with the research problem (Amin, 2005).

2.2 Crop production and the pest problem in Ajumador

The Ningo-Prampram district of the greater Accra region is primary rural. Agriculture (crop production) such as cereals (maize, rice), vegetables (okra, pepper, tomato, onion, cabbage, garden eggs, cucumber), cow pea (beans) and watermelon, are notably grown in the district including Ajumador (Ghana statistical service, 2014). The production of these crops is associated with pests such as insect, fungi, weeds, rodents, nematodes attacking and reducing the productivity of crops and their overall yields (Singha, Pandeyb and Singhb 2018), requiring control. For the purposes of this study, all the above-mentioned vegetables in addition to maize and watermelon will be considered and where necessary, references will be made to them.

2.3 Pesticides, pests and crop production

A major challenge associated with crop production is pest attacking crop (sporadically, seasonally, or fully established) describing the vulnerability context within which farmers produce crop. For instance, Soni and Ellis (2018) identified occasional pests that sporadically sprung up to attack vegetables and producing shock to the farmer. On trend basis, they also identified major pests that are fully established in the agro-ecological system and always attacked crops. Again, Netam, Gupta and Soni (2013) identified pests that attacked soybean on seasonal basis. Pesticides have therefore become a vital component and integral part of modern agriculture (Jallow et al., 2017). This is because of their use in pest management to protect crop plants against harmful pests such as insect, fungi, bacteria, viruses, nematodes weed etc which attacks crops (Sharifzadeh et al., 2018).

For the purposes of this study, a pest is defined as any living organism that has the ability to harm or destroy crops or farm produce of the farmer (Hollyer et al.,2013)

2.4 PESTICIDES

2.4.1 Broad definition

‘‘Pesticide means any substance, or mixture of substances, or micro-organisms including viruses, intended for repelling, destroying or controlling any pest, including vectors of human or animal disease, nuisance pests, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feeding stuffs, or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as insect or plant growth regulators; defoliants; desiccants; agents for setting, thinning or preventing the premature fall of fruit; and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.’’ (WHO/FAO 2010).

Table 1: A Cross Section of Environmental Protection Agency (EPA-Ghana) pesticide approved list (2015) in Ghana

N0	Trade name	Registration number	Concentration of active ingredient	Hazard class	Uses
1	Agro-thoate 40EC	FRE/1310/00 602G	Damethoate (400g/l)	II	**Insecticide** for the control of insect pes in vegetable
2	Atom super 50 SC	FRE/1308/00 6193G	Thiamethoxam (30g/l) + Delthamethrin (20g/l)	II	**Insecticide** for the control of insects and mites in vegetables and fruits
3	Attack 1.9 EC	FRE/14104/0 0723G October 2014	Emamectin benzoate (1.9%)	II	**Insecticide** for the control of insect pest in vegetable
4	Aweradlamp 2.5 EC	FRE/14146/0 0701G April 2014	Lamda Cyhalothrin	III	**Insecticides** for the control of insect pest in vegetables and horticulture crops
5	Agrithane 80WP	FRE/1302/00 628G	Mancozeb 800g/kg	III	**Fungicide** for control of leaf spot, mildew, blight in vegetables
6	Atracol 70WP	FRE/13137/0 0672G	Propineb 700g/kg	III	**Fungicide** for the control of diseases in vegetables
7	2,4-D Super Herb	FRE/1467OO 793G November 2014	2,4-D Amine 720g/l	II	**Herbicide** for the control of broadleaf weeds
8	Adom 48SL	FE/1467/OO7 91G November 2014	Glyphosate 410g/l	III	**Herbicide** for the control of grasses broadleaf weeds in cereals ang vegetables
9	Brody Fresh Bait	FRE13100/00 578G March 2013	Brodifacoum (0.005g/kg) and Denatonium benzoate (0.001g/kg)	II	**Rodenticide** for the control of rodents andmites
10	Agrocelhone NE	FRE/13136/0 0665G November 2013	Dichloropropene (60.8%) + Chloropicrin (33.3%)	II	**Nematicide** for the control of nematodes
11	Compact 10GR	FER/1308/00 622G September 2013	Ethoprophos (10%)	II	**Nematicide** for the control of nematodes in pineapple and vegetables

II = moderately hazardous, III = slightly hazardous

EPA (2015). Online:https://waapp.org.gh/waappmedia/manuals/46-revised-register-of-pesticides - accessed on the 30th April 2020

2.4.2 Pesticides - narrow definition

Pesticides are also defined pesticide as ‘‘any substance, or a mixture of substances of chemical or biological ingredients intended for repelling, destroying or controlling any pest or regulating plant growth’’ (WHO/FAO 2015).

The term pesticide covers a wide range of compounds including insecticides (eg. Dichlorodiphenyltrichloroethane (DDT), endrin, heptachlor etc) fungicides (e.g. zineb, captan, and maneb), herbicides (e.g. paraquat), rodenticides (e.g. warfarin, bromodiolone), molluscicides (e.g. quaternary and polyquaternary ammonium compounds), nematicides (e.g. carbofuran, fenamiphos) plant growth regulators such as auxins, ethylene releasers, gibberellins (Singha, Pandeyb and Singhb 2018).

2.5 TYPES OF PESTICIDES AND THEIR USES

According to Singha, Pandeyb and Singhb (2018), the following types of pesticides can be identified based on their use. They include insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides.

2.5.1 Insecticides:

Insecticides are pesticides prepared to kill, repel, or lesson one or more species of insects. Insecticides work in many ways; some interrupt the nervous system of the pest; others may also destroy the exoskeleton of the insect and others may repel or control them by some other means. Insecticides are packaged and marketed in the form of sprays, dust, gels and baits (Npic, 2019).

2.5.2 Herbicides:

Herbicides are pesticides purposely formulated to kill weeds. Some herbicides are selective and may kill only some weeds while others are non-selective and therefore capable of killing any green plant it gets in contact with (Npic, 2019).

2.5.3 Fungicides:

Fungicides are pesticides that are prepared to kill fungi or prevent the growth of fungi and their spores (Rohr et al 2017). Fungicides may be used to treat plant parts infected with fungi pathogens. Fungicides may also be used to dress seeds before sowing or nursing them. They are also effective in treating soil-borne fungal pathogens such as dumping off on nursery beds (Rohr et al., 2017).

2.5.4 Nematicides:

Nematicides are chemical formulations used to manage nematodes (wormlike crop pathogens) in crop production (Liu et al., 2014).

2.5.5 Rodenticides:

are pesticide that are prepared to manage rodents such as rats, mice etc in crop production. An example of rodenticide is bromadiolone (Goulois et al. 2016).

2.5.6 Molluscicide:

are pesticide formulations aimed at managing snails and sludges in crop production, for example, quaternary and polyquaternary ammonium compounds (Singha, Pandeyb and Singhb 2018).

2.6 FARMERS DECISION MAKING PROCESSES REGARDING PESTICIDES USE

This section of the literature review looks at the various decision farmers take with regards to pesticides. The review covers four (4) broad dimensions (economic, social, environmental and technological considerations of decision that farmers make). These are defined for the purposes of this study and supported with existing literature.

Decision making is the process of identifying and choosing alternatives based on the values, preferences and beliefs of the decision maker (Frensch and Funke, 1995).

According to Rossi, Caffi, and Salinari (2012), decision making regarding crop protection starts with the identification of a problem (the pest problem), action is taken after the farmer has considered all possible alternative means of managing the pest situation.

2.6.1 Farmer decision making regarding pesticides use based on gender

Alwang, Larochelle and Barrera (2017) indicated that, farm decision making involving pesticides, could be the sole responsibility of the men, women or both depending on the situation. In households where both men and women are involved in the decision making, they reported men claimed a higher level of the decisions made. Mrema et al., (2017) found that, women involved in crop production in developing countries are mostly uneducated, not empowered and they do make decisions with regards to pesticides in relation to their health.

2.6.2 ECONOMIC CONSIDERATIONS

Farmers decision to use pesticides to produce crops is influenced by economic factors, famers count the cost as against the financial benefits (Carpentier and Reboud, 2018)

farmers decision regarding pesticides use based on cost of pesticides and pest management

In the decision-making process of farmers with regards to pesticides use, the smallholder farmer considers the cost of pesticides and management of the pest situation. Ntow et al. (2006) identified that, farmers also buy less expensive pesticides and these products may be ineffective and not suitable to the pest requiring control. Van den Berg et al., (2020) reported that, participating farmers in farmer field schools made gains by saving cost on the use of pesticides, there was reduction in the use of pesticides by farmers.

Farmers decision regarding pesticides use based on the objective of the farmer

Decision regarding pesticide use is heavily influenced by the objective of the farmer. Where the objective of the subsistence's farmers is to grow crops to feed his or her family, decision regarding pesticides use may be different from the same subsistence farmer whose target is to produce crops to meet market demands. Where the objective of the farmer for growing crops is oriented towards market demands, higher quantities of pesticides are found to be used to protect the crops compared to crops grown for subsistence-home consumption (Riwthong et al., 2017).

Farmers decision regarding pesticides use based on the economic injury level and economic threshold of pest problem

One major principle about pest management is that pesticides must be applied before economic damage has occurred. Therefore, to enhance Farmers' decision-making process, the Economic Injury Level (EIL) concept was developed by expects as the lowest pest population density, capable of causing economic damage to plants. In the same way, Economic Threshold (ETL) is the lowest pest population density at which control must start (warrant control) to prevent an increasing pest population from finally reaching economic injury level (de Freitas Bueno et al 2011). According to Sarwar (2015), where there are local standards, Both EIL and ETL are economic decisions that farmers could take due to cost implications with regards to pesticides use. Prasenna et. al (2018) suggested the need to train farmers to scout and observe pest on crops before initiating pesticides use to manage pest.

2.6.3 SOCIAL CONSIDERATIONS

This looks at all sources of information regarding pesticides uses and the ease with which farmers access information from such sources. It also considers the involvement of male and female farmers in pesticides decision-making and how individual farmers and farmers in cooperative source and utilize pesticides information, finally, the perception of farmers regarding pesticides.

farmers decision making regarding pesticides use based on available sources of information

According to Hashemi et al. (2012) cited by Damalas, C.A. and Koutroubas, D.S., (2014), accurate and dependable information about pesticides use is very important for decision making and developing improved practices of pest control among farmers.

Work done by Mattah, Mattah and Futagbi (2015) identified three farmer sources of information with regards to pesticides use. These sources include government Agricultural Extension Agents (AEAs), agro-chemical shop dealers (local vendors or retailors) and farmers own colleagues and neighbours.

Apart from agricultural extension agents, pesticide retailers and farmers own colleagues, Ntow et al. (2006) identified media advertisement (television, radio and newspapers) as additional sources through which farmers obtain information on pesticides use. Work done by Jin, Bluemling and Mol (2015) suggest that, farmers trust for a source of information depends on how long the relationship has existed, and how the source continue to improve their farming activity to help them make gains. Leikei, Ngowi and London (2014) identified pesticide retailers lack adequate knowledge in pesticides use.

Farmer decision making regarding pesticides use – the perspective of farmer cooperatives (group) or as individuals

Rossi, Caffi and Salinari (2012) indicated that, individual farmers make decision independently based on their circumstance before choosing what seem best to address the pest problem and is usually influenced by experiences gained in the past by the farmer. On the other hand, Yang, Klerkx and Leeuwis (2014) reported that, farmers who are in cooperatives (groups), collectively, are able to access specialist (technician) advice to provides them with pesticides information, assist in pest diagnosis and make recommendations to group members based on diagnosis, to best solve such pest problems. Similarly, Grashuis and Su (2019) found out that, farmers who are in cooperatives (groups), better acquire knowledge and skill in using inputs. They further indicated that, members in such farmer groups are more efficient users of farm inputs including pesticides. Jin, Bluemling and Mol (2015) identified that farmers in groups build trust among themselves and this helps then to support each other in the safe use of pesticides.

farmers decision making regarding pesticides use based on social status

Considering social status, that is educated farmers can read and understand pesticides label information, understand label instructions, associated risks and can use pesticides safely. Such farmers are also in better position to influence other colleague farmers to use pesticides safely (Jallow et al., 2017). Mengistie, Mol and Oosterveer (2017) also found out that, richer or resource endowed farmers have better linkage to access and buy pesticides from accredited sources and influence farmers in such class to do same, on the other hand, poorer farmers buy cheap broad spectrum pesticides from any source.

farmers decision making regarding pesticides use based on beliefs and perceptions

For the purposes of this study, perception of farmers with regards to pesticides means, farmers' belief, opinion, how they regarded, understand, or interpret pesticides (Abdollahzadeh, Sharifzadeh and Damalas 2015)

Van den Berg et al., (2020) found out that, farmer field school (FFS) trainees upon completion and practicing what they learnt, attached heavy importance to the results of their own field crop performance rather than myth, or any witchcraft being the cause of the failure of their crops.

Damalas and Koutroubas (2017) found that, farmers belief concerning pesticides influence how they use it. According to morning AgClips, (2017), religious farmers may not use pesticides due to their belief, such farmers believe that, using pesticides pollutes the land. Bester and Muller (2017), identified that, some religious leaders use pesticides for spiritual healing and recounted of a pastor who claim to cure cancer and HIV by spraying an insecticide called 'Doom' into the client's face.

The perception of farmers regarding pesticides influences their decision concerning its use. If farmers opinion about pesticides is different from expert's opinion, it could lead to farmers taking more risk. This also influences how they protect themselves against pesticides. Advice given to farmers with regards to pesticides use and crop protection may be unsuitable and immaterial if it is not in line with their own views (Ntow et al., 2006).

Farmers who consider pesticides as effective and the only way to manage pest will use pesticides extensively, such farmers, are likely to overuse pesticides (Khan and Damalas 2015).

At the same time, ''decision about pest control (using pesticides) are quite subjective and may depend on several characteristics of farmers including personal beliefs, perception and preferences (Hasheni et al. 2012 cited by Abdollahzadeh, Sharifzadeh and Damalas 2015).

2.6.4 ENVIRONMENTAL CONSIDERATIONS

This comprise all other forms of pest management other than chemical, synthetic and conventional pesticides, which are environmentally friendly and therefore does not pose danger to environment and other living organisms within the agroecological environment.

farmers decision regarding pesticides use based on other options of pest control (indigenous cultural farming practicies)

According to Rossi, Caffi and Salinari. (2012), the first decision concerning crop protection measure**,** that is, deciding not to use pesticides in order to protect the environmental is prevention through all necessary steps that is needed to be taken to suppress the pest from showing up in the first place. This is done through the selection of appropriate cultural methods of crop production such as careful selection of farm site, choosing the right crop which is resistant to pest, good land preparation such as ploughing and harrowing to expose pest to hash conditions to destroy them. Improvement of land and water management can also be used. Timely planting period such that, crops are harvested before pest population could grow, mixed cropping, crop rotation and clean farm sanitation to ensure there are no breeding grounds for pest can also be considered (Rechcigl and Rechcigl, 2016). Al-Zaidi et al. (2011), found out that, the farmers they studied had positive approach considering the harmful effects of pesticides on the environment while using.

Zhang et al. (2018) identified lower pest populations in mixed crop fields, this was inimical to pest population growth. Similar work done by Wahbi et al. (2016) showed that mixed cropping potentially reduces pest population and even more when crops are grown in rotation (crop rotation, where different crops are grown in succession).

Khater (2012) identified that, biopesticides when used to produce crops, are less toxic to human health and are also environmentally friendly compared to conventional (synthetic) chemical pesticides. They are less expensive, locally available, needed in small quantities, and decomposes quickly leaving no residue in the targeted crop. Similar work done by Mossa (2016) revealed that, biopesticides has less negative environmental effects than synthetic chemical pesticides in the long run. The use of microbial pesticides, for instance the *Baccillus thuringiencis* and many others have been used as natural enemies in protecting crops against insect pests in many developed countries and are found to have less environmental impact (Ruiu 2018).

2.6.5 TECHNOLOGICAL CONSIDERATIONS

This section looks at pesticides label information and technically, their ease of use and application by farmers.

Pesticide Label Information

Pesticides labels are stickers placed on pesticides which contains major sources of information (for decision making) on how to use that pesticides (Damalas, and Khan 2016).

The purpose of pesticide labelling is to guide users and applicators on how to use it rightly to get the desired result with minimal or no negative effect on humans and the environment. For this reason, farmers and users of pesticides are required to refer to pesticide labels when storing and before use. They are also required to refer to the labels during mixing, loading, applying it, after use, disposing off unused pesticides and empty containers (Dugger-Webster and LePrevost, 2018). Pesticides label information covers the following:

- Hazard statement (with regards to health and environment)
- Precautionary statement (eg. Do not eat, drink or smoke when using, wash down after use)
- First aid and medical advice (in case of an eventuality)
- Accidental spill advice
- Supplier information
- Trade or brand name
- Date of manufacture, expiry and batch number

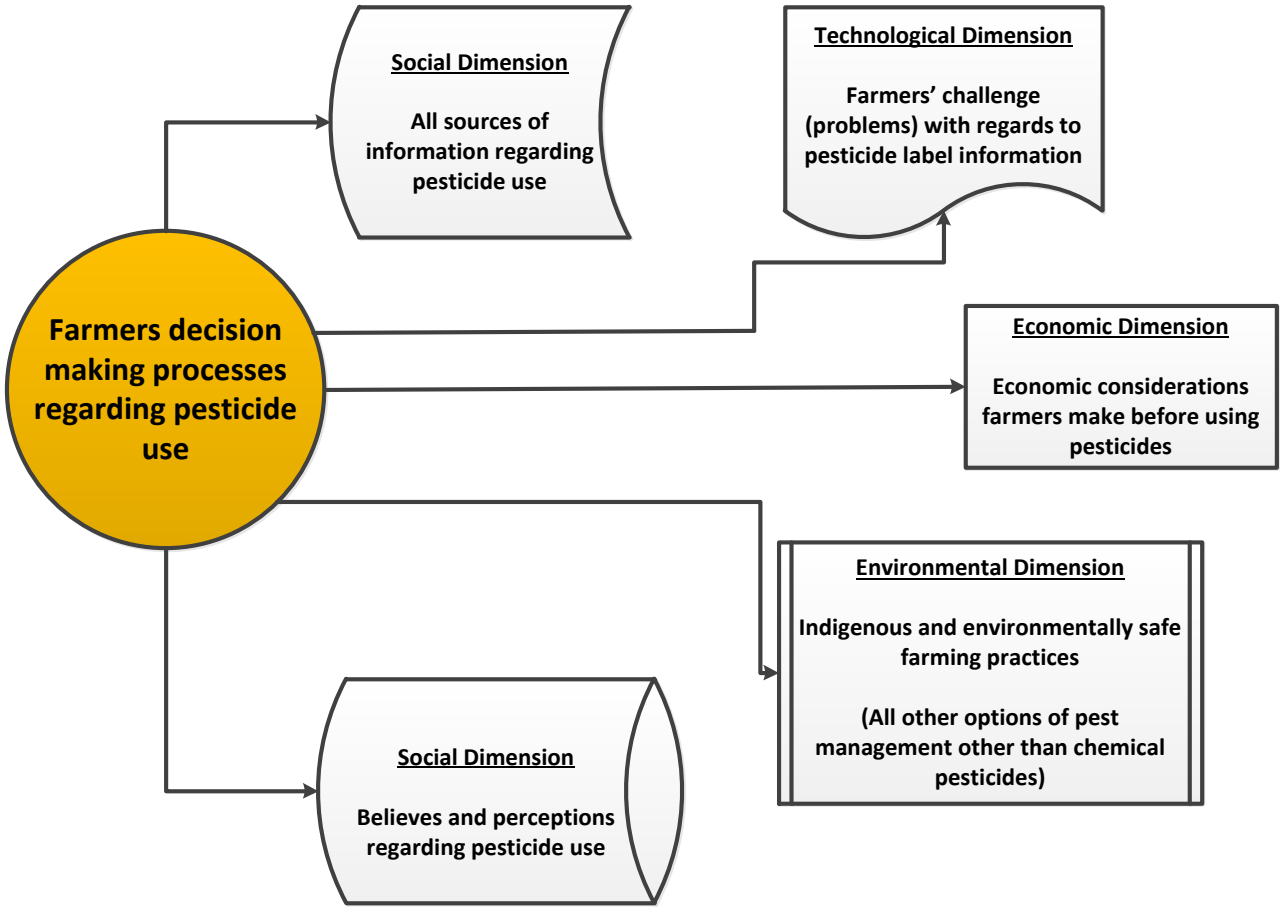
Direction on safe use

- Recommended crop(s) on which pesticide is to be used
- Targeted pest (specific pests on which pesticides must be applied to)
- Dosage (rate of application)
- Mixing information
- Incompatibility (with other pesticides) information
- Method of application
- Pre-Harvest Interval (also known as withdrawal period)
- Re-Entry Interval, ie. Farmer is not to return to sprayed plot (usually 24hours after application)
- Spray drift information

Lekei, Ngowi and London (2014) showed that, the farmers they studied heavily depended on pesticides label information for decision They however reported that, farmers complained that most of the pesticide label information were not readable and some of the pesticides were not in their original containers making decision-making, problematic. Waichman, Eve and da Silva Nina (2007) reported educated farmers lack technical understanding of label information.

Rijal et al (2018) showed that, smallholder crop farmers generally do not understand pesticides label information including the toxicity colour codes. This puts the smallholder crop farmers in a difficult situation to be able to make safe decisions with regards to pesticide use. With regards to pesticides usage, Waddington et al.,(2014) identified that, Farmer Field Schools (FFS) approach of adult learning among farmers, encourages discovery learning, farmers critically think about their practices, empowering them to come out with their own investigation, improving and transforming their decisions-making based on their own assessment. Westendorp (2012), found out that, farmer field schools can be an important learning ground about pesticides and a means of giving charge to farmers for their own progress through solving their own problems. In this case, the utilization of farmer groups and the use of farmer-trainees are some of the examples of transferring responsibility for service delivery from the state to the farmers themselves.

Figure 1: Conceptual framework-farmer decision making processes regarding pesticides use



Source: Author 2020

The conceptual framework focuses on the decision-making process of smallholder crop farmers with regards to pesticides use in four dimensions, economic, social, environmental and technological. The theory guiding the framework is that farmers makes varying degrees of decisions, usually complex to manage pest, (Rossi, Caffi, and Salinari, 2012) and therefore must be supported by credible sources of information for farmers to use pesticides safely.

CHAPTER THREE.

METHODOLOGY

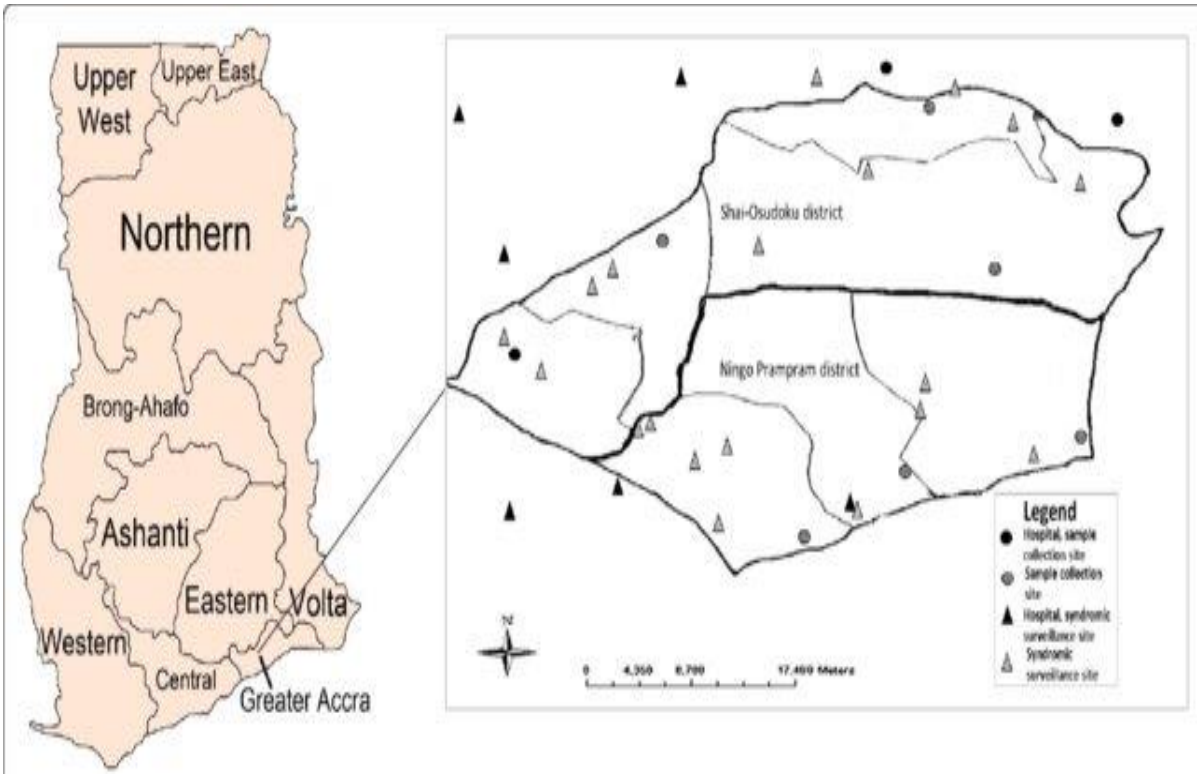
3.1 Introduction

This chapter describes the area for the proposed study, the materials and methods that were used for collection and analysis of data. It also covers the research design and strategy, sampling, research tools, reliability and validity of results as well as ethical considerations.

3.2 Description of study area

The proposed research work was carried out between July and August 2020 in Ajumador, a rural farming community in the Ningo-Prampram district of the Greater Accra region of Ghana. The Ningo-Prampram district assembly was created in the year 2012, carved out of the then Dangme West District (now Shai-Osudoku district) with Prampram as the capital. The district covers a total land area of about 622.2 square kilometres and about 40 kilometres from the national capital and has about 90% of the total land area being arable, and suitable for crop production (Ghana statistical service, 2014)

Figure 2:Map of Ningo-Prampram district



source: Ghana statistical service, 2014

According to Ghana Statistical Service (2014), the total population for the Ningo-Prampram district during the 2010 National Population and Housing census was seventy thousand, nine-hundred and twenty-three (70,923) with a total of 40,426 women representing 52.7% and 30,497 men representing 47.3% The census further revealed that, the rural population of the district is about 58.3% and are mainly into agriculture. Rainfall in the district is generally low and erratic. Majority of farmers in the district depends on the rain for farming activities which comes in mostly between September and November. Crops such as cereals, vegetables, legumes, and fruits are grown in the district and DoA NiPDA provide extension services to theses farmer as they depend on pesticides to protect their crops from pest.

3.3 Research design and strategy

Qualitative research method was used by the researcher to obtain in-depth information and deeper understanding of the complex decision farmers make with regards to pesticides use. The reason for choosing qualitative approach is that it considers participants perspective as necessary, reduce the imposition of the researcher's ideas on participants and contributes to an in-depth study for richer information and understanding of human experience in action.

According to Creswell (2007), research design can be explained as a plan that guides how the study is to be carried out and provides the framework for the collection and analysis of data.

Case studies best suits qualitative research method whereby semi-structured interview is used to gather data from a limited sample. Case study was therefore adopted for this study. The reason for opting for case study design is that, it did not only support the use of multiple techniques for data collection from different sources but also allowed the researcher to determine what evidence to look out for and what analysis technique to use with the data to answer the research question. This study was considered case study and focused on the decision-making processes of smallholder crop farmers in Ajumador community with regards to pesticides use.

3.5 Data sources

Primary and secondary sources of data were collected and used for this study. Secondary sources of data reviewed included journal articles, published books, policy documents of the Ministry of Food and Agriculture, (MoFA, Ghana). This was used for the background of the study. Secondary sources of data were also used to define and operationalise all key concepts that were used in the study. Furthermore, secondary sources of data were used during discussion of the results of the study. For this study, the researcher conducted the review of secondary sources of data prior to the field work.

Primary data concerning the complexity of the decision-making processes of farmers regarding pesticides use in the selected community were collected through semi-structured, in-depth interview (IDI), Key Informant Interviews (KII), Focus Group discussions (FGD), and participatory observation (how farmers use pesticides and why they do it that way). The multiple sources of the primary data collected (for triangulation) aimed at increasing reliability and confidence in the result of the study.

Checklist was prepared by the researcher and pre-tested to three farmers in the community with the aim of eliminating uncertainty or confusion. Before the commencement of field work, the research assistant and the local agricultural extension agent visited the community local leader and the village chief. The essence of the visit was to introduce the research assistant, explain the objective of the study and to seek their blessing for field work to begin. Qualitative research method was employed for IDI, KII and FGD where open ended questions followed by probing were asked to respondents. The local language (Ga-Dangbe) was used as means of communication. Responses from respondents were recorded using audio recorder and notebook.

3.6 Research tools (instruments for primary data collection)

3.6.1 Semi-structured, In-Depth Interview

Semi-structured, In-Depth Interview (IDI) focuses on a combined framework of general themes along with pre-established questions and can therefore be adopted in the context of individual sessions.

Figure 3: Photograph with respondents during semi-structured IDI

source: field work, 2020

This gave the researcher the opportunity to use different questions or vary the order of the questions or standardize them depending on the prevailing context. Both open and closed ended semi-structured questions were used by the researcher during interview (figure 3). Semi-structured In-Depth Interview was used to assess the complexity of the decision farmers make with regards to pesticides use. Each interview lasted between 35minute to an hour. Where internet connectivity was very poor, the research assistant conducted the interview. Seven (7) out of the eight (8) female respondents (slated for this study) who earlier accepted to be part of the study later successively declined speaking to the team. They all told us to either interview their husbands or leave them in peace. The eighth female respondent on the list, who happened to be the head of a household was successfully interviewed and through her, a snowball tactical approach was used until the desired number of women farmers slated for the study was attained, all of whom happened to be the head of their households. This prompted the researcher to find out more on the extent to which women were involved in the decision-making regarding pesticides and its use in the community. The local language, Ga-Dangme, was used for all the interviews and this gave the respondents the opportunity to express themselves.

3.6.2 Focus Group Discussion

Focus group discussion (FGD), which is a qualitative method of research was used to interview a group of farmers of similar background with the aim of generating discussions in order to gain diverse views and opinions on an issue among the participants, for example, their perceptions concerning pesticides, their sources of information on pesticides use etc, all in the bit to understand the bigger picture of the decision making process of farmers in the community with regard to pesticides use. Focus group discussion was adopted as part of the primary data gathering process and issues raised was used to triangulate, validate, and strengthen semi-structured in-depth interview as well as key informant interview. Probing techniques were used during the focus group discussion process to clarify or confirm issues that were raised.

Figure 4:Photograph during focus group discussion with farmers in a cooperative (group)

Source: field work, 2020

Two focus group discussions were conducted during the study, each group comprised ten (10) smallholder crop farmers. One group involved those farmers who belong to the community farmers group (cooperative) as showed in figure 4 above, and the other are those individual farmers who do not belong to any group and takes decisions independently (figure 5). This helped the researcher to understand the dynamics of the decision-making processes between farmers in the community group and those who are not. Researcher ensured that each group has at least four female farmers and ensured a safe environment was created for them to express themselves to understand the extent to which women as farmers are involved in decision-making regarding pesticides and its use in the community.

Figure 5: Photograph during FGD with farmers who do not belong to a group:

source-field work 2020

Focus group discussions centred on finding from the farmers, the sources of information regarding pesticides use that is available to them in the community. The same platform was used to explore the challenges farmers go through with regards to pesticides label information at the time of using pesticides. The beliefs and perception of farmers regarding pesticides was also explored. Information on indigenous and local cultural farming methods of pest control other than chemical pesticides use by the farmers in the community was also explored.

3.6.3 Key Informant Interview

Four (4) key informant interviews were conducted during the study period with key actors. A leader of the community farmers group, a researcher at the entomology department of the University of Ghana-Legon, an officer from the regional Crop Services Department (CSD) of the Plant Protection and Regulatory Services Directorate (PPRSD) of MoFA and a pesticide retailer, served as key informants. Key informant interview guide was prepared and administered. Probing techniques was used to obtain more information related to the objective of the study. The key informant's data gathered was used to triangulate, confirm and strengthened findings from semi-structured In-Depth Interview, and focus group discussions.

Steps used to collect primary data:

One focus group discussion (FGD) was first conducted and this gave the researcher a general overview and understanding of the decision-making process regarding pesticides use. The first FGD was with farmers who are in cooperative (group). This was followed by individual semi-structured (IDI) for in-depth understanding of the complexity decision-making process with regards to pesticides use. After this, the second focus group discussion was conducted with individual farmers who make decisions regarding pesticides independently

(that is, are not in farmers group). Finally, the deep and rich experience of key informants about pesticides, crop production and the Ajumador community was tapped through key informant interviews.

3.6.4 Participant observation and field visit

Participant observation technique was an integral part of the data gathering process to compliment IDI, KII and FGD. Research assistant was guided to be on the look-out for participants' behaviour which could reveal some hidden information that participants did not raise during interview and field visit. For field visits, local, cultural methods of pest control other than chemical pesticides, cropping patterns, pesticides handling, disposal of empty pesticides containers, wearing of personal protective clothing (PPEs) during pesticides application, storage of pesticides among others were observed to confirm what participant said or did not mention during interview. Some photographs were taken to that effect with their full permission.

3.6.5 Field notes and reflective diary

Throughout the field work and the primary data gathering process, the researcher and the assistant kept field notebooks and recorded all responses and relevant observations during the interview processes (with individual, focus group and key informant). Additionally, a reflective diary was used to recorded relevant information during the field work period. This helped the researcher to reflect on the process of the field work and adjusted where necessary.

3.7 Sampling methods and study population (data collection strategy)

Qualitative method of data collection was used in this study to understand the decision-making processes of farmers in Ajumador with regards to pesticides use. Qualitative data collection strategies such as semi-structured In-depth Interview (n=20), key informant interview (n=4) and focus group discussion (n=2) were used for the primary data collection for this study. The researcher was not able to gather data from all the farmers in Ajumador community because this will take long time and can be very expensive (Laws et al., 2013). The justification for using qualitative method of data collection is that it enabled the researcher to describe, capture and communicate the experiences of the respondents as it is in their own situation.

The researcher with the help of the research assistant and the local Agricultural Extension Agent (AEA) in charge of the community, selected 20 farmers from among the lot of other farmers for IDI.

The criteria used to select farmers for IDI, that is, characteristics of participating farmers (sample) in the study were as follows: (1) Participants were living within the Ajumador community, (2) participants were smallholder crop farmer growing at least one of the following crops (maize, cowpea beans, okra, pepper tomatoes, onion, cabbage, garden eggs, cucumber and water melon) and uses pesticides to some extent in the production of their crops under open field conditions. These crops were chosen because they are the common crops grown by farmers in the community for consumption as well as for sale. For the purposes of this study, ''Smallholder farmers are those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour'' (Aaron, 2012).

The total number of farmers selected for the semi-structured In-Depth Interview (n=20) who also meet the criteria were on purposive sampling basis since there were other farmers in the community who are not into crop production or grew the above crops in green houses. Twenty farmers were chosen for IDI to ensure that at least two farmers who growing at least one of the crops in this study are represented in the interview.

3.8 Covid-19 context and considerations

In view of the Covid-19 pandemic which has not spared Ghana either, the researcher was not be able travel to his home country for research due to closure of all borders leading to the country. Currently, there are less Covid-19 restrictions in Ghana and up to 100 people can gather at a place. A research assistant was proposed and trained ahead of field work to assist in primary data collection. The role of the research assistant was to organise the farmers to be studied. He was equipped with a smart phone and a laptop and ensured internet connectivity. He facilitated the organisation of famers in the rural community, making it

possible for semi-structured IDI to be conducted as well as focus group discussion. Skye and zoom which were earlier on proposed to be used for IDI and FGD were not successful due to poor internet connectivity, however, what's up call through the assistant was used instead. Key informants were contacted through what's up phone calls. The assistant was also guided and wrote down important observations and took photographs which were necessary for the study, for example, indigenous cultural farming practices.

3.9 Methods for analysing data (Data processing and analysis)

Data analysis started from the moment field work begun. This means that the framework and tools for data collection were right to be able to collect relevant data. Semi-structured In-Depth Interview (IDI), Key Informant Interview (KII) and Focus Group Discussion (FGD) were the main tools used for primary data collection in this study. Content analysis was employed to analyse the information collected from the respondents. Electronic recording of interviews was listened to and their content were transcribed and compared with field notes and other interview notes that were documented. The transcribed texts were broken down into manageable categories on a range of levels, using key words, word sense, phrase, sentence or themes based on the sub-questions. The content was qualitatively assessed for trends, patterns, relationships, similarities, differences and so on, from which insight was gained by the researcher to deduce or make inferences about the message within the text and context. The researcher adopted thematic content analysis to perform a qualitative analysis of occurrences of themes in the raw data. Narrative and visual tools were finally used to present results. In order not to sound anecdotal, the narratives were backed up with quotes from respondents to offer some evidence.

3.10 Reliability and validity of the results

It is very important and critical that researchers take necessary steps to ensure the reliability and validity of their research findings particularly in the case of qualitative research. This is because, qualitative research is based on subjective, interpretive and contextual data, making findings more likely to be scrutinized and questioned. The exact extent to which the process and the result of any study can be replicated is reliability. The validity on the other hand is described as the degree to which a research study measure what it intended to measure (in this case, that is the decision-making process of smallholder crop farmers regarding pesticide use). Probing characterised IDI, KII and FGD interviews which were employed along with participant observation to ensure triangulation. Using three or more methods and or sources to gather data is referred to as triangulation. The advantage associated with triangulation is that it enhances the reliability and validity of findings to give a more detailed and balanced picture of the situation in the study area. IDI interview questions meant for this study were pre-tested among a small number of farmers in the community, to check if questions were not ambiguous and could generate the needed information for the study.

3.11 Ethical considerations

The researcher was conscious of power relation in research process, the fact that I work with the department of agriculture played a role as well as farmers expectation towards me. The researcher and his assistant had the responsibility of safeguarding the integrity and anonymity of respondents and treated each of them with optimum respect. The researcher and his assistant did not abuse power in this regard, bearing in mind that, the value of the study was not worth (more important to the extent of) destroying the people or the community to be studied in the process. Before the start of data collection process, the researcher through his assistant and the local agricultural extension agent introduced themselves to the community and explained what the study was all about. It was made known to all potential respondents that, participation was voluntary and are therefore free to accept or reject the invitation to be part of the study. The research team ensured the safety of respondents by conducting semi-structure In-depth Interviews at the place where respondents felt safe and comfortable and spoke their mind without feeling intimidated. The researcher ensured that, findings from the study were presented in a manner such that, the views and stands of respondents were treated with the best anonymity and confidentiality it deserved, for example, names of

respondents were not attached to findings. The full consent of all respondents and all those whose title or photos etc. were used to support findings in this study were sought and granted permission before it was used.

3.12 Research Limitations

- In this study, sampling focused on some specific crop grown by the farmers. Even though, the design targeted representative sample for the targeted crops, the researcher admits that the study sample is not representative enough for the entire community. Based on strength of sample size, this study has a weak basis for generalisation than a study with a statistically representative number.
- The researcher discovered that, there were several other crop farmers in the community growing crops that were not part of this study, so those farmers were not included in this study. Again, there were other farmers who were growing crops stated in this study but under greenhouse and protected conditions, such farmers were also not included in the study. The decision-making process of these farmers regarding pesticides use is therefore not known. The findings in this study, is therefore valid only for farmers with crops stated for this study and under open field conditions.
- The study was conducted in Ajumador community, which is just one community out of the many communities in the district where this study was commissioned. Findings in this study, therefore, cannot be generalised for the entire district.
- Observation is an important aspect of qualitative research. Observation of respondent's demeanour, gestures, field practices and comparing it with responses from respondents, could give a lot of information to the researcher. This was lacking to some extent as the researcher was not able to travel to home country because of Covid-19 restriction and the researcher had to work through a research assistant.

Table 2: summary of approaches and methods used in primary data collection

No.	**Sub-question**	**Strategy and research instrument**	**Source of information**
I	Sources of information regarding pesticides	Interviews (KII, IDI, FGD), field notes	Farmers, Community farmers group, key informants
II	Challenges farmers face with regards to pesticides label information	Interviews (KII, IDI, FGD), field notes, participant observation	Key informants, farmers, community farmers group
III	Economic considerations farmers make before using pesticides	Interviews (KII, IDI and FGD), field notes	Farmers and key informants, community farmers group
IV	Local (indigenous) cultural farming practices used to manage pest other than chemical pesticides	Interviews (KII, IDI and FGD) Participant observation, field notes	Farmers and key informants, leader(s) of community farmers group
V	Beliefs and perceptions of farmers concerning pesticides	Interviews (KII, IDI and FGD), participant observation, field notes	Farmers, key informants, community leaders, traditional leaders

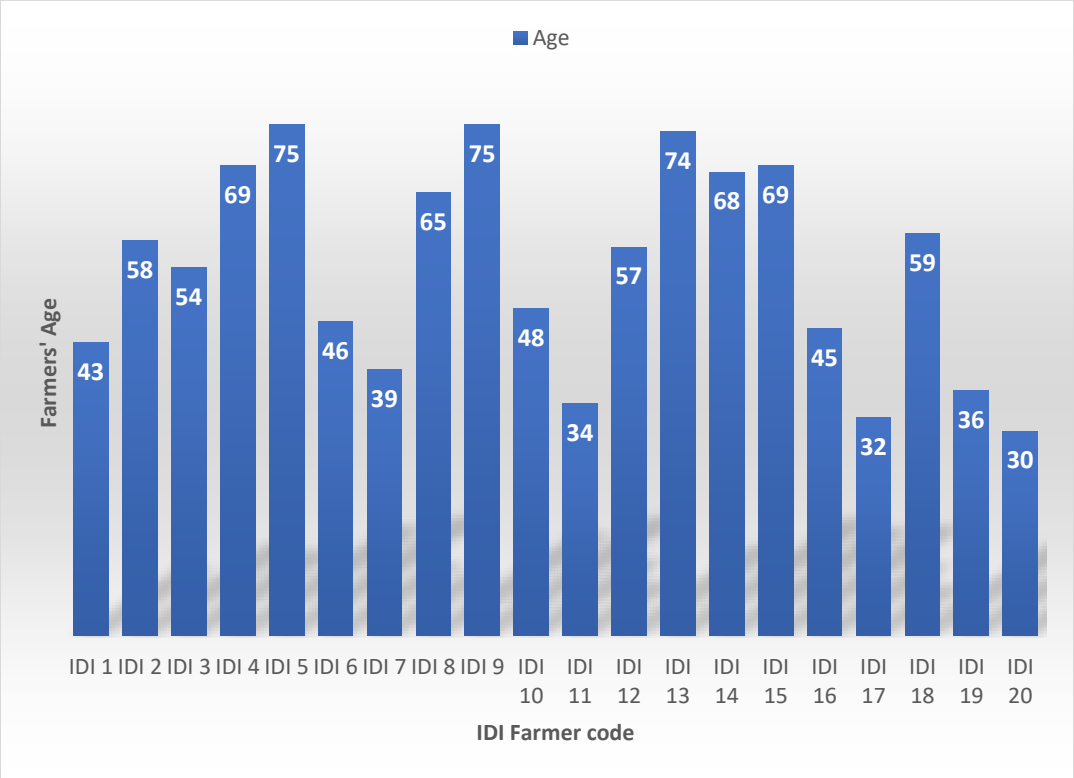
CHAPTER FOUR. PRESENTATION OF RESULTS AND FINDINGS

4.1 Introduction

In this chapter, findings to the main question ‘‘factors influencing the decision-making processes of small holder crop farmers of Ajumador, with regards to pesticide use’’ in the Ningo-Prampram district of the greater Accra region of Ghana are presented. The data from the study were structured according to the research question using the sub questions as a guide. The results are based on findings from semi-structured IDI, FGD, KII and field observations. **Section 4.2** looks at the demography of respondents (IDI), and the involvement of male and female farmers in pesticides decision making. **section 4.3,** the sources of information regarding pesticides use available to smallholder crop farmers of Ajumador. **section 4.4,** considers the challenges (problems) faced by these smallholder crop farmers regarding pesticides label information, **section 4.5**, the economic considerations made by the farmers before using pesticides, **section 4.6,** the indigenous cultural farming practices used by them to manage pest other that synthetic chemical pesticides and **section 4.7,** the perceptions, believes, opinion and how they regarded and understood pesticides.

4.2 Demographic profile of respondents.

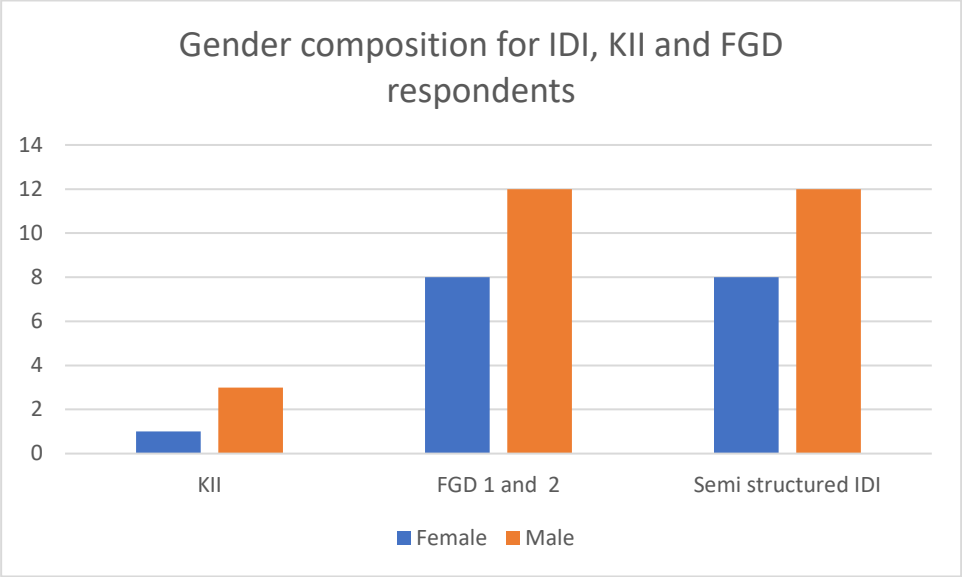
Figure 6:Demography of IDI respondents and their ages



Source: fieldwork 2020

The profile (Figure. 6) shows that, the average age of the respondents is fifty-four (54) years, the oldest being seventy-five (75) years and the youngest thirty (30).

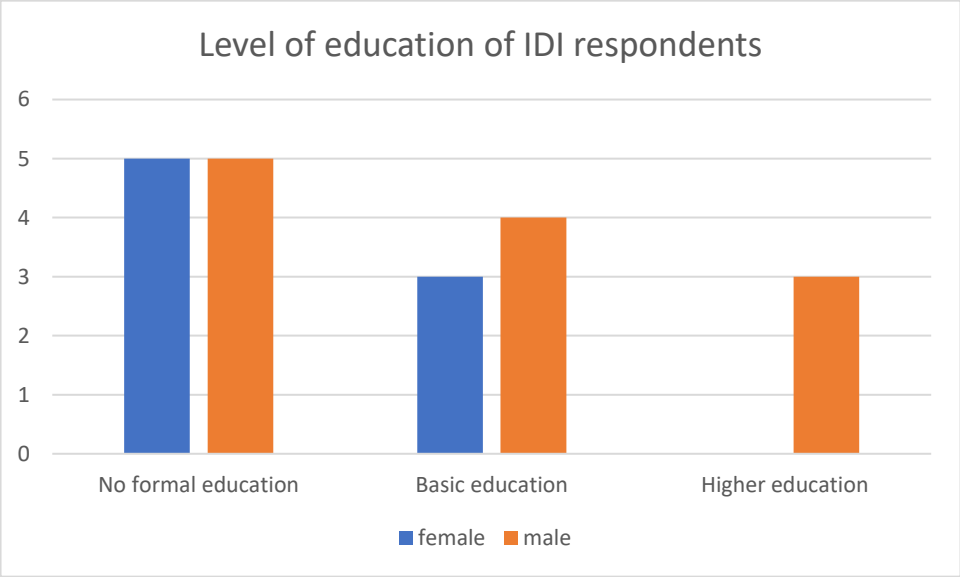
Figure 7 Gender composition of respondents (IDI, KII and FGD)



Source: field work 2020

Based KII, FGD and IDI respondents, (figure 7), profile of respondents shows a fair representation of women in the study, for KII (1 female, 3 males), FGD 1 (4 female and 6male), FGD 2 (4 female and 6maleS) and IDI (8 female, 12 male).

Figure 8: Level of education of IDI respondents



Source: field work 2020

The profile (figure 8) also shows that, ten (10) respondents, (5 females and 5 males), representing 50% of IDI respondents have had no formal education. Seven (7) others, made up of 3 females and 4 males representing (35%) have had basic education. Three (3) respondents, all males (15%) have had higher education.

4.2.1 The Involvement of male and female farmers (gender) in pesticides decision making in Ajumador

The study found out that, both male and female farmers alike were involved in decision-making regarding pesticides and its use. It was also found that women who were heads of their homes took independent decisions regarding pesticides use, same way as men. On the other hand, women who were married and staying with their husbands (also farmers), worked on the farm but were not involved in decision making regarding pesticides use. Their husbands were the decision makers. All eight female respondents for IDI were the heads of their households.

[….] *You either interview my husband or leave me in peace. I work with my husband on the farm, but I do not make decisions on what pesticides is to be bought, when to buy it or how to use it* [……] IDI.

The above statement was made in similar ways by eight women who earlier accepted to be part of the study. A search for married women farmers staying with their husbands (also farmers) who made pesticides decisions proved futile. During FGD 1, all four women who were in cooperative were all found to be married and staying with their husbands, they were the decision makers regarding pesticides as their husbands were not farmers but involved in other businesses. These women therefore were the owners of the farm enterprise and made pesticides decisions.

4.3 Sub-question 1: Assessing the sources of information regarding pesticides use available to smallholder crop farmers of Ajumador.

The above sub-question was answered by exploring: **(i)** the various sources where farmers in Ajumador community got information on pesticides which guides their decisions on pesticides use and practices. **(Ii)**To have a deeper understanding, the sub-question was further explored by the researcher to understand the challenges farmers in the community go through to access pesticides information. The challenges associated with the sources of information on pesticides as well as what farmers would have preferred to be their sources of information regarding pesticide was also explored. **(iii)** The dynamics between how farmers in group and individual farmers accessed and utilized information concerning pesticides were also explored.

(I) Three (3) sources of information were identified in this study as where farmers in the community got information on pesticides, these included: The local pesticides vendor/retailer, the local government Agricultural Extension Agents (AEA) and farmers own colleagues including those in groups. All the twenty respondents from the semi-structured IDI as well as participants in the two focus group discussions, confirmed they have accessed information from all the three sources at one point in time or the other.

(ii) Further probing and exploration of the sub-question revealed that, local pesticides vendors/retailers as a source of information was the easiest to access and the most accessed, usually serving as the first point of call when farmers in the community needed pesticides information. This was confirmed by ten (10) respondents, (4females and 6 males) representing 50% of all those involved in semi-structured IDI and was confirmed in all two focus group discussions.

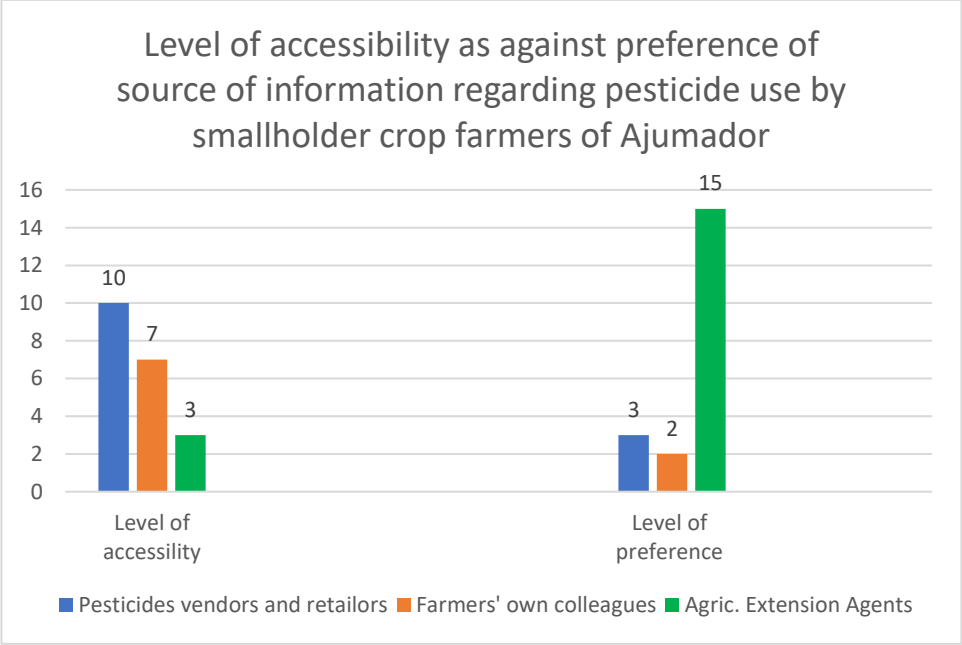
> […..] *Their shops are always open to us and you are sure to find someone in the shop (the owner, assistant or a relative) to talk to when we needed some information concerning pesticides* [….] IDI 3, IDI 18 and FGD 1 and 2.

The local pesticides vendors/retailers as a source of information regarding pesticides use was again described by the farmers as one that they preferred less as most of their information were not consistent and were not specific in their recommendation compared to the government agricultural extension agents. This was made evident during the focus group discussion involving the farmers who are not in a group and was confirmed by fifteen (15) respondents (5 females and 10 males), representing (75%) of those involved in the semi-structured IDI.

[…..] They are doing genuine business, we need their services and they also need us to buy their products, but most often, the information they give us are not consistent, it is almost as if they are playing try and error game with us. They are never specific, they give too many options and at times, they tell you that, one product plays versatile roles and could treat multiple conditions, this gets us confused, and decision making becomes very difficult. If what they give you today does not work to your satisfaction, they recommend other ones to you on your next visit, with assurances that, it was going to work this time round. In the end, we are the ones almost always disappointed. Some of them are sincere, when we send our infected crops to them for diagnosis and recommendation, they tell you they do not know what product could solve the problem […]. IDI 8, 1DI 18 and FGD 2

The farmers reiterated that, though the pesticides vendors/retailers are easy to access and usually the first point of call for information, they would prefer to have their farms inspected by AEAs (whom they described as relatively knowledgeable due to their training compared to the retailers), to help identify the exact pest causing the problems to their crops and a specific recommendation made, based on which they could go to the pesticides vendor/retailers to only buy the specific recommended pesticides, rather than sending their infected crop specimen to the vendor for diagnosis and recommendations from them and at the same time buy pesticides from them.

Figure 9: Level of accessibility as against preference of sources information regarding pesticides use of smallholder crop farmers of Ajumador



Source: Fieldwork 2020

Fifteen (15) out of the twenty (20) farmers (5 females and 10 males) for semi-structured IDI (figure 9) agreed and confirmed that, the local government AEAs posted to the community in the past and present (as a source of information) were more precise in their pesticides recommendations, they supported them well to make good decisions on pesticides use, helped them to cut down on pesticides expenditure and got value for their money from crops produced compared to retailors and colleague farmers.

[….] *it took the intervention of an AEA to detect that an insecticide was mistakenly recommended to me instead of fungicide by a pesticides retailer, by that time, most of my crops had gone bad and cost already incurred* […..] IDI 14

They however described the local government AEA (a source of information) as the most difficult to access and a farmer could lose his or her crop investment if they depended only on them.

> [….] *It is very difficult to get them on my farm at the time I want them most. Sometimes when I call, thy tells me they are in another community, on someone else farm and it becomes very difficult for me to wait,* ***…….*** *As a group, we do not get their services on our farms as often as we would have wanted, however, when we arrange with them earlier, our farms are visited, crops are inspected and necessary recommendations are given. Some of them tells us sincerely when they are not sure of what is causing the pest problem and for that matter the solution. This tells us that, they also do not know everything. On several occasions, they come along with other people who appear to be more knowledgeable than them to our meetings and they also educate us, this supports us as a group very well [….] IDI 7, IDI 9 and FGD 2.*

The level of accessibility as against preference of the three sources are presented in figure six (6) above.

(iii) Decision making regarding pesticides use by farmers in group compared to individual farmers in Ajumador

From the two focus group discussions conducted, the decision-making process of farmers in group (cooperative, the only farmers' group in the entire community) how they accessed and utilised information concerning pesticides was found to be quite different from the way individual farmers made their own decisions concerning pesticides use. This became evident when the researcher sought to find out how being in a farmers' group or otherwise was important to them and how it supported them in their decision-making concerning pesticides use.

From the cooperative (farmers in group) perspective, farmers relied on the vast human and social capital within the group to make significant decisions to their advantage compared to the way individual farmers made their decisions as follows.

- **Synchronization of farming activities and farmers checking each other occurred in farmers group but not among individual farmers**

> [….] *For us in this group, we grow similar crops*, *most of our activities are therefore synchronised, example sowing of maize. At the beginning of the farming season, we pay our dues. our leaders sometimes arrange with the pesticide vendors, they buy all the pesticides we need for the season in bulk at a relatively cheaper price and the cost is shared among us. Pesticides application to our crops, often takes place relatively at the same time. We check each other to ensure that, everyone is on track and no one is left behind or do something too differently. We also have a common incinerator that we use to incinerate empty pesticides containers at the same time [….] FGD1*

- **Shared learning and spreading of experience among group members**

Shared learning and spreading of experience concerning pesticides were found to be common among members of farmers in group (cooperative), this was either lacking or not well coordinated among individual farmers.

> […] *We as group members also have lots of challenges when making decisions on how to manage pests on our farms due to emergence of new pests that shows up from time to time (citing fall armyworm in maize as an example). Periodically we receive some training from the AEA and the other officials that come along with them, but it is so easy to forget what you are taught due to the technicalities involved. Some of our members however, always get it right (especially the educated ones among us) at the time of training as well as during field application and this knowledge and experience stays in the group to benefit us all as we learn from them [….] FGD1*

- **Farmers in groups attracted interventions (in the form of farming inputs as well as pesticides training) from external stakeholders better than individual farmers**

One of the biggest challenges raised by a key informant (an official from greater Accra regional office of PPRSD) concerning the challenges they face communicating with smallholder crop farmers was the fact that, they were many and scattered all over the region. It is therefore very difficult for them to target these farmers individually with interventions in the form of pesticides training, to support them make the best of pesticides decisions as compared to those in group.

> [….] *It is easy for us as regional coordinators at PPRSD to target farmers in group with their training needs compared to individual farmers. At one training section with farmers in group, many of them are reached and that also supports our monitoring process of how farmers are progressing. We prefer dealing with organised crop farmers compared to individuals* [….] KII 2

Suppliers and traders of farm inputs including pesticides, preferred dealing with farmers in groups, compared to individual farmers.

> […] *Dealers of farm inputs (pesticides inclusive) most of the time approach us with good offers. Sometimes, they give us input on credit and we pay the cost at the end of the farming season when we market our farm produce. This helps us to make decision concerning our pesticides needs in advance* [….] FGD1

- **Individual farmers**

During the focus group discussion with farmers who do not belong to any group, the researcher sought to find out why they do not belong to any farmers group. They described farmers group as having too many bureaucratic procedures. The motivating factor for this category of farmers for not belonging to any group was that, they wanted to be independent in all their decisions concerning their farming activities as well as decisions regarding pesticides use

> […..] *There are too many bureaucratic procedures to follow for being a member of the farmers' cooperative. We prefer to take our own independent decisions and act on them swiftly and promptly when it comes to pest management, we cannot afford to lose our investment. Also, to be a member of the farmers' cooperative, you are required sometimes, to sell your farm produces to specific buyers agreed upon by the group, but we also have our own buyers* […….] FGD 2

4.4 Sub-question 2: Assessing the challenges (problems) smallholder crop farmers in Ajumador face with regards to pesticides label information

The researcher answered the above sub-question by finding out from farmers, what they considered as challenges (problems) facing them with regards to pesticides label information. The researcher also explored how these challenges has affected their decision-making, and the effects of the decisions made with regarding pesticides use and practices on their farms. Adapted strategies used by these farmers regarding the challenges were also explored.

From the responses received from interviews (IDI, FGD and KII) conducted during field work, the causal diagram was used by the researcher to understand the challenges faced by the farmers by tracing the underlining causes of the identified problems and what these problems has resulted into, as presented in (figure 10) below.

It was identified in this study that, smallholder crop farmers in Ajumador, generally, poorly understood pesticides label information and subsequently applied it so on their crop farms, resulting to some degrees of unsafe pesticides use and practices. From the semi-structured IDI conducted, the respondents (farmers) could be categorised into three, based on their level of education and ability to read; the categories include

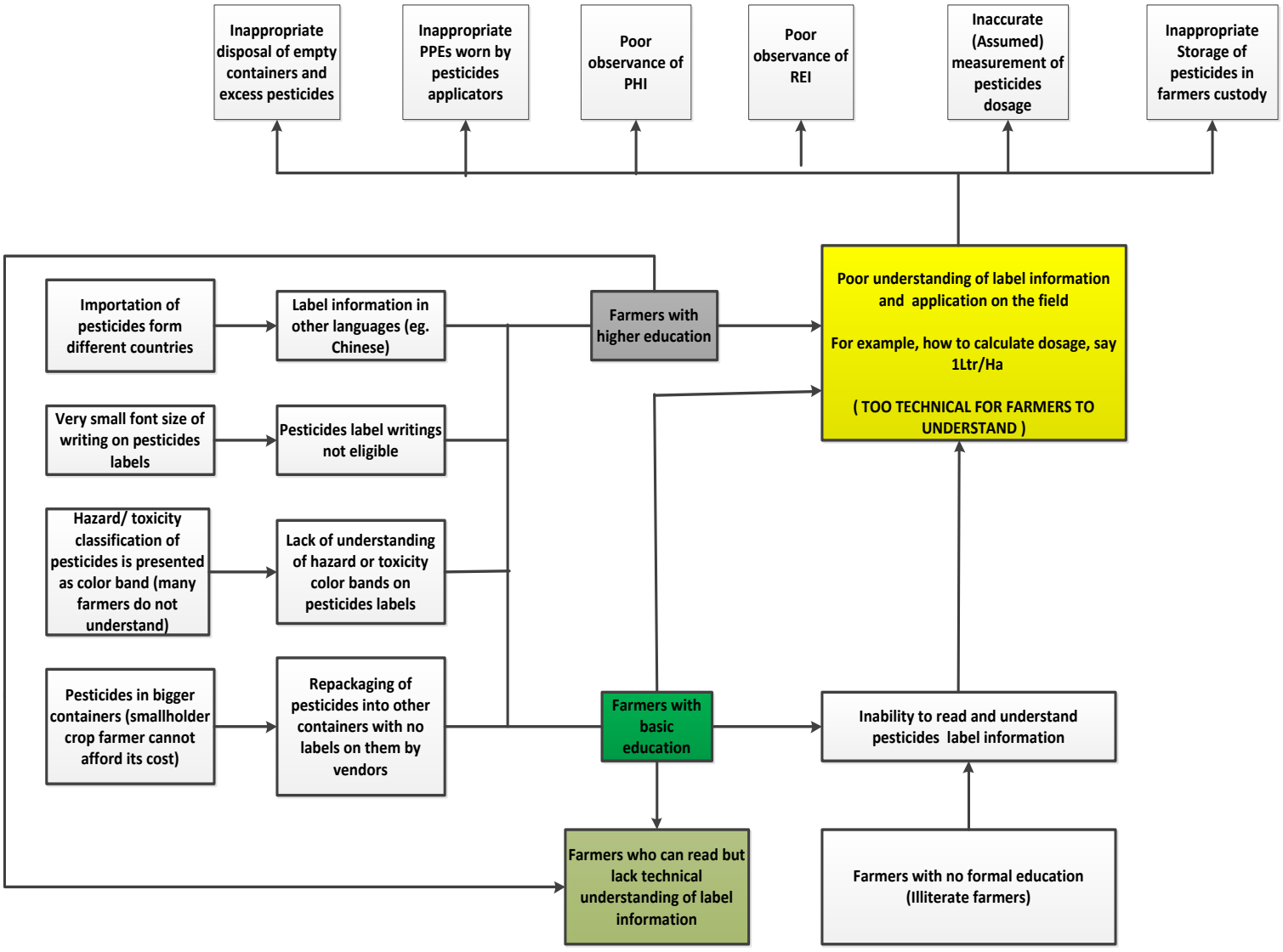
those farmers with no formal education (10), those with basic (elementary) education (7) and those with higher education (3).

Ten (10) out of the twenty (20) semi-structured IDI respondents (5 females and 5 males), representing 50% were found to have had no formal education and therefore could not read label information on pesticides.

> [….] *I have never been to school before, my major problem is that I cannot read anything written on the pesticide's labels* [….] IDI 2, IDI 8

Five out of the seven respondents who have had only basic education in the semi-structure IDI confirmed they could not read pesticides label information while the remaining two claim they could read and understand the label information. This therefore brings to a total of fifteen (15) respondents out of the twenty IDI respondents who could not read to understand label information to be able to make safe and sound decisions regarding pesticides use based on the label information.

Figure 10:Causal diagram of challenges (problems) smallholder crop farmers in Ajumador face with regards to pesticides label information, resulting in unsafe pesticides use and practices



source: Author, fieldwork 2020

Three (3) farmers with higher education in addition to two (2) other farmers with basic education (all of whom could read) confirmed they lacked technical understanding of label information. They also emphasized the fact that, most pesticides label information are written in a language which they cannot read at all, not alone to talk of understanding it (e.g. Chinese). They also stressed the point that, writings on pesticides labels were too small (smaller fonts size) making it ineligible to read. They again mentioned that some pesticides vendors and retailors re-packaged pesticides into smaller containers because the original containers are large, and farmers cannot afford the cost of it. This was confirmed by the pesticides vendor who served as key informant. The problem here is that these vendors and retailers do not label these re-packaged pesticides, making it very difficult to know the exact information that is on the original container to guide their decision making. Farmers lamented, even when vendors wrote some information on the containers of re-packaged pesticides, it fell short of details and some vital information were lost.

All the twenty respondents in IDI indicated total lack of knowledge and understanding of what the toxicological colour bands (level of toxicity colour code, refer to annex 2) meant on the pesticide labels. This was confirmed by the key informant from PPRSD who stated that:

[…] most of the farmers I have interacted with saw these colour bands as designs and not an indicator of warning or caution […] KII 2

All the above challenges put together, exposed some degrees of unsafe pesticides use and practices among the farmers in Ajumador community, as presented below:

- **Inappropriate disposal of empty pesticides containers and excess pesticides**

Farmers who were in cooperative (group) indicated they had a group pesticides incinerator, which they used to burn empty pesticides containers. Observations during field visit while conducting IDI revealed some unsafe practices regarding disposal of empty pesticides containers as could be seen in figure eight (11) below. It was also observed that, empty pesticides containers were found to be used for other purposes. For instance, a Fulani (a cattle herder) was found using an empty pesticides container as water bottle, oblivious of the health implications (figure 11). According to the research assistant, the Fulani herder claimed the bottle has been washed thoroughly by him and that he is not the only herder who uses such containers, other herders do as well.

Figure 11:Unsafe disposal of empty pesticides containers and a Fulani herder using pesticides container as water bottle

Source: 2020 field work

- **Inappropriate PPEs worn by pesticide applicators**

While conducting semi-structured IDI on farmers' fields, it was observed that, four (4) farmers who were applying pesticides at the time scheduled for the interview, did not wear appropriate personal protective equipment (figure 12) such as wellington boots, goggles, full face respirator, a coverall clothing or gloves, while spraying pesticides, exposing themselves to the full danger of the pesticides. They complained of heat stress any time they wear the PPEs, especially, wearing a coverall dress and wellington boot at the same time was uncomfortable for them while working. Eight (8) farmers also from IDI however indicated they are concerned about their health and therefore wear trousers, wellington boots, a long sleeve dress and a hat whenever they are spraying pesticides.

Figure 12:Farmers spraying (applying) pesticides without appropriate PPEs

Source: field work 2020

- **Poor observance of pre-harvest interval (PHI)**

During FGD 1 and 2, farmers mentioned and agreed that, they do their best to stop pesticides application when their crops starts fruiting, adding that they also eat from those same crops produced and wish they were not using pesticides at all to produces crops.

Eight (8) out of the twenty (20) IDI respondents (2 females and 4 males) who were into the production of okra and other crops however, indicated they did not fully observed PHI recommendations, giving reasons why they do not, particularly with reference to okra. This was also confirmed in all the two focused group discussion.

> [.....] *We have been informed that; most pesticides have seven to twenty-one days withdrawal period……. When okra plants start fruiting, harvested is done in the interval of every three days, in that case, I stop pesticides application when the okra plants start fruiting and there are no pests on*

them. However, I cannot watch my crops go bad, I have calendar days of spraying, I apply pesticides at the fruiting stage so long as the pests are on the crops. […..] IDI 10, IDI 18

- **Poor observance of re-entry interval**

During semi-structured IDI and all the two FGDs, it was observed that, most farmers had mix-shaped structures serving as farmhouses and resting points on their farms. Most farmers after spraying (applying) pesticides, continued to stay and do other activities on the farm they have just finished spraying with pesticides. women cooked and eat with their husbands and workers, had rest on their farms before leaving for their homes in the evening, not paying attention to re-entry requirements which demanded the farmer to leave the sprayed farm for at least 24 hours.

- **Inaccurate (assumed) measurement of pesticide dosage**

According to KII 4, a major challenge (problem) that smallholder crop farmers face with pesticides label information is how to translate dosage recommendation quoted on pesticides labels to suit their own local condition and be able to get it right. Farmers lamented it was a big challenge to them, considering the exact quantity (dosage) of pesticides to use per the knapsack sprayers used by them to apply most of their pesticides. This is because, pesticides dosages are quoted or expressed in litres, millilitres, grams and kilograms per hector. They prefer to have the dosage quoted in a quantity per the type of spraying machines used by them (the knapsack sprayer). This problem was expressed by farmers in all two FGDs and most IDI respondents. All the four key informants for this study also confirmed that, most farmers have challenges calculating the exact quantity, when it comes to pesticides dosage measurement.

Inappropriate storage of pesticides in the custody of farmers

From the IDI and the two FGDs conducted, farmers had various ways of storing the pesticides in their custody. Farmers who were in the group (cooperative) did not have a common place of storing pesticides. Individual members stored their own pesticides in their own way. Seven (7) out of the twenty farmers from IDI stored pesticides in their custody at home (in their kitchen, behind their traditional outdoor bathroom, and others hanged them at corners of the house, out of reach of children). On the other hand, and in consideration of the fact that pesticides could pose danger to humans, five (5) farmers from IDI said, they only buy the quantity of pesticides needed at a time and therefore do not store. Six (6) other farmers said, they stored their pesticides on the farm in boxes with key and lock, and two (2) farmers also stored theirs under trees on the farm and never brought it home.

The above information does not only answer the qestio

Strategies used by farmers to address the challenges relating to pesticides label information

Researcher sought to find out how they are coping and managing with the challenges:

Farmers have adopted some strategies to help them in one way or the other, to address the challenges facing them concerning pesticide label information. Farmers depended on the advice given to them by pesticides vendors and retailers, local agricultural extension agents and fellow farmers to address their challenges with label information. Farmers in group (cooperative) heavily depended on each other to understand label information to guide their decisions. With regards to pesticides dosage, five (5) farmers (all males) from IDI indicated they observe the effectiveness of a quantity of pesticides used at one point in time to decides their next action.

[….] *If I use a certain quantity of weedicides per knapsack today, I watch how effective it is able to control the weeds, based on that, I then decide to increase or maintain the same quantity next time […..] IDI 13*

[….] it is as if the insect pests get stronger by the day as we spray them with pesticides. Most often, I will either increase the quantity of pesticides (dosage) I previously used or mix more than one pesticide to get the desired result [….] IDI 16.

To be able to know what pest and crops a particular pesticides is to be used for, six (6) farmers from the IDI (4 males and 2 females) indicated they look at pictures and drawings of the pest and crops provided on the label to give them an indication of what the pesticides is used for. To address the issue of pre-harvest interval, twelve (12) out of the twenty respondents from IDI (4 females and 8 male) indicated, they stop using pesticides immediately the crops starts fruiting. This was however contrary to what eight (8) others (3 females and 5 males) farmers said, they indicated that, they could not watch their crops go bad because of pests, and therefore continued spraying of pesticides on crops at fruiting stage, as long as there were pests on them (these were mainly farmers growing okra).

4.5 Sub-question 3: assessing the economic considerations farmers in the study area make before using pesticides

To answer the above sub-question, the researcher sought to find out the economic considerations that smallholder crop farmers in the study area made before using pesticides. **(i)** The pest population levels on crops (ETL/EIL) at the time farmers initiate management control using pesticides was explored to determine the level of economic justification of pest management of the farmers. **(Ii)** The researcher also explored to know whether the objective of the smallholder famer to grow crop for sale influenced their decisions concerning pesticides use differently form the same smallholder farmer, who grow crops purposely to feed his or her family. **(Iii)**The extent to which the cost of pesticides and the cost of pest management influenced their decisions concerning pesticides use was also explored.

(i) The ETL/EIL of pest management

Findings from this study shows that, farmers in the study area do not observe ETL/EIL of pest when making decisions regarding pest management involving pesticides (refer to annex 2). This was made evident, when they were asked to describe what informed them to initiate pest management considering pest population levels on their crop. The study further found out that, while farmers lacked knowledge and understanding of the concept of ETL/EIL, there were no local standards to guides the farmers to determine the economic thresholds at which specific pests are to be controlled in specific crops. To avoid crop damage and losses to pests, farmers used prophylactic means of pest management and therefore armed themselves with pesticides in advance, just before or immediately after sowing their crops as recommended by pesticide retailers.

This was confirmed in all the two FGDs and was also confirmed by fifteen (15) semi-structured IDI respondents, (4 females and 11 males) citing maize and fall army worm attack as an example in recent times.

[….] One cannot wait for the fall worms to start attacking the maize crops before commencing management, we will lose the fight to the worms and moreover, we do not have any criteria to determine the point at which we need to start managing these pest to make economic sense. We therefore spray the maize crops with pesticides just after emergence and every fourteen (14) to twenty-one (21) days until cobs are fully formed and seeds also set […] FGD 2, IDI 5, IDI 14.

A farmer with identification code number IDI 4, who also grows cowpea shared similar scenario.

[….] I grow cowpea every year. The experience I have is that, I do not have to wait for the insects to start attacking the cowpea plants before I start to manage them, this is because, once the insects

(pests) establishes on the cowpea crop, they multiply very fast making management and control very difficult. I therefore spray insecticides fortnightly until cowpea pods are fully set and seeds fully formed in them [….] IDI 4

In the same way, eleven (11) farmers (3 females and 8 males) from IDI indicated that, for crops such as cabbage, tomato, pepper and garden eggs which are prone to nematode and fungi attack, farmers applied nematicides and fungicides on nursery beds where seedlings are raised even before they are sent to the field for transplanting.

For crops such as watermelon and cucumber which are planted in-situ, farmers applied nematicides at the same time when seeds were being sown before treating them with insecticides and fungicides later again in the field, after germination and when plants are fully established.

(ii) The objective of the smallholder crop farmer for growing crops

The objective of smallholder farmers in the study area for growing crops is first and foremost, to feed their household and then also sell for income. Their objective for growing crops, whether to feed their household or sell for income did not influence pesticides decision and use differently from each other. How they treated crops meant for home consumption was the same way they treated crops meant for sale, however, farmers extended pesticides application on crops until harvesting coincides with local market day. This was made evident during FGD and semi-structured IDI.

From the two focus group discussions conducted as well as the semi-structed IDI, farmers indicted that, the crops grown by them to feed their families are the same crops that they usually send to the market for sale whether it was grown from their backyard or distant fields. Decisions concerning pesticides and its use in both situations are the same. During FGD with individual farmers, it was indicated and confirmed by all the respondents as stated below:

[….] *we grow our crops first and foremost to feed ourselves and also sell some for income. There are no differences in the way we treated the crops meant for sale or the ones we use to feed ourselves with regards to pesticides [….] FGD2.*

The above statement was not different from what was said by respondents in FGD1.

Six (6) respondents (3 females and 3 males) from semi-structured IDI however, indicated, they extend pesticide application to their crops until they are ready for the market. A farmer wit identification code number IDI 11 who grows cabbage and garden eggs said that:

[….] *I have my own customers who buy my produce. They complain when they find out that my cabbages are not whole with signs suggesting insect damage. They refuse to buy and if I do not get anyone else to buy, I will not break even. If my garden eggs get punctured by insects, my customers either refuse to buy or pay very low price for my crops. I therefore try as much as possible to protect my crops (meant for sale) with insecticides until about 3-7 days when they will be ready for the next market day (the other farmers and myself, usually harvest our crops to coincide with local market days) and am sure they will not be damaged by pest* [….] IDI 11

Similar comments were made by five other farmers who also grow cucumber, cabbage and garden eggs with identification code number IDI 5, IDI 7, IDI 13, IDI 16 and IDI 17.

(iii) Cost of pesticides and pest management

Findings from this study shows that, cost (i.e. the cost at which a pesticide is bought, and the cost incurred in applying pesticides to manage pest in crops) is an important economic consideration smallholder crop farmer in the study area made before using pesticides. It was found that, in the case where farmers has to use pesticides because there is a pest situation but the cost of pesticides and its application to crops was higher than what they could afford, they use less expensive pesticides to manage the pest situation or desist completely from the use of pesticides due to cost and accept whatever yield accrued to them in such situations.

> [….] *pesticides are very expensive. When we realise the need to apply pesticides, we compare the cost of the pesticides, the amount to be spent on labour to apply it, in most cases, we go in for less expensive pesticides* […] FGD 2

Farmer in FGD 1 also agreed and confirmed the above statement.

In the decision-making process of farmers regarding the cost of pesticides, some farmers treated some crops better than others based on their value.

> [….] *I grow maize and watermelon very often. Sometimes, I do not have enough money on me to buy pesticides to cover both crops because they are expensive, I therefore buy only for the watermelon because am sure some few heads of melon will give me more money than a whole plot of maize, in that case, whatever I get from the maize, I accept it like that* [….] IDI 3

A pesticides vendor, who also served as a key informant confirmed that, farmers usually want less expensive pesticides which are also effective in managing the pest situations in their crops.

> […..] *When farmers come to my shop to buy pesticides, they first of all, want to know how much it will cost them for the pesticide in question. When they are told, they further enquire if there are other less expensive but effective ones that could solve the pest problem on their farm. Most of them go away without buying if they do not have enough money* […] KII 3

A key informant from PPRSD described farmers as ''rational'' when it comes to the cost of pesticides, this was agreed up on and confirmed by the researcher at the University of Ghana who also served as key informant.

> [….] *smallholder crop armers are rational when it comes to the cost of pesticides. My interaction with farmers over the years shows that, they weigh cost as against gains, they will always go for relatively cheaper pesticides that can treat their pest problems. They know that pesticides are very important in the production of their crops but are constrained with lack of funds* ….] KII 2.

4.6 Sub-question 4: Assessing local (indigenous) cultural farming practices used by smallholder crop farmers in Ajumador to manage pest other chemical pesticides, which they consider environmentally friendly.

To answer the above sub-question, the researcher focused on and asked farmers about other methods of pest control strategies used by them to manage pest other than chemical pesticides and which is also considered environmentally friendly.

Findings from this study during FGD 1 and 2, KII and semi-structured IDI, revealed a number of local (indigenous) cultural farming practices used by smallholder crop farmers of Ajumador to manage pest other than chemical pesticides. The practices found in this study are characterised by the following and represented in table three (3) below.

- ❖ Practices that were attached and firmly rooted in the believes of respondents (and for that matter members of the community)
- ❖ Practices that were common among respondents (farmers) who were above the age of sixty (60+)
- ❖ Practices that were common among all ages of respondents (farmers)

It is worth mentioning at this point that, findings regarding the local practices used to manage pest by the farmers did not necessarily mean that, farmers who adopted them did not use chemical pesticides, for instance, throughout a particular cropping season. However, they were found to reduce the use of chemical pesticides on the part of the farmers. Some of the practices were found to expose pests to hash natural conditions such that, they could not survive, for example, ploughing and harrowing exposed harmful soil pathogens and weed seeds to the sun for destruction. Timely planting enabled the farmers to escape the period at which certain pest multiplied, by which time farmers had already harvested their produce.

Table 3: Summary of local (indigenous) practices, that is other options of pest management other than chemical pesticides used by smallholder crop farmers of Ajumador

DIMENSION	SPECIFIC PRACTICES
Practice(s) that are attached and firmly rooted in the believes of respondents (and for that matter members of the community)	Pacification of the gods through pouring out of libation and sacrifices (land cleansing) to usher in the farming season.
Practices that were common among respondents (farmers) who were above the age of sixty (60+)	Mixed cropping, land fallowing, use of neem extracts and other locally made herbal based biopesticides (of which some were used as decoys). Involved in the pacification and sacrifice process which also required them to strictly observe taboo days,
Practices that were common among all ages of respondents (farmers)	Good land preparation e.g. ploughing and harrowing, timely planting, clean farm sanitation and crop rotation.

Source: field work 2020

Practices attached and firmly rooted in the believes of respondents (and for that matter members of the community)

- Pacification of the gods through pouring of libation (a form of traditional prayers) and sacrifices (land cleansing) to usher in the farming season

Farmers in Ajumador community are predominantly members of the Ga-Dangme tribe of the greater Accra region of Ghana. Members of the Ga-Dangme tribe celebrates the ‘‘Homowo festival’’. Homowo literally means ‘‘hooting or jeering at hunger’’ and is celebrated every year amidst dancing and jubilations to usher in the farming season and to pave the way for the sowing of corn and other crops. Members of the Ningo-Prampram traditional area including Ajumador also celebrates the festival.

According to KII 1 (a traditionalist, a farmer and a leader in a farmers group), it is the practice of the community (based on their beliefs) to participate in the celebration of the Homowo festival at the beginning of the farming season and climaxed during the harvesting period. They believe that, for any farming season of the year to have good rainfall, without pest and disease incidence affecting their crops, there is the need to celebrate the occasion for traditional leaders and priests to pour out libation and make sacrifices to the gods of the land (deities) to appease them (figure 13 below). He reiterated that, if these are not done (and properly according to custom), that year's farming seasons will be characterised by poor rainfall, outbreak of pest and diseases to affect their crops and subsequently lead to poor harvest.

Figure 13:traditional priests and priestess performing sacred rituals with the symbolic hoe (a traditional farming tool) during a Homowo festival

Source: https://en.wikipedia.org/wiki/Homowo

This was confirmed during the semi-structured IDI, where all respondents above the age sixty, except IDI 4 indicated their full involvement in this practice.

> *[…] This is the legacy we inherited from our predecessors, we do it every year to make every farming season a success. Every year, the traditional priesthood performs this to make the fields and the agroecological environment conducive for crop production with abundance of rain, less pest and disease incidence.* [….] IDI 5.

Similar comments as indicated above were also made by respondents with codes IDI 8 and IDI 13.

During the two FGDs, respondents in the age bracket of 30-50 but blow sixty, indicated they knew about the practice, it was agreed by all that, though they participated the festivities, they were not involved in the sacrifices and the pacification process.

> [….] *We usually participate in the festival, as for the sacrifices and the pacification processes, we do not involve ourselves in that* [….] FGD 1 and 2.

Practices that were common among respondents (farmers) who were above the age of sixty (60+) Findings from this study also shows that, some of the indigenous cultural farming practices were more common among older farmers (respondents above 60 years). As already indicated, the process of sacrifice, pacification of the gods during the festive occasion was commonly among the older farmers (respondents). Mixed cropping, land fallowing, the use of neem extract and other locally made herbal based biopesticides (of which some served as decoys) were commonly practiced among older farmers who were above 60 years. During FGD 1 and 2, the researcher asked why farmer below sixty years were not involved in the above-mentioned local practices of pest management common among the older farmers.

It came to light that, **mixed cropping (**figure 14**),** where two or more crops are grown together on the same piece of land at the same time, required a lot of patience in arranging the various crops on the same piece of land, it was laborious and time consuming and normally carried out on very small plots. This made it unattractive to farmers who were below sixty years.

Figure 14:a plot of land with maize, pepper, okra and tomato growing on the same piece of land at the same time (mixed cropping)

Source: field work 2020

It also came to light that, **land fallowing** as a measure of pest management, meant that, a farmer has to leave his or her old plot of land for a certain period of time without growing crops on them but possibly go in for a new plot, this was considered very expensive for relatively younger farmers and women who had limited access to land.

> […] *We cannot afford to leave our old fields to lie fallow, it is expensive acquiring new plots. Most of the older farmers have larger plots of lands to themselves especially the men, they can afford to fallow part of their lands but not us* [….] FGD 1

The above was also confirmed in FGD 2 and by two farmers with code IDI 17 and IDI 20 from semi- structured IDI.

The findings further revealed that, the preparation of **neem extract and other locally made herbal based biopesticides and decoys** was a painstaking activity, very laborious, time consuming and were also not available on the market in large quantities for sale (decoys were either herbal based, fish based or both fish and herbal based; all the elderly farmers who were experienced in the preparation of the decoys refused to share how they prepare it). The study also found out that, the preferences and demands of consumers

influence pesticides decision-making and its use, in that, farmers stated they were willing to explore the use of organic pesticide to produce crops instead of the synthetic ones, if consumers will appreciate and pay a bit more for organic produce or accept crops with a bit of damage on them. Once consumers are not willing to pay a bit more and continue to demand farm produce that are whole, clean with no damage at all them, they will use synthetic pesticides. During semi-structure IDI, farmers with code IDI,7, IDI 17, IDI 19 and IDI 20 (relatively young farmers) indicted they did not know how to prepare these locally made herbal pesticides. They added that, most Ghanaians consumers, are yet to appreciate the difference between crops treated with synthetic pesticides and organic produce or crops that have receive some amount of organic treatment.

> [….] *we prefer to just go ahead and use the synthetic chemical pesticides to grow our crops, though we sometimes stop using these chemical pesticides when crops start fruiting and there is no pest on them. If consumers will appreciate it and we can get extra income from growing organic crops, we may consider the organic pesticides* […] FGD 2.

Common practices among all ages of respondents (farmers)

Good land preparation e.g. ploughing and harrowing, timely planting (to avoid certain crop pest), clean farm sanitation (using hoe and cutlass which are the traditional farming tools), crop rotation was commonly practiced by all respondents irrespective of their age.

4.7 Sub-question 5: Assessing the perceptions of smallholder crop farmers of Ajumador concerning pesticides and their use in crop production.

To answer the above sub-question, the researcher asked farmers and focused on what they believed about pesticides, their opinion, how they regarded and understood pesticides.

Findings shows that, farmers in the study area had both **positive** and **negative** perceptions concerning pesticides and its use. The perceptions of the respondents revolved around issues such as health, the environment, crop protection and beliefs.

As already indicated in sub-question four (other options of pest management other than synthetic chemical pesticides), it is the belief of farmers in the study area (and for that matter, the community) that, appeasing the gods (deities) through sacrifices and pacifications to cleanse the land on yearly basis, provides some form of primary protection for their crops against pest and diseases, making pesticides a secondary means of doing same. This perception, however, did not rule out the use of pesticides by the farmers. Pesticides use was an important practice among the farmers.

Positive perceptions concerning pesticides, common among all respondents (farmers)

During FGD 1 and 2, semi-structured IDI, it was revealed that smallholder crop farmers in Ajumador community perceived pesticides **positively** in two ways: (i) essential farming input and solution to all kinds of pest problems without which crop production will be difficult. They also perceived pesticides (ii) as able to increase crop yield.

(i) Farmers perceived pesticides as essential farming input and a solution to all kinds of pest problems without which crop production will be difficult.

> [….] *some years ago, we used to grow crops without the application of pesticides, our yields were okay. Nowadays, we cannot do that anymore. It is almost impossible to grow any crop without pesticides. pesticides have become part of the essential inputs that we budget for every year. Without pesticides, pests will destroy all our crops and farming will be very difficult* [….] FGD 1.

Similar comments were made during FGD 2 and semi-structured IDI

[….] Pesticides are very necessary once you made up your mind to produce crops. They protect the crops from pests, it will be difficult to produce crops without it [….] IDI 18, IDI 20

(ii) Farmers perceived pesticides as being able to increase crop yield.

[….] *Pesticides help us to get increased yield from our crops when we apply them. Pesticides protect the crops from all kinds of pests. If a farmer fails to protect his crops with pesticides, she or he may not even harvest enough to cater for him or herself and the family* [……] FGD 1 and 2.

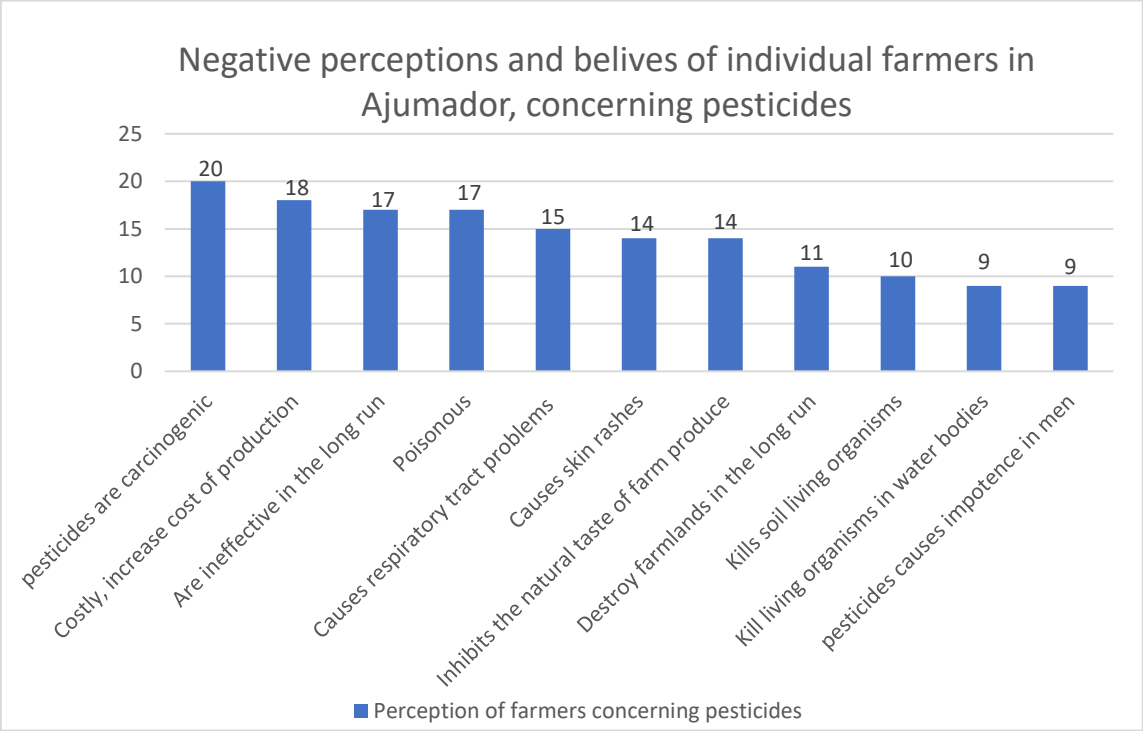
[….] *The year that I do not get enough money to buy enough pesticides to protect my crops, that year, my crops fail to grow well, and the yield is so poor. Pesticides help my crops to grow well with increased yields* [..] IDI 12 and IDI 18

According to KII 4 (a researcher at the university of Ghana, Legon), farmers regard pesticides as very important input and is used extensively by them to protect their crops from pest. He again confirmed that, his interaction with many farmers shows that, any time smallholder crop farmers think of ways to increase crop yield, pesticides are part of the considerations they make. This was also confirmed by KII 2 and KII 3.

Negative perceptions and believes concerning pesticides, common among all respondents (farmers)

The analysis below looks at the individual farmers' negative perceptions and believes concerning pesticides as represented in figure 15 below during semi-structured IDI.

Figure 15:summary of negative perceptions of individual farmers in Ajumador concerning pesticides during IDI



Source: field work 2020

All the twenty respondents from IDI interview indicated they perceive pesticides as carcinogenic.

Eighteen (18) respondents form IDI made up of ten (10) males and eight (8) females indicated that, they perceived pesticides as very costly and it increases their cost of crop production. As indicated in sub-question

three, (economic considerations farmers make before using pesticides), Key informants with codes KII 2 and KII 4 indicated that, farmers always count the cost of pesticide as against gains.

A farmer wit identification code IDI 18 stated:

> [….] *Pesticides help my crops to grow well even though they are very costly and makes cost of production go up. We have no choice, that is what we are faced with now* [….] IDI 18

Seventeen respondents (10 males and 7 females) also indicated that, when a pesticide is used over a period, it becomes infective against those same pests it has controlled in the past, five farmers indicated that as one of the reasons why they do land fallowing

> […..] *Different pesticides are often sold to me by the retailers at different times, when I complain they are no longer effective, they always have alternative, they say it does the same work. As for me, I think they are all the same, it may work today, but not tomorrow, I use higher quantity to get some result* [….] IDI 6

Again, seventeen (17) respondents, comprising eight (8) females and nine (9) male said, they regarded pesticides as a poisonous substance against living beings including humans. Fifteen (15) respondents, of which eleven (11) were male and four (4) female perceived pesticides cause respiratory tract problems, citing catarrh as an example. Eight of these farmers earlier said they wore protective clothing while applying pesticides.

> […] *any time I apply pesticides to my crops, I have trouble in breathing, and I get catarrh* […] IDI 2, IDI 13

Fourteen (14) respondents made up of ten (10) males and four (4) females have the opinion that, pesticides could cause skin rashes if not handled carefully and it splashes on the skin. Similarly, fourteen (14) respondent comprising all eight (8) female respondents and six (6) males indicated that, they perceive pesticides inhibits the natural taste of farm produce when crops are produced with it.

> […….] *in the olden days, we used to grow crops without pesticides, the taste of food crops was superb. These days, food crops are grown with pesticides and are no longer tasty as before* [….] IDI 5, IDI 15

The above perception on taste of food crops was also strongly emphasized and agreed upon by respondents in FGD 1 and 2 respondents. Eleven (11) respondents (7 males and 4 females) indicated they perceive pesticides destroy farmlands over time. They cited weedicides as an example, that it eradicates certain weeds but favour the strong growth and invasion of farmlands by other weeds making them difficult to control.

Ten (10) respondents, accounting for eight (8) males and two (2) females said, they perceive pesticides kill soil living organisms, with one of them citing the example below.

> […] *Any time I apply nematicides to the nursery bed and the field before sowing of crop, I see all kinds of soil living organisms dying including earthworm which are not my target* , this makes me no use it all the time […] IDI 13

Nine respondents (all males) also indicated they perceive pesticides kill living organisms in water bodies. In view of that, they do not farm near the only water body (stream) in the community and that it was a rule in the community for no farmer to farm close to water body because of the pesticides they use.

Eight (8) respondents who were all male also indicated they perceive pesticides causes impotence in men.

CHAPTER FIVE. DISCUSSION OF FINDINGS

5.1 Introduction

The findings as underscored in chapter four are analysed to assist the researcher in coming out with necessary conclusions that will guide in achieving the research objective. In section 5.1, the sources of information regarding pesticides use available to smallholder crop farmers of Ajumador will be analysed and discussed. The challenges (problems) faced by these smallholder crop farmers regarding pesticides label information will also be analysed in section 5.2. The economic considerations made by the farmers before using pesticides (5.3), the indigenous cultural farming practices used by them to manage pest other that synthetic chemical pesticides will also be analysed (5.4). Finally, the perceptions, believes, opinion and how they regarded and understood pesticides will also be analysed (5.5).

5.2 The sources of information regarding pesticides use available to smallholder crop farmers of Ajumador.

The study identified three (3) sources, the local pesticides retailers and vendors, the government agricultural extension agents and farmers own colleagues as sources from which farmers in the study area got information and advice on pesticides to guide their decision.

The local pesticides vendors and retailers (in their shops), were found to be the first point of call when farmers had pest problems with their crops. This was because, the local retailers, had their shops always open and they sold pesticides to farmers, they lived in the same community inhabited by the farmers, making their contact with farmers very high. This also made them more accessible to the farmers compared to the agricultural extension agent who had many communities and farmers within their operational areas and jurisdictions of work and did not live in the farming community with the farmers. Findings from the study also showed that, farmers in the study area, preferred pesticides vendors and trailers less for having dual role of serving as a source of information on pesticides and at the same time those who sell pesticides to them. This is attributed to the fact that; pesticides vendors and retailers are business inclined people and may not necessarily be knowledgeable in pest management issues involving pesticides. As businesspeople, they had conflict of interest in advising, recommending and at the same time selling pesticides to the farmers. Agricultural extension agents on the other hand, were found to be relatively knowledgeable about pesticides but were also difficult to access as they had many farmers and communities under their jurisdiction.

The study also identified that, farmers in cooperative (groups) sourced and utilized pesticides information much better than individual farmers. Educated farmers in groups assisted in reading of label information, shared knowledge acquired during trainings, checked each other's activities to ensure everyone was on track.

Findings on the sources of information regarding pesticides use in this study is consistent with work done by Mattah, Mattah and Futagbi (2015). They identified Agricultural Extension Agents (AEAs), agro-chemical shop dealers (local vendors or retailors) and farmers own colleagues as sources of information. Television, newspapers and radio as additional sources of information on pesticides as identified by Ntow et al. (2006) was however inconsistent with this study. Rijal et al. (2018) reported that, pesticides retailers though technically deficient, are farmers' only source of pesticides information and heavily access information from them than AEAs.

The study is also consistent with Leikei, Ngowi and London (2014). They identified most pesticides vendors and retailers are untrained, lacking adequate knowledge on pesticides and pest management, yet serving as a major source of information to farmers on pesticides use. They described them as likely to be biased in the promotion and sale of their products at the expense of encouraging farmers to make their own decisions concerning pest management. They encourage farmers to use their products over others and this causes confusion among farmers. They however reported majority of farmers in their study depended heavily on pesticides label for information and less of agricultural extension agent and retailers, this is inconsistent with

this study. The study agrees with Jallow et al., (2017) who showed that, pesticides vendors and retailers serve as the primary source of knowledge and information on pesticides to farmers and play a very important role in the spreading of pesticides information among farmers. They, however, stated that, retailers could undermine the information they give to farmers when dealing with them to make huge gains to themselves. They also found them to lack adequate knowledge concerning pesticides and therefore strongly recommended interventions in addressing their knowledge gap if they are to provide quality advice and information to farmers. Jin, Bluemling and Mol (2015) reported that, farmers in cooperatives(groups) directly obtain accurate information on pesticides use, maintaining trust amongst themselves and can therefore serve as a solution to pesticides use as most extension service providers prefer to work with such organised farmers. They further reported that, for farmers who are not in groups, the more they became familiar with pesticides vendors and retailers, the more distorted the information retailers provided them.

5.3 The challenges (problems) smallholder crop farmers in Ajumador face with regards to pesticides label information

The study found out that, farmers in the study area poorly understood pesticides label information which is very vital for informed decision making. This was because of underlying conditions such as: majority of farmers have not had any formal education and therefore unable to read and understand label information. Those able to read, lacked technical understanding of the label information but necessary for making appropriate decisions regarding pesticides use. Label information in foreign language, e.g. Chinese, ineligibility of label information, repackaging of pesticides into other containers with little or no information on them greatly, contributed to farmers lack of understanding of label information for informed decision making. This has consequently led to some degrees of unsafe pesticides use and practices among the farmers such as, inappropriate disposal of empty pesticides containers, inappropriate PPEs worn by pesticides applicators, poor observance of PHI and REI, assumed dosage and inappropriate storage of pesticides in the custody of farmers. Farmers have adapted strategies to cope with the situation.

Waddington et al., (2014) identified that, concerning pesticides, Farmer Field Schools (FFS) approach of adult learning among farmers, encourages discovery learning, critical thinking on the part of the farmers, empowering them to come out with their own investigation, improving and transforming their decisions-making based on their own assessment, which in the end lead to confidence building and improvement in the quality of their farming practices and livelihood. Looking at the challenges and the problems associated with pesticides use, Westendorp (2012), found out that, farmer field schools can be an important learning ground on pesticides and a means of giving charge to farmers for their own progress through solving their own problems. In this case, the utilization of farmer groups and the use of farmer-trainees are some of the examples of transferring responsibility for service delivery from the state to the farmers themselves.

Findings in this study agree with Waichman, Eve and da Silva Nina (2007). They reported that, while the uneducated farmers are unable to read and understand pesticides label information, the educated lack the technical understanding of the information on pesticides labels. They noted that, when label information challenges the socioeconomic and cultural context of farmers, it becomes unsuitable and farmers will find their own way out because of the high technical language used by those who supply pesticides. They indicated that, even when farmers are aware of the challenges posed by pesticides, they do not have access to some basic materials like PPEs , where they exist, they are very expensive to the smallholder crop farmer and unsuitable to the climatic condition. This has the tendency of pushing farmers to adopt their own strategies, and the risk associated could be high. Rijal et al (2018) showed that, farmers generally do not understand pesticides toxicity colour codes. Mengistie, Mol and Oosterveer (2017) stressed farmers do not usually follow label information. They mix two or more pesticides to form a cocktail without paying attention to label information, applying same in repeated forms on crops. This has the potential risk of building immunity and resistance in pest to pesticides (Kariathi, Kassim and Kimanya, 2016 in Ngowi et al. 2007).

5.4 The economic considerations farmers in the study area make before using pesticides

Findings from the study shows that, farmers in the study area considered and counted the cost of pesticides and pest management against gains, (profit) from every pest management activity carried out by them during crop production. This however did not reflect in judicious use of pesticides, as farmers did not observe ETL/EIL. Whiles farmers lacked knowledge of the concept of ETL/EIL, there were no local standards to guide them in making such economic decisions. To avoid the risk of crops being damaged by pest, farmers used pesticides to protect their crops and continued to do so until crops were ready for the market. The study also found out that, the objective of the smallholder crop farmer for growing crops, whether to feed their household or sell for income did not influence pesticides decision and its use differently from each other. The way farmers treated crops meant for home consumption with pesticides was the same way they treated crops meant for sale, however, farmers extended pesticides application on crops until harvesting coincides with local market day.

Carpentier and Reboud (2018) showed that, the cost of pesticides plays an important role in the decision-making process of farmers regarding pesticides use. They want to make profit from their farming business and will therefore buy cheaper pesticides for crop production. However, in the decision-making process of farmers concerning pesticides, Rijal et al., (2018) realised, farmer do not observe ETL/EIL. ''Farmers use chemical pesticides without considering insect pest monitoring and economic thresholds'' and consequently increase their cost of crop production due to over-reliance on calendar spray regimes. Van den Berg et al., (2020) reported that, participating farmers in farmer field schools made gains by saving cost on the use of pesticides, pesticides usage reudced. Prasenna et. al (2018) recommends scouting, where farmers observe pest on crops to determine ETL for judicious of pesticides. They recommend localised scouting over a period, through research and data gathering to determine best thresholds in given crops at which pest management should be initiated. This can be amassed and included into formal monitoring schemes at larger geographic range.

5.5 Local (indigenous) cultural farming practices used by smallholder crop farmers in Ajumador to manage pest other chemical pesticides, which they consider environmentally friendly

Findings from the study showed that, respondent had good knowledge of several indigenous practices used to control pest other than synthetic chemical pesticides. These practices are useful in reducing farmers dependency on chemical pesticides for crop production. The identified practices were either related to their believes or among a certain age bracket. It was obvious that, older farmers above the age of sixty (60+) had very good knowledge of these indigenous methods and in their decision-making concerning pesticides use, they practiced them. While the relatively younger generation of farmers lacked knowledge of some of these practices, they also showed less interest in them and were not attractive to them. For the younger generation of farmers, focus is more geared towards economic gains with their interest shifting towards the use of chemical pesticides to protect their crops, and their willingness to use bio-based pesticides depended on consumers' demands and willingness to pay a bit more for such produce.

Van den Berg et al., (2020) found out that, farmers who participated in FFS upon completion and practicing what they learnt, attached heavy importance to the results of their own field crop performance rather than myth, or any witchcraft being the cause of the failure of their crops. Findings agree with Rossi, Caffi and Salinari (2012), they found out that, the first decision concerning crop protection measure is prevention through all necessary cultural farming practices such as good land preparation, timely planting, mixed cropping, land fallowing, clean farm sanitation, in order to suppress pest multiplication. Benelli (2018) stated that, overdependence on synthetic chemical pesticides by farmers to produce crops has led to several pests developing resistance to such pesticides, polluting the environment and non-target organisms and stressed the importance of integrated pest management (IPM) in crop production. Lucchi and Benelli (2018) strongly

recommended the use of biopesticides as another option of pest control rather than chemical pesticides, they however identified that, this option is highly underused by farmers as a result of lack of knowledge and trust, despite their benefits. The situation as it is now, is because of reporting gap existing between farmers, researchers and other stakeholders (Lamichhane et al., 2016) and therefore called for research into the use of biomaterials as an alternative means of pest management.

5.6 The perceptions of smallholder crop farmers of Ajumador concerning pesticides and their use in crop production.

Findings from the study showed that, farmers in the study area had both positive and negative perceptions, opinion, views and different understandings concerning pesticides and their use. These were based on their individual and collective assessments and use of pesticides for farming activities over the years as well as hearsay. These revolved around issues such as health, environment, beliefs and crop protection. Although farmers perceived pesticides as poisonous and harmful, there is need to improve practices for it to reflect in the way they protected themselves whiles applying and spraying pesticides, care for the environment, the way they disposed-off pesticide containers, PHI and REI and pesticides storage. Their perception concerning pesticides as able to increase crop yield and a solution to many pest problems however featured strongly, as farmers dependence on chemical pesticides was high for crop protection.

Ntow et al., 2006 stated that, how farmers perceived pesticides influences their decision concerning its use. found that If the way farmers consider pesticide is different from expert's opinion, it could lead to farmers taking more risk and influences how they protect themselves against it. Advice given to farmers with regards to pesticides use and crop protection may be unsuitable and immaterial if it is not in line with their own views. Khan and Damalas, (2015) showed that armers who consider the use of pesticides as the only way to manage pest will use pesticides extensively, such farmers, are like to overuse pesticides

CHAPTER SIX. REFLECTION ON MY ROLE AS A RESEARCHER

It is a requirement for all Master of Development (MOD) students to carry out research in their home country under the guiding watch of an assigned supervisor, to fulfil the requirement of being awarded a master's degree. In this section of the thesis report, I reflect on my role as a researcher, on my study titled ''farmer decision making processes regarding pesticide use: a case study of smallholder crop farmers in Ajumador, a farming community in the Ningo-Prampram district of the greater Accra region of Ghana''.

The research focused on finding from the respondents, their decision-making processes with regards to pesticides use. This is a delicate topic as it is sets to search the mindset and approaches of the respondents with regards to pesticides use. Exploring the topic, required a high level of professionalism and skill on my part to probe deeper to get the right answers to address the research objective, and also understand why they do things the ways they do it now, with pesticides.

My decision to research on pesticides use was a motivational factor for applying to VHL, and dear to my organisation because, the farmers we work with are producers of crops and pesticides are used by them to protect these crops and there is the need to support these farmers to use pesticides safely. Choosing a study area (pesticides) was therefore not a problem for me from the beginning. However, coming out with a specific, researchable topic, objective, and sub-questions that can help me answer the main question, making it relevant to generate appropriate recommendations was very challenging and it took a bit of time until I was officially assigned with a supervisor and got it straightened up. I knew I lacked insight into how to conduct applied research. In view of that, I paid a lot of attention to the lectures on conducting research during the module, research design and implementation. I also begun reading on how to conduct research, especially qualitative research. This enabled me to gather enough confidence in the process. Then it became evident that, due to Covid-19 restriction on traveling and the situations in the various home countries, students were to conduct research from the Netherlands with the help of a research assistant back home. This called for leadership on my part, to be able to organise, train a lead assistant and coordinate my research study away from home. The researcher was responsible for designing the research context, the data collection, processing of the data and the research report.

Before the commencement of fieldwork, a research proposal, comprising the topic, the research problem, the objective, main and sub questions, details of all the steps to be used was submitted for approval. Qualitative research strategy, design and methodology was what I employed in this study and used in the collection of primary data (IDI, FGD and KII) in Ajumador. The conceptual framework I came out with after desk study was very useful to me and it guided me in the preparation of my checklist, and I could not have come out with any good report without it. To ensure quality of research findings, the researcher was responsible for the preparation of topic check list guiding the interview and discussions and were modified to make room for probing while conducting field work, linking the theories and the conceptual framework with the research questions. The researcher was responsible for the conduct of the interview, transcription of the data collected, entry, analysis and the writing of the final report. The collection of Primary data from IDI, FGD and KII, was very challenging because, this is my first applied research in development context, however it exposed me to new people and networks from whom I gained much insight, listening to respondents share their story in their own situation and perspective is one memorable experience I had in the study.

One intriguing finding among the many useful findings of this study has to do with the relation between the festival of the people studied, pest and subsequently pesticides. Growing up as a young man, I had observed the celebration of the ''Homowo'' festival many times before, though I knew it literally meant hooting or jeering at hunger, I did not know that, it had connections with pests and therefore pesticides issue, until the opportunity to conduct this research helped to uncover it, like the iceberg theory, beneath the tip of the iceberg are several other things.

Several challenges were encountered during the fields work. Looking back, I realise some things could have been done better by myself and the research assistant to make the fieldwork run smoothly without going forth and back. Seven (7) out of the eight (8) female respondents (slated for this study) who earlier accepted to be part of the study, later, successively declined speaking to the team. They all told us to either interview their husbands or leave them in peace. The eighth female respondent, who happened to be the head of a household was successfully interviewed and through her, a snowball tactical approach was used until the desired number of women farmers slated for the study was attained, all of whom happened to be the head of their households. Later, I got to know, the women who declined speaking to us are all married women staying with their husbands, worked with them on their farms but were not the ones who made decisions on pesticides, it was their husbands. The fact that we left their husbands to interview them without their permission too, was an affront to certain cultural values of theirs. I learnt a useful lesson, we should have probed well and obtain permission, and am glad I was able to apply flexibility to use the snowball approach.

During the field work and data gathering process, I planned to use zoom and skype for interview, but internet connectivity was so poor in the village. I managed to use what's app call through the research assistant as the main means of communication to reach of the respondent, they were not having smart phones. Some of the scheduled meetings for interview coincided with the time when farmers were busy working on their fields. It also coincided with registration of Ghanaian eligible voters for this year's election exercise, and this delayed some of the interviews. Other interviews had to be rescheduled for different days and all these had cost implications (transportation and refreshment) because the research assistant had to go to those same respondents again and again before interview was conducted. If we had probed well from the beginning, we would have known when the farmers were scheduled for the voter registration exercise and be on the field at the time when they were not carrying out any activity. During the analysis period, I realised I collected data that were not relevant for the analysis, a typical example is the farm sizes of the respondents and years of experience in farming, the effort spent was not worthwhile. I also realised I should have interviewed more pesticides retailors as key informants considering the importance of their role of providing information.

There were things that I would have loved to do as part of the process of this research study, which I did not get the full opportunity. Since this was my first applied research study, I eagerly looked forward to carrying out face-to-face IDI and FGD , apply all the necessary observation skills as well as the field interactions, but this could not fully materialise as it was done from afar due to Covid-19 situation.

An important factor that I would like to reflect on in this study is my positionality. I work with the Department of Agriculture, Ningo-Prampram district, the problem owner of my research and therefore wanted the facts on the ground to speak for themselves without it being influenced by any of my experiences, knowledge and biases as an insider. Expectation from the farmers I studied are high as farmers asked, what will you do about our pesticides and crop production problems in this community after the completion of your study abroad? In order not to be distracted, I remained focused and objective as I wanted the outcome of the findings in the study to be sufficient to address the objective set for the study. Though I had the objective in mind, I ensured my tone of language used for data interpretation, analysis and reporting was free from prejudice and exaggeration but rather reported based on the farmers' (respondents) own story, words and their circumstance. My initial thesis report (proposal) had some bit of plagiarism after assessment feedback, going forward, I need to pay more attention to proper referencing and information sourcing.

This is my first applied research study, writing the report was obviously a difficult one, analysis of the data thematically based on the sub-questions were very challenging. However, through determination, hard work and adherence to feedback from supervisor and implementation of recommendations has enabled me to come this far. Through the conduct of this research, my understanding of how to design and conduct research, especially qualitative applied research in development context has improved. It has sharpened my skills in time management through self-discipline and working under pressure. It has improved my skills in team building and management, improved my writing skills and analytical strength than before.

CHAPTER SEVEN. CONCLUSION AND RECOMMENDATIONS

7.1. **Introduction**

The study set out to examine the complexity of the decision's smallholder crop farmers in Ajumador make with regards to pesticides use in four dimensions: Social, Economic, Technological and environmental. This is to enable the researcher to make appropriate recommendation to DoA-NiPDA to tailor its extension services to farmers in the study area in this regard for safe, sound and effective practices of pesticides use.

7.2 Conclusion

Pesticides retailers (vendors), agricultural extension agents and farmers colleagues were the sources of pesticides information to smallholder crop farmers in Ajumador, with pesticides retailers being the major source. Pesticides retailers were found to be always available in their shops in the community to serve farmers. Agricultural extension services provided by the local government through AEAs aimed at providing pesticides information and to improve farmers knowledge on pesticides use, appears to be inadequate. This has led to farmers depending heavily on pesticides retailers for information for decision making. Information provided by the retailers appear to be misleading the farmers as most of them are untrained, inconsistent in their information, and not specific with their recommendation and this is causing confusion among the farmers, therefore, farmers trust and prefer them less as a source of pesticide information. As businesspeople, pesticides retailers were not necessarily knowledgeable in pesticides use and had conflict of interest in diagnosing, recommending and selling pesticides at the same time. The study also found that, women were involved in pesticides decision making and their role cannot be underestimated. Meanwhile, AEAs and other pesticides information service providers are making great efforts in providing the pesticides information needs of the only farmers' cooperative in the community and this is helping them to make appropriate decisions with regards to pesticides use than majority of farmers who are not in groups. They grew similar crops, requiring similar technological information. Educated farmers in groups assisted in reading of label information, there was sharing of knowledge acquired during trainings, they checked each other's activities to ensure everyone is on track. The lack of understanding of pesticides label information on the part of farmers in the study area has not enabled them to make appropriate decisions regarding pesticides use. This has resulted into some degrees of unsafe pesticides use and practices in terms of proper disposal of empty pesticides containers, right use of PPEs, proper observation of PHI and REI, correct measurement of pesticides dosage and safe storage of pesticides in the custody of farmers. While farmers counted the cost of pesticides and pest management as an important economic consideration before using pesticides, they do not observe ETL/EIL as there are no local standards for guidance. Farmers therefore use prophylactic means to manage pest. Farmers' objective for growing crops, either for sale or to feed the family did not influence pesticides use differently. Farmers studied had both positive and negative perceptions, views, opinions and understandings about pesticides with respect to health, the environment, crop protection and their beliefs. The negative perception of farmers concerning pesticides as being poisonous and harmful did not reflect heavily in the use of other options of pest management, which is very important in reducing the negative impact of pesticides on the environment. While the older generation of farmers had good knowledge of other options of pest management (other than chemical pesticides) and practiced them, this was not the same with the younger generation of farmers. The later lacked knowledge of these other options and appear to excessively depend on chemical pesticides to protect their crops.

7.3 Recommendations to DoA-NiPDA

Based on the findings, the researcher recommends for DoA-NiPDA to:

- Register and have a strong database of all pesticides retailers in the district, licencing them to undergo compulsory training to address their knowledge gap, laying emphasis on trust, to provide quality services to farmers concerning pesticides use. This is in consideration of the fact found in the study which showed that, the pesticide retailers lived in the community with the farmers and were always available to serve the farmers.

- Facilitate the establishment of viable and sustainable farmer groups (cooperatives), spearheaded by the farmers themselves, to serve as a platform for DoA-NiPDA and other stakeholders to reach out to farmers with pesticides knowledge and information for effective and safe pesticides use practices.

- Conduct Farmer Field School involving farmers and AEAs as an intervention to support farmers manage pest in crops through scouting and critical observation and also tackle the issue of disposal of empty pesticides containers, right use of PPEs, proper observation of PHI and REI, correct measurement of pesticides dosage and safe storage of pesticides in the custody of farmers.

- Promote the use of other options of pest management other than chemical pesticides and make it attractive to young farmers (youth) in Ajumador community and other communities in the district.

- Include women in all pesticides training programme and such trainings should be geared towards empowering them to make independent decisions with regards to pesticides and its use.

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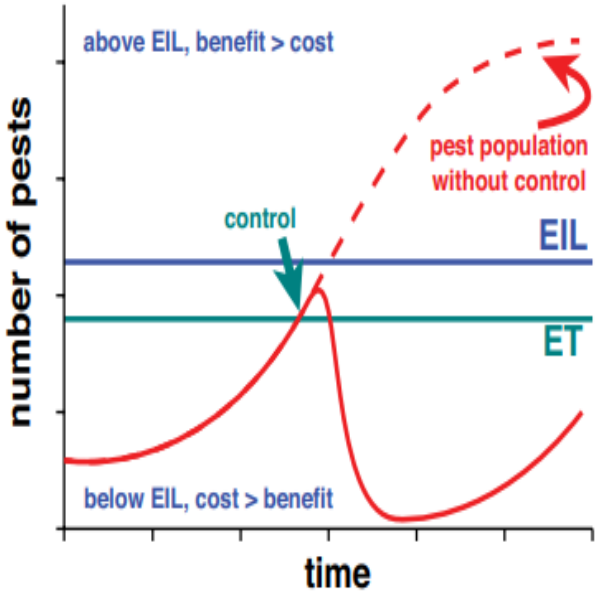
ANNEX

Annex 1: The relationship between pest and numbers over time and calculating the economic threshold level and the economic injury level

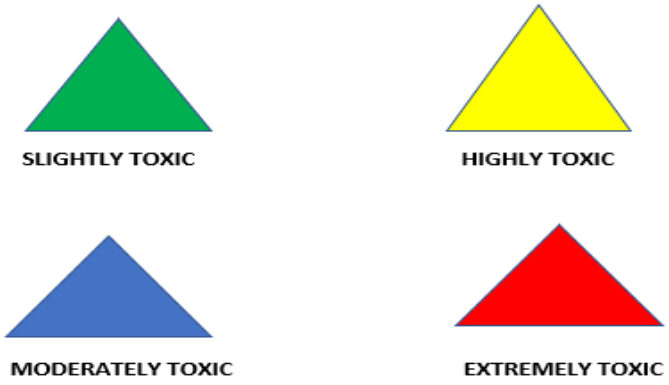
Figure 16:The relationship between pest and numbers over time and calculating the economic threshold level and the economic injury level



Source: Prasanna et al. 2018 in Barbercheck and Zabroski 2015

Annex 2: Pesticides toxicity colour classification

Figure 17: Pesticides toxicity colour classification



Source: pesticides toxicity colour classification by W.H.O.

Annex 3, Demography of respondents – FGD 1, FGD 2 AND KII and IDI

Table 4: demography of respondents - Focus group discussion one (FGD1): Farmers in a group (cooperative)

FARMER'S CODE	SEX		CROPS GROWN
	M	F	
FGC 1	M		Maize, Cowpea, Pepper, Onion
FGC 2	M		Maize, tomato, garden eggs, onion
FGC 3	M		Okra, Cabbage, Pepper, Tomato
FGC 4		F	Tomato, Maize, Okra, Pepper,
FGC 5		F	Maize, Watermelon, Pepper,
FGC 6	M		Maize, Cucumber, Okra, Pepper,
FGC 7		F	Maize, Okra, Pepper, Watermelon
FGC 8	M		Cowpea, Okra, Pepper, Tomato
FGC 9	M		Maize, Tomato, Okra, Pepper,
FGC10		F	Maize, Okra, Pepper,

Source: field work 2020

Table 5Table 6: demography of respondents - Focus group discussion two (FGD2): (individual farmers who are not in any group) Source: field woe

FARMER'S CODE	SEX		CROPS GROWN
	M	F	
FG 1		F	Onion, Pepper, Tomato, Maize, cowpea
FG 2	M		Cucumber, watermelon, maize, onion
FG 3	M		Tomato, maize, pepper, cowpea
FG 4	M		Garden eggs, cabbage, okra
FG 5		F	Watermelon, cucumber, onion, tomato
FG 6	M		Garden eggs, tomato, maize
FG 7		F	Maize, cabbage, onion, pepper, okra
FG 8		F	Cowpea, pepper, tomato, cabbage
FG 9	M		Okra, onion, tomato
FG10	M		Maize, Okra, tomato, onion,

Source: field work 2020

Table 6: demography of respondents - key informants

CODE	RESPONDENT	ORGANISATION	DESIGNATION
KII 1	A traditionalist and a leader of community farmers' group	Farmers' group	Leader-Farmers' group
KII 2	An Officer from PPRSD	PPRSD - Ghana	Field staff
KII 3	Pesticides vendor and retailer	Community Pesticides vendor and retailor shop	Salesperson
KII 4	A researcher	University of Ghana-Legon	Entomologist

Source: fieldwork 2020

Table 7 : demography of IDI respondents

FARMER'S CODE	SEX		AGE	LEVEL OF EDUCATION	CROPS GROWN THIS YEAR (2020)
	M	F			
IDI 1	M		43	Basic	Onion, pepper, maize
IDI 2		F	58	NIL	Tomato, pepper, cucumber
IDI 3		F	54	NIL	Watermelon, maize
IDI 4	M		69	MSLC	Cowpea, onion, garden eggs, tomato
IDI 5	M		75	NIL	Maize, onion, pepper, cabbage
IDI 6		F	46	Basic	Cabbage, cucumber, watermelon
IDI 7		F	39	Basic	Maize, okra, pepper, cabbage
IDI 8		F	65	NIL	Cowpea, okra, tomato,
IDI 9	M		75	NIL	Cowpea, onion
IDI 10	M		48	Basic	Okra, pepper, tomato, cabbage
IDI 11	M		34	Diploma	Pepper, okra, garden eggs, cabbage
IDI 12		F	57	NIL	Watermelon, cucumber, onion
IDI 13	M		74	NIL	Maize, okra, onion, tomato, garden eggs
IDI 14	M		68	Basic	Watermelon, cucumber
IDI 15		F	69	NIL	Onion, pepper, tomato
IDI 16	M		45	NIL	Maize, cowpea, okra, garden eggs,
IDI 17		F	32	Basic	Maize, okra, pepper, onion, cabbage
IDI 18	M		59	NIL	Maize, okra, pepper
IDI 19	M		36	Diploma	Maize, okra, pepper, tomato, onion,
IDI 20	M		30	Basic	Onion, pepper, okra

Source: field work 2020

Annex 4: IDI, FGD and KII checklist

Individual (In-depth interview) checklist

Sub-question 1:

From what source(s) do you obtain information regarding pesticides use?

Probe:

- What influence your choice of source of information?
- What challenges do you face with your choice of source of information?
- What other sources would you have preferred (with reasons) other than your current source?
- Any other information with regards to source of information, specify

Sub-question 2:

What challenges do you face with pesticides label information when you use pesticides?

Probe: How do you manage (determine, get to know) information on pesticides labels with regards to:

- The specific crop to which a pesticide is to be applied.
- The specific pest to which a pesticide is to be applied
- Dosage and how pesticides are mixed (for example with water) before application
- Pre-harvest interval (after spraying crop with pesticides)
- Manufacture and expiry date of pesticides
- How to dispose-off unused pesticides and empty pesticides containers
- Your ability to read and understand pesticides label information (written in English or other language?)
- How do you protect yourself during and after spraying pesticides

Sub-question 3. What economic considerations do you make before using pesticides?

Probe:

- Based on your objective as a subsistence farmer growing crops only to feed your family
- Based on your objective as a subsistence farmer growing crops purposely for sale
- How do you determine when to apply pesticides (for example, calendar spraying, appearance of first pest on crop, when about 2% of crop have been attacked by pest)

Sub-question 4.

What indigenous, local cultural farming practices do you use to manage pest other than chemical pesticides?

Probe:

All other options of pest management other than chemical pesticides (for example, selection of farm site, choosing the right crop which is resistant to pest, good land preparation, land and water management, timing the planting period, mixed cropping, crop rotation and clean farm sanitation).

Sub-question 5. How do you perceive pesticides?

Probe:

The farmer's belief, opinion, how they regarded, understand, or interpret pesticides.

FOCUS GROUP DISCUSSION- CHECK LIST

Q1.

What are the sources of information regarding pesticides use available to you as farmers in this community?

Probe:

What challenges do you face with available sources of information

Q2.

What challenges do you face with pesticides label information in this community?

Probe:

Ability to read and understand label information

Language in which label information is written

Packaging of pesticides products including repackaging

How does being in a group or not support you

Q3. What economic considerations do you make before using pesticides

Q4.

What indigenous, local cultural farming practices do you use to manage pest other than chemical pesticides?

Probe:

Other options of pest management other than chemical pesticide

Q5.

How do you as farmers regard, understand or interpret pesticides in this community?

Probe: beliefs and perceptions of farmers regarding pesticides

Environmental concerns (why they undertake indigenous practices)

KEY INFORMANT INTERVIEW CHECKLIST

f) From which sources do smallholder crop farmers obtain information regarding pesticides use
g) What challenges do smallholder crop farmers face with regards pesticide label information when using pesticides?
h) What economic considerations do smallholder crop farmers make before using pesticides?
i) What local (indigenous) cultural farming practices do farmers use to manage pest other than chemical pesticides (considered environmentally safe)?
j) What are the beliefs and perceptions of smallholder crop farmers concerning pesticides?
k) What challenges do you face communicating with smallholder crop farmers