SMALL-SCALE FARMERS' COPING STRATEGIES TO FALL ARMY WORM OUTBREAK

A CASE OF KANENGO AGRICULTURAL CAMP IN KAWAMBWA DISTRICT

LUAPULA PROVINCE-ZAMBIA

A research project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfilment of the requirements for the degree of master's in management of Development specialization Rural Development, Disaster Risk Management

By

Steven Pule Musonda

September 2019

van hall larenstein
university of applied sciences

ACKNOWLEDGEMENT
I am highly indebted to the Netherlands Government through NUFFIC program for according me a full scholarship to study at Van Hall Larenstein University of Applied Sciences, indeed it has been such a great honour.

I would like to give my profound gratitude to my supervisor and at the same time my mentor Dr. Annelies Heijmans whose insight and knowledge into the subject matter steered me throughout my research work. I am equally grateful to Dr. Pleun Van Arensbergen for her unwavering support and all the members of staff at VHL.

I am thankful to my employer Ministry of agriculture for granting me study leave, my supervisor Mr. Davis Mwansasu for logistical support rendered to me during research data collection. I wish to thank the following members of staff Mr. Sikanyika, Mr. Musenge, Mr. Muyunda, Mr. Matutu and Ms Zaza for their support during focus group discussion.

It would be incomplete if I don't acknowledge my fellow peers in MOD program for their support especially during peer reviews of my research proposal. I do convey my special gratitude to small-scale farmers who willingly participated in sharing with me their time and knowledge during interviews.

Finally, many thanks to my family for all the support rendered to me throughout the period I have been away, you are such a beautiful family.

DEDICATION

I dedicate this thesis to my wife Winnie and my children Steward, Redeemer, Victor and my only daughter Tinashe who have always stood by me in prayers and managed to deal with all my absence from family occasions with a smile.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CRF	Community Resilience Framework
CSO	Central Statistics Office
DMC	Disaster Management Cycle
DMMU	Disaster Management and Mitigation Unit
FAO	Food and Agriculture Organisation
FAW	Fall Army Worm
FGD	Focus Group Discussion
GRZ	Government of the Republic of Zambia
IC	Information Centre
IHHI	Individual Household Interview
IPM	Integrated Pest Management
KII	Key Informant Interview
MOA	Ministry of Agriculture
NGO	Non-Governmental Organisation
SFAZ	Small-Scale Farmers Association of Zambia
SSF	Small-Scale Farmers
UN	United Nations
USD	United States Dollar
VHL	Van Hall Larenstein University
ZCF	Zambia Co-operative Federation
ZNFU	Zambia National Farmers Union
ZMK	Zambian Kwacha (National currency)

ABSTRACT
This report presents a case study assessing the coping strategies of small-scale farmers to fall army worm (FAW) outbreak. The fall army worm *spodoptera frugiperda* is a migratory pest from America with over 100 years prevalence, the pest is relatively new to the African continent whose presence was first reported in Sao Tome and Principe around January 2016 and it is known to cause extensive crop losses of up to 73% and difficult to eradicate.

The case study focuses on Kanengo agricultural camp of Kawambwa district in Luapula province of Zambia. Kanengo has the highest number of small-scale farmers growing maize and highest producer of maize in the district. The outbreak of FAW pest is a potential threat to food security, especially that it thrives mostly on maize crop a staple food in Zambia. There is need to investigate what is being done by small-scale farmers to prevent, control or manage FAW pest to make recommendation on how to improve resilience capacities.

This study assesses predisposing factor to rapid spread of FAW among small-scale farmers, farmers' practices being carried out by small-scale farmers to combat the pest, challenges that small-scale farmers encounter in combating the pest and its economic impact on maize production. The report also assesses collaboration of small-scale farmers, stakeholders and government in the fight against the pest. A total of 30 individual household heads were purposively sampled and interviewed, 6 key informants were purposively selected and interviewed, one focus group discussion was conducted with 11 members who were purposively selected.

Results show that the fall army worm pest remains a serious threat to household food and income security as it continues to impact negatively on maize yield. To combat the pest in maize production, small-scale farmers rely on their local knowledge such as hand picking, crushing, use of sand soil and traditionally formulated plant pesticides. Effectiveness of these practices is reported when used in combination with other science-based practices including crop rotation, intercropping, weeding, early planting and pest scouting. Therefore, the study establishes that no one single method of pest control is found effective among small-scale farmers but rather a combination of several practices has proved effective.

Key concepts: *Community, Coping strategy, Resilience, small-scale farmer and social capit*

CHAPTER ONE: INTRODUCTION

This chapter being the first of thesis introduces the research problem and justification for undertaking it on the specific research problem. The sections include the back ground to the study, the problem statement and significance of the study. It also presents research objective which followed by research goal, research main question and sub-questions.

1.1 Background

Maize (*zea mays*) is the most widely grown crop in Africa across diverse agro-ecological zones as a staple food and over 200 million people depend on the crop for food security (Rwomushana *etal*., 2018). However, the growing of maize across the continent has been characterised with several challenges in terms of pests such as the fall army worm (FAW) and diseases like maize streak virus impacting negatively on yields. According to FAO (2017) the fall army worm *spodoptera frugiperda* is a migratory pest from America with over 100 years prevalence, the pest is relatively new to the African continent whose presence was first reported in Sao Tome and Principe around January 2016 and it is known to cause extensive crop losses of up to 73% and difficult to eradicate.

In recent years Zambia has experienced an increase in the presence of fall army worms *spodoptera frugiperda*. The pest is negatively impacting on maize yields since 2016 when the it was first reported. The rapid multiplication and spread of the FAW to nearly all parts of the country including Kawambwa district has been exacerbated by a number of factors including variability in weather conditions as a result of climate change (Rwomushana *etal*., 2018).

The Government of the Republic of Zambia in consultation with stakeholders in the agriculture sub-sector such as the Zambia National Farmers union (ZNFU), Small-Scale Farmers Association (SSFA), Zambia Co-operative Federation (ZCF) has declared the outbreak a national disaster. According to EM-DAT (https://www.emdat.be/explanatory-notes, 11:00hrs, 2019) an occurrence is recorded as a disaster if it falls into the following categories: there have been 10 or more fatalities, 100 or more people have been affected, a state of emergency has been declared, or international assistance has been called for. In this regard, government has declared a state of emergency with over thousands of small-scale farmers are affected and the fall army worm outbreak is found in the category of biological disaster sub-group with the main disaster type of insect infestation. It is defined as a hazard caused by exposure to organism's toxic substances venom or insects (https://www.emdat.be/classification, 11:00hrs, 2019).

As an immediate action, government has spent over USD 3 million in pest control, involving military planes spraying affected areas to halt the infestation of FAW, and over 106,000 litters of chemical pesticides distributed to smallholder farmers (Patterns and Occurrence, 2017). The response action included provision for replanting early maturing maize seed of about 90,000 hectares for the affected smallholder farmers (Food and Security Organization of United Nations, 2017).

Zambia is a land locked country found in the southern part of Africa with population estimated at about 13,046,508 of which 6,394,455 are males while 6,652053 are female (CSO, 2010). It borders with eight countries including; Democratic Republic of Congo, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, Namibia and Angola. The high number of borders puts the country more at risk to migratory pests and diseases with regards to movement of agricultural products in and out of the country. Zambia is divided into ten provinces for administrative purposes including Luapula province. The province is situated between 8-12 degrees south of the equator and longitude 28-30 degrees East of the Greenwich Meridian, it is further subdivided into twelve districts and it includes Kawambwa district which is a research study district found in the northern part of the province with a population of 23,000 registered small-scale farmers (MoA, 2016).

There are three major categories of farmers in Zambia namely; small-scale (traditional) farmers cultivate <5 ha each and consume most of their produce, medium-scale farmers cultivate 5-20 ha each and sell most of their crop, large-scale and commercial farmers cultivate >20 ha each and sell most of

their produce and round 67% of the Zambian labour force is employed in the agriculture sector (FSAZ, 2009). Small-scale farmers in kawambwa district depend mostly on agricultural extension services provided by government through ministry of agriculture, are resource poor, cultivate less than five hectares of land, have access to government inputs subsidies and sale their maize mainly to government through Food Reserve Agency (FRA).

In line with the second national agriculture policy (GRZ-MOA, 2016) which encompasses key facets of the agriculture sector as food and nutritional security, agricultural production and productivity, agricultural diversification, agricultural research and extension services, sustainable resource use, promotion of irrigation, agro-processing and value addition, agricultural marketing and trade. The extension services provided focus on the promotion of improved technologies and practices to increase agricultural production and productivity for consumption-based satisfaction. One of the approaches of extension service delivery to farmers is participatory through farmer organisations such as co-operatives, women clubs, farmer groups, farmer field schools as well as commodity study cycles.

Agriculture in Zambia is one of the key priority sectors that contribute to economic growth and poverty reduction, currently it accounts for about 22% of Gross Domestic Product (GDP) and provides livelihood for more than 50% of the population (MoA, 2016). Women participation in agricultural development is another key priority area for the government. It has put in-place a policy framework to ensure that gender is mainstreamed throughout government operations by all government and private institutions with at least 30% women participation (CSO, 2014). It sets out priority areas even at community level in terms of planning and resource allocation for promotion of gender equity and equality. Most rural households depend on consumption of their own produce and are associated with high poverty levels due to inadequate access to productive assets, poor road infrastructure, market systems and high dependence on mono cropping of maize.

1.2 Statement of the problem

Zambia is among the Southern African countries facing the negative effect of climate change like El Niño-induced drought with approximately 40 million people affected with about 23 million are in urgent need of humanitarian assistance (Rwomushana *etal*., 2018). The recent outbreak of the fall army worm in Zambia has worsened the situation of food security among small-scale farmers involved in subsistence farming. Some of the affected vulnerable groups are unable to afford expensive countermeasures of chemical pesticides at USD 10 per hectare (Patterns and Occurrence, 2017). According to the household socio-economic survey conducted in Zambia to examine losses in maize production specifically due to fall army worm reveals an estimated loss of 40% translating close to USD 160 million (Rwomushana *et al*., 2018). In addition, one of the reports from East Africa indicate that if left unchecked the pest has potential to ravage the crop leading to 100% loss (Sage-el, 2017). The ministry of agriculture is charged with huge responsibilities including maintaining national food security and providing agricultural extension services to small-scale farmers. Therefore, Kawambwa district agriculture co-ordinators' office wants to know how small-scale farmers are dealing with the fall army worm invasion. Therefore, this study will be helpful in providing information about farmers response actions in the fight against fall army worm as well as recommendations to ministry of agriculture on how to improve small-scale farmer's resilience capacities to prevent, control or manage the pest.

1.3 Research goal

To build small-scale farmers resilience capacities essential for household food security through appropriate and sustainable measures for preventing, controlling and managing the fall army worm in maize production.

1.4 Research objective

To investigate what is done by small-scale farmers to prevent, control or manage fall army worm outbreaks in Kawambwa district in order to make recommendations to the Zambian Government through Ministry of agriculture on how to improve resilience capacities to the pest attack.

1.5 Main research question

What measures are being employed by small-scale farmers, private and government to combat fall army worm outbreaks in Kanengo agricultural camp of Kawambwa district in Luapula province of Zambia?

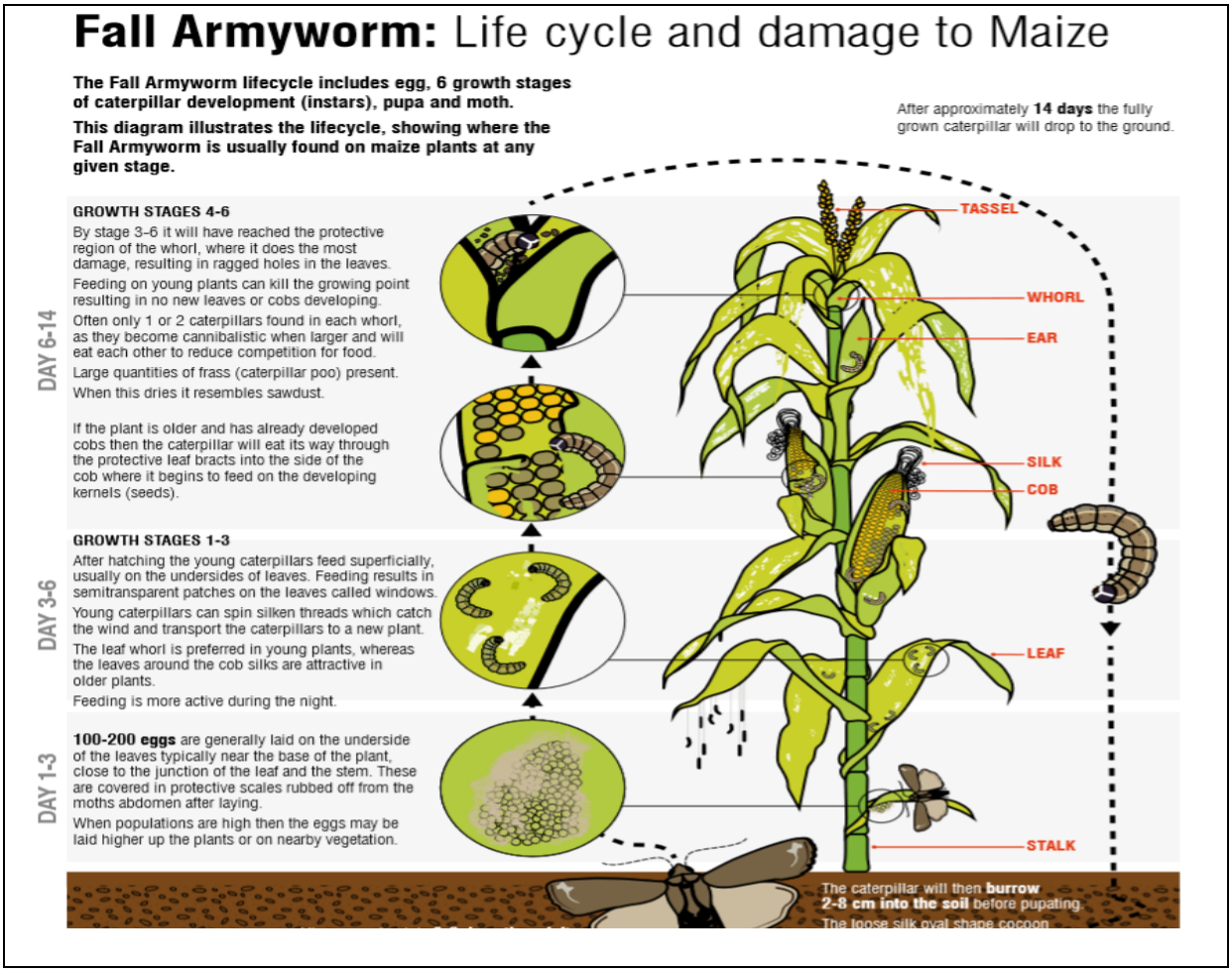
1.6 Research sub-questions

i. What are factors causing rapid spread of fall army worm among small-scale farmers?
ii. What are farmers' practices being carried out by small-scale farmers to counter FAW occurrences?
iii. What are the limitations facing small-scale farmers in the fight against fall army worm?
iv. How are stakeholders involved in agriculture sector (e.g. farmer organisations, agro-input suppliers) influencing control of fall army worm?
v. How is government through ministry of agriculture engaging small-scaler farmers to prevent, control or manage fall army worm pests?

CHAPTER TWO: UNDERSTANDING FALL ARMY WORM PEST DYNAMICS AND IMPACT

This chapter looks at the life cycle of fall army worm pest and its damage to maize crop. It provides regional overview of pest invasion and contributing factors to the spread. The chapter also presents the effects of climate change on the pest outbreak as well as social-economic effects of the pest attacks. Finally, it presents collaboration of stakeholders and response actions in combating the pest.

Figure 1: Fall army worm life cycle



Source: (Food and Agriculture Organization of the United Nations, 2018)

According to FAO (2017), the FAW is one of the most damaging pests for maize, it also feeds on over 80 different crops including, rice, sorghum, millet and sugarcane as well as others such as cabbage, and pasture grasses. The organisation describes the larva stage of the insect that causes the damage and reproduces at a faster rate of about 1500 eggs per adult female with a life cycle (as shown in figure 1 above) of 21 days of which eggs take three days to hatch and the moth can fly up to 100 km per night.

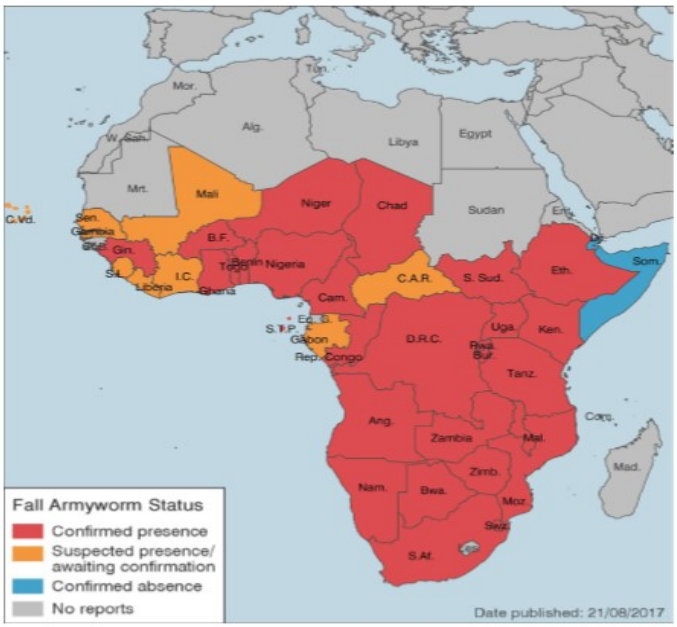
The female fall army worm *spodoptera frugiperda* moths lay egg masses of fifty to several hundred eggs at night, usually on foliage or sometimes on light coloured objects and often eggs are laid in areas of the pasture with the most lush growth of which the total egg production per female ranges from about 1,500 to 2,000 (Loftin *et al, 2*016). The life cycle of the pest signifies; its multiplication and spread within shortest period provided desired environmental conditions are favourable. Just as indicated in other literature above concerning the incubation period, Loftin *et al.*, (2016) explain that

eggs hatch into small (1⁄8 inch) light green caterpillars usually within 2 to 4 days, even though the female FAW can live about 2 weeks and most of her eggs are laid within the first week of her life. Fall armyworm outbreaks are more likely during periods of dry spells and droughts because the warmth is more conducive for movement and some of their natural enemies are less active during droughts.

2.1 Regional spread of FAW pest

Research to date suggests that both strains of FAW that are found in America have entered Africa, perhaps as stowaways on commercial aircraft, either in cargo containers or airplane holds, before subsequent widespread dispersal by the wind *(Rwomushana, et al.,* 2018).

Figure 2: Regional spread of FAW pest



Map 1. Current FAW distribution in Africa (August 2017).

Source: (Rwomushana *et al*., 2018).

The region is likely to have negative economic impact on agricultural products from countries with confirmed outbreaks such as import bans because the fall army worm is classified as a quarantine pest, resulting in lower revenues (Patterns and Occurrence, 2017). Vulnerable groups as described by Patterns and Occurrence include households dependent on maize production for access to income are expected to be particularly affected by crop damage due to pest outbreaks as they are unable to afford expensive countermeasures like USD10/hectare chemical costs (FAO 24/02/2015).

The southern African region is already facing the negative effect of climate change like El Niño-induced drought which has affected approximately 40 million people including around 23 million who are in urgent need of humanitarian assistance of which most affected countries are Mozambique, Zimbabwe, Madagascar, Lesotho, Malawi, Swaziland, Angola, and Zambia (Rwomushana *etal*., 2018). This shows dual negative impact on household food security as fall army worm affects regions which are already facing droughts and floods due to climate change.

2.2 Effects of climate change on FAW outbreak

Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Ibrahim and Ward, (2012) explains also that climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Additionally elevated temperatures, CO2 and extreme weather events such as floods and storms have an influence on reproduction, development, survival and distribution of insect pests and diseases in a changing climate (Katsaruware-Chapoto, Mafongoya and Gubba, 2017). There is more build-up of pests during dry spells as lack of rains and increase in temperature provide rightful conditions for rapid multiplication while the spread is also more in different forms like eggs during floods and storms tend to increase the rate of flying by the adult month.

2.3 Collaboration among stakeholders in combating the FAW pest

As the region faces up to new emerging challenges, that are threatening livelihoods over 70% of the population that depend on agriculture, there is crucial need to enhance capacity at country and regional levels to prevent, detect and respond to any new pest and disease threat (FAO, 2018). The Food and Agriculture Organisation is one of the international organisations spearheading the fight against FAW pest in Africa. The goal is to enable African farmers sustainably manage the insect in their fields, with the help of local, national, regional and international research, educational, extension and policy organizations (Food and Security Organization of United nations., 2017). Furthermore, collaboration as indicated by Ibrahim and Ward, (2012) at community level is an essential element that provides farmers platforms for exchange of ideas, information and experiences because the most affected are small-scale farmers who would need support from each other as well as from outside the community.

2.4 Socio-economic effect of the pest

Pests are all organisms causing significant economic damage to crop while diseases are disorders or physiological disturbances of normal functions of plants caused by physical, chemical or biological factors. According to Katsaruware *et al.,* (2017) pests and diseases reduce the income for farmers, crop yield, market prices and value of the affected crop. The aspect of pest and disease in reducing crop productivity, value and quality are some of the major concerns influencing attainment household food and income security among smallholder farmers. The singular item “food” shows its strength in world politics, peace or war since one must eat to sustain life on earth (Maxwell *et al.*, 2013). Therefore, it was important to consider some mechanisms, ways and means to produce enough food, fibre and energy in a much more sustainable manner because food production is central to human development and world peace as emphasised by Maxwell, et al. The household socio-economic survey conducted in Ghana and Zambia to examine farmers’ perception of losses specifically due to FAW over the last full growing season revealed an estimated national mean loss of maize in Ghana was 45% (range 22–67%), and in Zambia 40% (range 25–50%) as outlined in table 1. (Rwomushana *et al.,* 2018). The economic impact of the fall army worm pest at regional level remains source of concern and potential threat to regional development.

Table 1: Regional Economic impact of FAW

FALL ARMYWORM

Table 1. Estimated lower and upper yield and economic losses in the 12 maize-producing countries included in the study (lower and upper losses based on lower and upper quartile of significance in yield loss values for each agro-ecological zone).

Country	Maize production (three-year mean) (thousand tonnes)	Value of maize (three- year average FAO stats) US$ million	Yield loss (lower) (thousand tonnes)	Yield loss (upper) (thousand tonnes)	Mean yield loss (thousand tonnes)	Economic loss (lower) (US$ million)	Economic loss (upper) (US$ million)
Benin	1,285.3	376.5	295.6	735.8	530.4	86.6	215.6
Cameroon	1,665.7	697.8	319.2	794.4	687.4	133.7	332.8
Democratic Republic of Congo	1,173.4	343.7	254.5	633.4	484.2	74.5	185.5
Ethiopia	6,628.3	1,580.2	1,227.2	3,054.7	2,735.2	292.6	728.3
Ghana	1,825.5	629.8	401.6	1,213.9	824.3	138.5	418.8
Malawi	3,344.9	979.7	769.3	1,915.0	1,380.3	225.3	561.0
Mozambique	1,247.2	365.3	286.2	712.4	514.7	83.8	208.7
Nigeria	9,302.7	3,271.8	2,129.1	5,299.7	3,838.9	748.7	1,863.6
Uganda	2,748.3	805.0	558.9	1,391.1	1,134.1	163.7	407.5
Tanzania	5,732.6	1,679.1	1,301.3	3,239.0	2,365.6	381.2	948.8
Zambia	2,913.0	500.9	728.1	1,456.1	1,154.0	125.2	250.4
Zimbabwe	1,104.1	360.7	234.8	584.4	455.6	76.7	190.9
Total	**38,971**	**11,591**	**8,506**	**21,030**	**16,105**	**2,531**	**6,312**

Source: (Rwomushana *etal*., 2018)**.**

From table 1, households are affected as the FAW have an impact on many different aspects of household livelihoods such as the natural capital, through yield losses and the ability of agricultural lands to respond to shocks, financial capital; through increasing the cost of production and also its effect on income; indirectly affect households' social and physical capital (Rwomushana *et al*., 2018). Furthermore, Rwomushana *et al*., (2018) explain that international trade is also being impacted by pest because trade carries the risk of introducing pests to countries where the pest is not yet present, which implies that consignments of food and agricultural products are having additional production or handling requirements with cost implications for the exporters.

2.5 Response practices to pest invasion

Disaster Risk Reduction (DRR) and other forms of risk management should not be seen simply as defensive measures: they also facilitate positive change, especially that effective DRR actions provide development benefits in the short term, as well as contributing to vulnerability reduction in the long term (Bosher and Chmutina, 2017). Learning how other small-scale farmers are coping with the pest outbreak in crop production helps to cross pollinate ideas and practices in the management of the pest. Some practices done by small-scale farmers in Kenya include; identification of effective chemical pesticides; formation of village based spray teams to provide services to affected small-scale farmers, development of spray regime that includes monitoring infestation, early (Kasina, 2017). This shows that, management of the pest requires collective efforts among the farming community members and other stakeholders.

According to the study by Kumela *et al.*, (2019) conducted in Ethiopia and Kenya on small scale farmers' knowledge, perception and management practices of the new invasive fall army worm revealed that about 14% of the farmers in Ethiopia mentioned using handpicking while about 39% of the farmers in Kenya mentioned traditional control methods such as adding soil to plant whorl, drenching tobacco extracts to damage plants. In addition, farmers pointed out that chemical insecticides affect human health and kill bees whereas in Kenya deformed shape of maize was reported.

Many scholars like Ratnadass *et al.*, (2012) have argued that continuous use of chemicals to control pest to be unsustainable and find it necessary for a drastic reduction in pesticide use while keeping crop pest and disease damage under control. It also points out that this can be done using an agro ecological approach whose main pillar is conservation farming practices or introduction of plant diversity in agro-ecosystems.

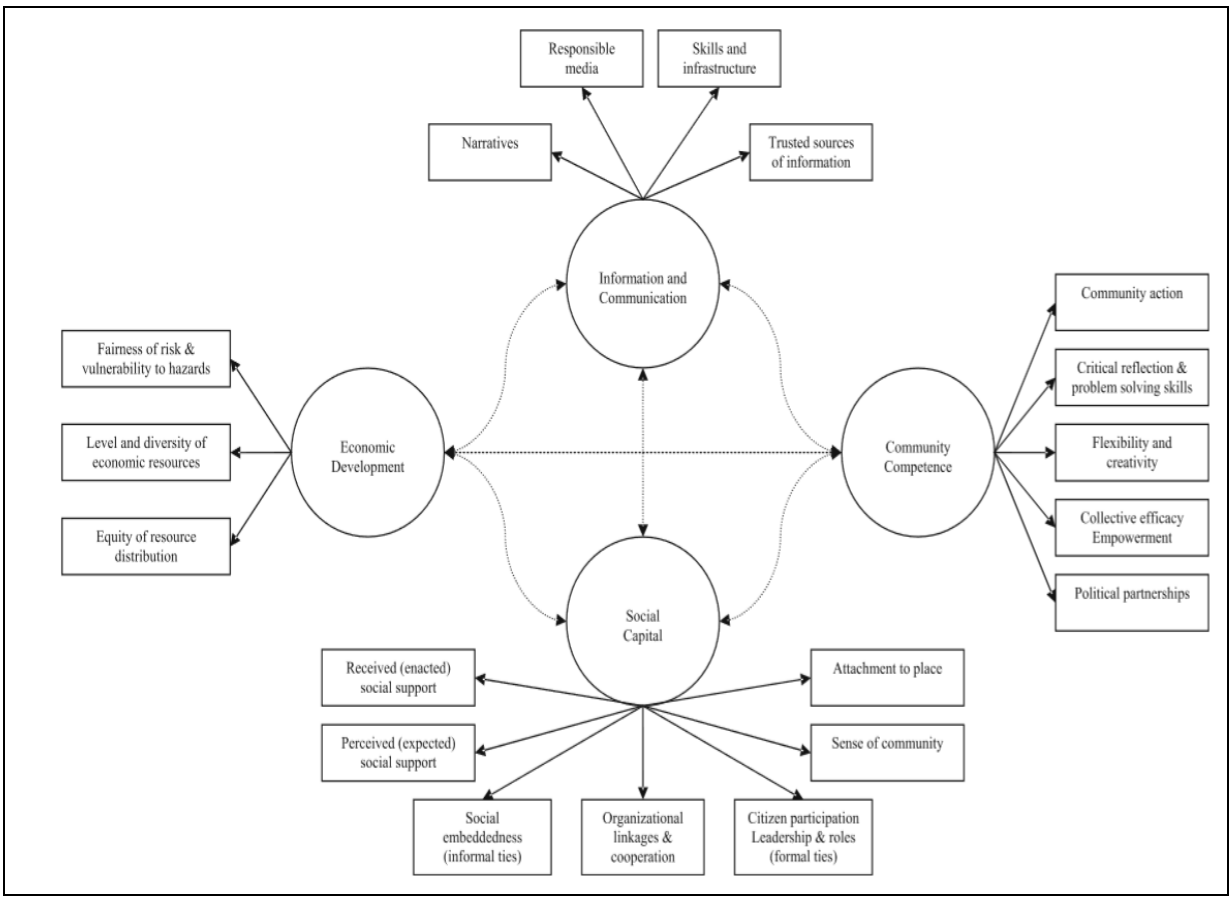
Disaster Risk Reduction (DRR) and other forms of risk management should not be seen simply as defensive measures: they also facilitate positive change, especially that effective DRR actions provide development benefits in the short term, as well as contributing to vulnerability reduction in the long term (Bosher and Chmutina, 2017). Learning how other small-scale farmers are coping with the pest outbreak in crop production helps to cross pollinate ideas and practices in the management of the pest. Some practices done by small-scale farmers in Kenya include; identification of effective chemical pesticides; formation of village based spray teams to provide services to farmers, development of spray regime that includes monitoring infestation, early (Kasina, 2017). This shows that, management of the pest requires collective efforts among farmers.

According to the study by Kumela *et al.*, (2019) conducted in Ethiopia and Kenya on small scale farmers' knowledge, perception and management practices of the new invasive fall army worm revealed that about 14% of the farmers in Ethiopia mentioned using handpicking while about 39% of the farmers in Kenya mentioned traditional control methods such as adding soil to plant whorl, drenching tobacco extracts to damage plants. In addition, in Ethiopia farmers pointed out that chemical insecticides affect human health and kill bees whereas in Kenya deformed shape of maize was reported.

Many scholars like Ratnadass *et al.*, (2012) have argued the continuous use of chemicals to control pest to be unsustainable and find it necessary for a drastic reduction in pesticide use while keeping crop pest and disease damage under control. He also points out that prevention and control can be done through an agroecological approach based on conservation farming practices or introduction of plant diversity in agro-ecosystems. The importance of collaboration at regional and country level for collective effort in addressing challenges associated with fall army worm has been at the centre of discussion as literature reveals.

Furthermore, community approach by small-scale farmers in sharing experiences and finding alternatives or solutions to perceived challenges has not been left out. Therefore, a community is defined as an entity that has geographic boundaries and shared fate (Norris *et al.*, 2008). While other scholars like Douglas, (2010) describes the community as positive aspects of society, a 'good thing' that will improve individual well being, it has emotional overtones, implying familiarity, social and emotional cohesion, and commitment. He explains that; community implies a degree of attachment and belonging which offers a common sense of identity. From his explanation, a ccommunity is anticipated to offer beneficial contributions to build a strong and vibrant society.

Figure 3: Community Resilience Framework



Source: (Norris *et al.*, 2008)

To better understand how the process of resilience capacities produces adapted outcomes. I have opted to use the community resilience frame work (CRF) with a view to concentrate on only 3 capabilities; community competence, social capital and information and communication because the pest outbreak attacks across farmer's fields regardless of their individual capacities. The three adaptive capabilities show how community can build resilience through collective efforts of individual members to deal with the pest outbreak. Resilience is therefore, defined as a set of adaptive capacities which include information and communication, economic development, social capital and community competence (Norris *et al.*, 2008). The framework provides the community with a path to address shocks and stresses which they face, empowering action to reduce vulnerability, improve adaptability and build social capital in the face of hazards and changing conditions. Furthermore, these capacities become adaptive when they are sufficiently mobilised, accessible and have alternative uses to offset stressors. Chapter 2 reveals resilience as a key concept which helps to explain more on farmers' or community's ability to prepare, cope, respond, recover and adapt to fall army worm.

The adaptive capacities are influenced by the external environment which include; political, socio-economic, cultural and natural environment. The Zambian political environment is generally stable even at district level which makes it easier for agriculture service providers to implement their work with minimal interference. The district has two constituencies and two members of parliament, it has councillors at ward level who ensure that government policies are well implemented.

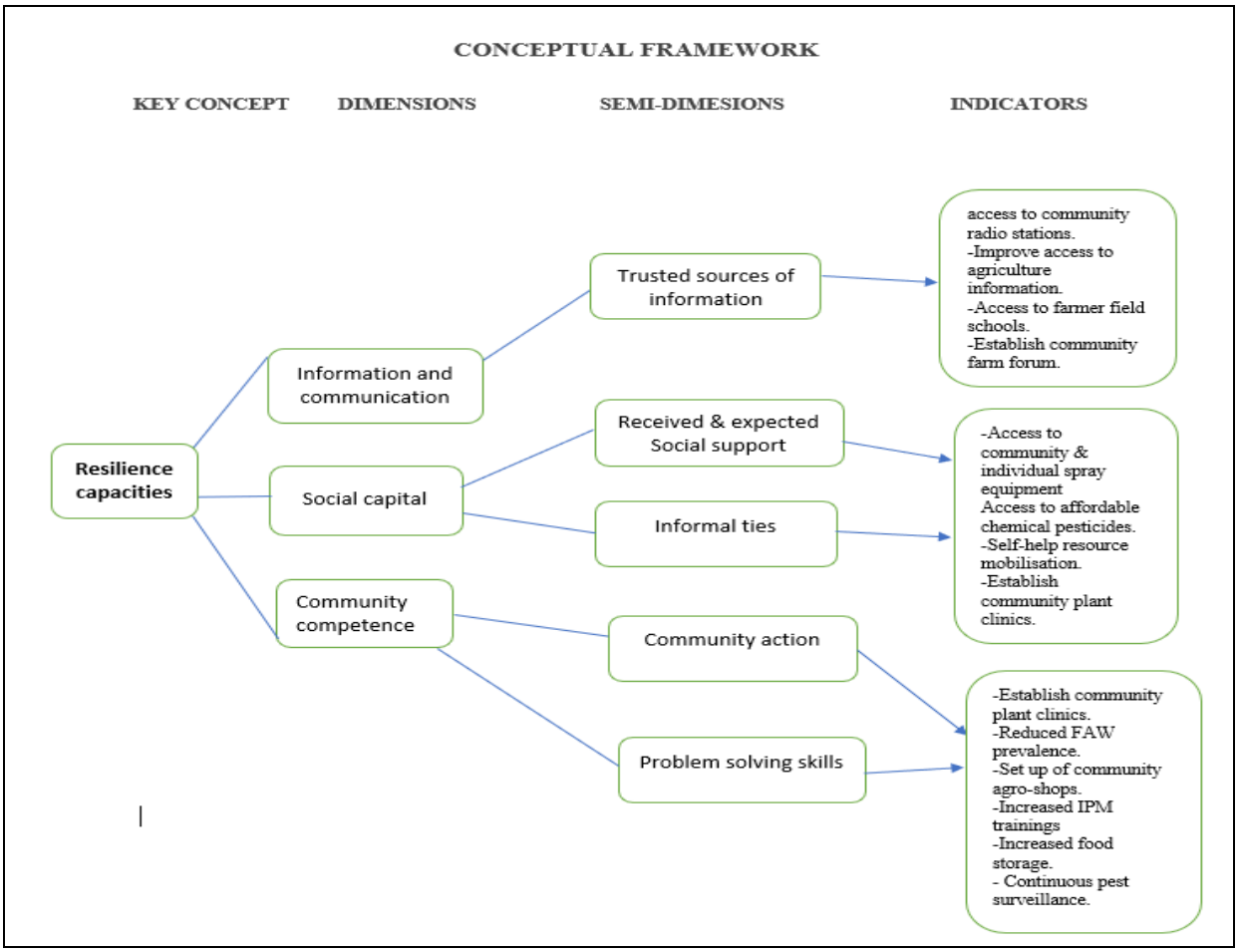
Economically, Zambia is rated as an emerging lower middle-income country, it has been a copper led economy since independence and now making strides to diversify into agriculture led economy. About 80 percent of farmers in Zambia are small-scale farmers and are resource constrained. (GRZ-MOA,

2016). In recent years climate change has significantly impacted on agriculture production in Zambia. The country has persistently experienced droughts, dry spells, floods and wind drafts which have affected crops like maize as well as fish and livestock production (Ngoma, 2008). Kawambwa district is not unexceptional to the effect of climate change which has put resource poor farmers at more risk.

2.6 Operationalisation of concepts

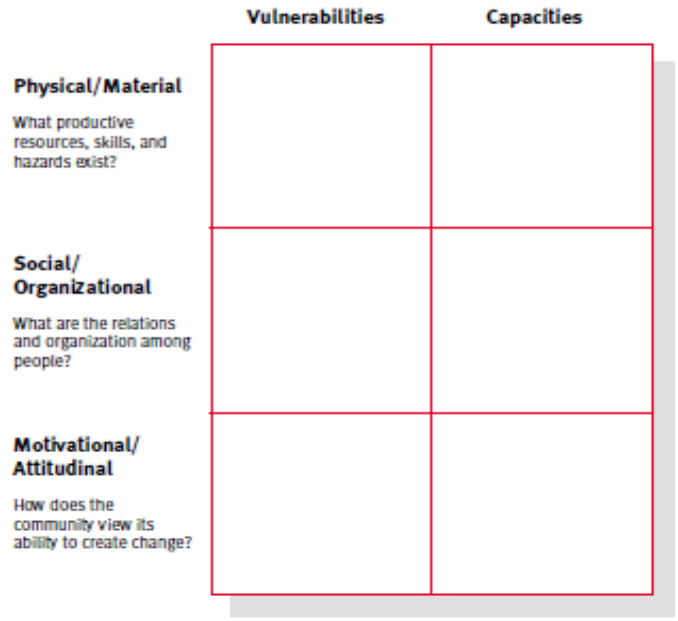
In this study, a cconceptual framework has been developed to operationalise the theoretical framework based on the reviewed literature on fall army invasion of the African region. Among many aspects reviewed include small-scale farmers' response to the pest outbreaks through local knowledge resources, government interventions and other organisation's support. The community resilience framework and capacity and vulnerability analysis aimed at helping to better understand existing capacities among affected as starting points in building resilience capacities to prevent, control or manage the fall army worm invasion.

Figure 4: Conceptual Framework



To achieve my research goal aimed at building small-scale farmers' resilience capacities essential for household food security through appropriate and sustainable measures for preventing, controlling and managing the fall army worm in maize production. Since the attacks by the pest affects community at once and individual farmers get affected differently, I decided to look at problem from community perspective. The Community Resilience Framework has been conceptualised to provide pointers to a resilient community.

Figure 5: Capacity and Vulnerability Analysis



Physical / Material which are the most visible area of vulnerability

Resources include kinds of livelihoods, natural resources such as land, health, skills and labour, infrastructure, housing, finance, technology, assets. Marginalized or poor people suffer from crises more often because they lack savings, income, production or other resources. Poor people are more vulnerable and recover slower(Levine and Chastre, 2011). As outlined, CVA provides information about what makes people affected by disaster more vulnerable and reasons such things to happen.

Sources: Levin and Chastre, (2011).

2.6.1 Social / Organisational which are less visible or less well understood

How society is organised; its internal conflicts and its management include: (in)formal political structures, safety nets, kind of relationships between people/actors, and (in)formal systems through which people get things done (Levine and Chastre, 2011). Poor societies that are well organised and cohesive can withstand or recover from disasters better than. As a tool, the CVA also examines social structure that existed before, during before the disaster and how it could have supported the affected people. It also helps to analyse impact of disasters on social organisation and to provide an understanding for having such an impact.

2.6.2 Motivational / Attitudinal which are poorly visible or understood

This is about how people in society view themselves and how they see their ability to affect their environment or situation. Groups with strong belief systems or experience in co-operating successfully are said to be better positioned to help each other at times of disaster because crises can stimulate communities to make extraordinary efforts (Levine and Chastre, 2011).

The CVA matrix helps to find out reasons for disasters to happen and what could be done better. Such as people's beliefs and motivations, whether fatalistic, hopeful, or dependent. It also provides answers on how crises or disasters affect peoples' beliefs.

Inconclusion, the CVA is rooted in the belief that enabling communities to genuinely participate in programme design, planning, and management leads to increased ownership, accountability and impact, and is the best way to bring about change, (OXFAM, 2012).

2.6.3 Schemes of resilience

Resilience is a term shared by many disciplines (e.g. psychology, engineering and ecology) and has been used in disaster studies since the 1970s (Schipper and Langston, 2015). For many specialists, resilience is believed to be the opposite to vulnerability and, likewise, similar to capacity, while others view capacities more as attributes of individuals and households and resilience as the coming together of capacities with the social, institutional and informational services that enable their effective use

(DFID, 2016). Resilience also emphasizes the importance of not only effectively managing change but also improving well-being in the face of multiple risks and shocks (DFID, 2014).

2.6.4 Trusted sources of information

Prudent and informed decisions can help small-scale farmers as well as the community build capacities that can enable them deal with shocks and stresses (Norris *et al.*, 2008). This implies that communities will need to expand their knowledge and access to information which is trusted and reliable if they are to understand the challenges of future uncertainties and able to develop responses to the emerging impacts of climate change such as the outbreak of fall army worms. In this regard, raising awareness and recognition of trends and their local impacts can be effectively achieved not only through government agencies but also farmer organizations and cooperatives which are active in providing extension services to their members (MoA, 2016). Therefore, access to relevant and timely information relating to impacts and how to deal with such remains to be one of the core capabilities in building resilience capacities. Do communities have access to reliable, prudent and trusted information about the fall army worm and how to deal with it? If at all, communities have access to such information, is it available at any given time and how is it accessed?

2.6.5 Received and expected social support

The build-up of resilience capacities is an important process that requires better understanding on how the affected communities perceive their own challenges or problems (Hossain, 2013). Queries such as; do communities expect external support or is there any form of support being rendered to them? If at all there is some level of support, who is doing it and to what extent? Awareness about such first-hand information on needs assessment can strength collective effort approach and avoid wasting of resources through duplication of efforts among external parties.

2.6.6 Informal ties

Informal ties among rural community members and communities are important forms of social capital in building resilience to confront shocks and stresses. Informal ties can be both strong and weak, yet all are very important in sharping communities (Norris *et al.*, 2008) this implies that weak relations between institutions and individual can provides an opportunity to search for more information while stronger relations can be important for discussion, experimentation and exchange of much more detailed information. The question remains as how do small-scale farmers relate to each other when faced with challenges or do communities promote such interactions aimed problem solving? It would provide guidance on how communities mobilise resources and efforts together to solve perceived challenges like drought, pest and disease outbreak, bush fire control or social events like weddings and funerals.

2.6.7 Community action

People have been facing shock, both natural and mans' influenced and having been devising and innovating a variety of responses including local knowledge based to cope with, recover and prevent future impacts (Pandey and Okazaki, no date). When a community is faced with problem, community members tend to experiment on several options that can best address their challenges depending on the nature of the problem at hand. It is therefore important to be patient with the community during time of challenges to find out what they can do, how they can do it and why taking such actions as well as by considering how the reduction of vulnerability to both shocks and stresses can integrate into daily activities and long-term goals.

2.6.8 Community leadership roles

To help bring a rural community to action, it is necessary for individuals and groups to provide good leadership. When good leadership is provided, people are encouraged to participate voluntarily in the implementation and achievement of set goals. The approach to rural community development is

always through local leaders who not only act as pioneers of projects but also help in influencing and motivating their people to action (Nwankwo, 2008). For any rural community development to be successful, influential local leaders must be involved so that they do not undermine the progress of such programmes. Nwankwo reveals that any agency or organization coming up with a development programme for the community must initially "clear" with these influential local leaders. This shows that the involvement of local leaders is an important aspect that builds community ownership of any intervention aimed at supporting the affected or concerned communities.

2.7 Definition of concepts

Following the review of concepts and theories, the following definitions provide the context in which they have been used in this entire study.

Community: A community is defined as an entity that has geographic boundaries and shared fate (Norris *et al.*, 2008).

Coping strategies: These are usually short term and immediate responses, often prompted by a crisis and are reactive responses which are orientated towards survival (Ibrahim and Ward, 2012).

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration or improvement of its essential basic structures and functions (Bosher and Chmutina, 2017).

Small-scale farmers: Refers to farmers who cultivate less than 5 ha each, consume most of their produce and access land through customary land tenure system (FSAZ, 2009).

Social capital: The basic idea of social capital is that individuals invest, access, and use resources embedded in social networks to gain returns (Norris *et al.*, 2008). Norris explains that social resources include formal and informal relationships; with family friends and neighbours as well as networks such as forums, farmer clubs and farmer groups including co-operatives within the wider community. Rural farmers have high degree of interdependence which makes it easier to address challenges that may arise among them.

This chapter shows how devastating the pest is and that a lot is being done to study about the fall army worm and sharing of information. The pest has rapidly spread into the African region and remains a potential threat to food security at regional, national and household level. Literature reveals what has been done from earlier affected regions to provide broader understanding about the best approaches in combating the best

3 CHAPTER THREE: METHODOLOGY

This chapter provides description of research strategy, the area where the study was carried out, it explains research approach and methods used for data collection. It also outlines sample size for individual household, different data collection tools used and how data was analysed to generate this report. The chapter describes some ethical dilemmas that were encountered during data collection in the field and how such scenarios were managed.

3.1 Research strategy

The strategy for this research was a case study because it focused around an in-depth investigation about what was being done by small-scale farmers, stakeholders and government to prevent, control and manage fall army worm outbreaks in Kanengo agricultural camp of Kawambwa district.

Figure 6: Research study area

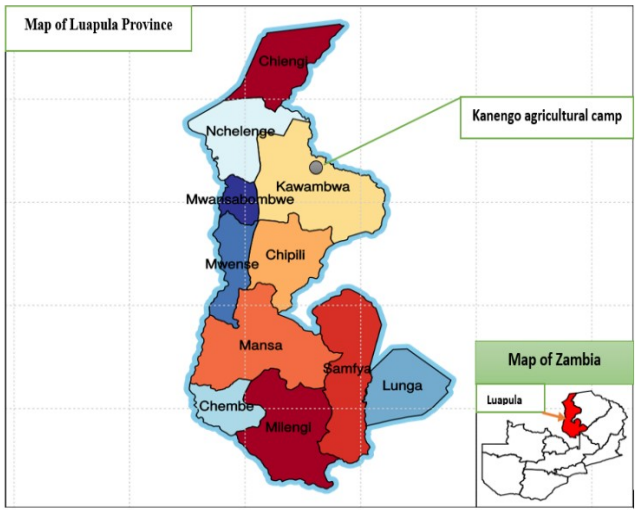


Figure 6. Research study area

The study area was Kawambwa district found in the northern part of Luapula province as shown in figure 6 above. Kawambwa is one of the highest producers of maize in the province and it was the main reason for choosing it as a study area. The district has a total number of 23,000 registered small-scale farmers and about 7,000 are females (MoA, 2016). According to Ministry of agriculture, the district is divided into five agricultural blocks which are Kawambwa central, Luena, Pambashe, Chibote and Musungu agricultural blocks of which each block is divided into agricultural camps.

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

Kawambwa district has twenty-nine agricultural camps. Furthermore, each agricultural camp is divided into zones. Zones are made up of villages and villages are made up of households. Pambashe agricultural block is purposively selected because it has the highest number of small-scale farmers growing maize who are likely to have an encounter with the fall army worm attacks. It has seven agricultural camps namely; Ntembo, Ilombe, Chabanya, Mweo, Wapamesa, Kuymba and Kanengo which was the research camp. Kanengo agricultural camp was purposively chosen because it had the highest number of small-scale farmers (Appendices 1 and 2) who were growing maize and that increased chances of interviewing farmers with pest encounter.

3.3 Research approach

The research approach in this study was qualitative, mainly centred around primary data which was collected from the field for the purposes of understanding small-scale farmers' responses as well as actions taken to prevent, control or manage the pest invasion. However, quantitative data were also collected during individual household interviews which focused much on demographic characteristics of respondents.

3.4 Data collection and sampling methods

Data sources included secondary and primary. Secondary data was collected through literature review of journals, books and news letters on internet using google search engines which informed and guided the entire research process.

Primary data was collected from the field using three different tools as follows;

3.4.1 Individual Household Head Interview (IHHI)

A semi-structured questionnaire was used with a view to collect both qualitative and quantitative data. Data collected included respondents' personal and socio-economic characteristics like age, gender, education level, marital status, family size, primary occupation, income levels from maize production, farming experiences and many more.

A sample of individual respondents was drawn using non-probability method as purposive sampling using snowball; snowball sampling started by interviewing a lead maize farmer who was also purposely selected and thereafter the respondent was asked to refer me as an interviewer to other farmer who shared similar characteristics of growing maize.

This method of sampling was ideal because the study targeted maize grower small-scale farmers and planned to have at least 30% women participation and that was achieved in line with the national agriculture gender policy according to FAO and ECOWAS Commission, (2018) which commits to mainstreaming gender by increase women's access to productive resources including utilisation of information and technology.

Sample size for individual household respondents was 30, included 30% women and got their views about the pest outbreaks. The study being qualitative, the planned sample of 40 was reduced to 30 which provided enough different individual views that answered the research questions.

Data collection for my thesis was done during marketing season of most agricultural produce including maize. In Zambia maize is referred to as a political crop because of government support in subsidising fertilizer and seed as well as buying the same maize through the food reserve agency and government had just announced the price of maize as K110.00/50kg bag while the previous marketing season was K85/50kg bag. The 29.41% maize price increase brought about happiness among small-scale farmers and could have had influenced the manner interviewees responded especially during individual household head interviews.

3.4.2 Key Informant Interviews (KII)

This was aimed at collecting different views about challenges associated with fall army worm pest outbreak since 2016 farming season and how small-scale farmers were coping with the pest in the district. Some of the views from key informant were compared with those from individual household head interviews and focus group discussions to draw some valid conclusions. Therefore, six key informants were strategically selected and interviewed as follows;

The camp extension officer (CEO)

At district level, the camp officer is the last person in the hierarchy of the ministry of agriculture and the officer is always in close contact with small-scale farmers. I considered him to be an important source of information for the farmers in the camp with potential influence on the farmers' decision making due to his function as an advisor on agriculture related issues. However, my work relationship with him could have had an influence in the manner he responded because he may not have wanted to disappoint me by providing answers differently.

The District agriculture co-ordinator (DACO)

My entry point in the district was through the District agriculture co-ordinator (DACO) because my research is purely agriculture based. I had a wonderful and exciting welcome by the DACO who happened to be my supervisor at district level. Little did he know that he was one of the key informants to be interviewed and that was not easy for me to interview my boss because our work relationship could have had an influence in the way he responded. The DACO being the chief executive officer for the ministry of agriculture at district level. I considered him to be well vested with agriculture related programs in the district and as potential source of information about the fight against fall army worm.

The executive director for Kawambwa District Farmers Association (KDFA)

The executive director spearheads the mother body of small-scale farmers at district level and was considered a potential source of information about the fight against fall army worm.

The District Co-operative Union (DCU) Former chairperson
The district co-operative union spearheads co-operatives' movement in the district. The chairperson was considered a potential source of information on farmers collective efforts and responsibilities in resource mobilisation aimed at addressing challenges associated with farming in the district.

The village headman
The village headman as a traditional leader at village or community level was considered as a potential source of information on norms, values, customs as well as community mobilisation in addressing perceived challenges.

Omnia fertilizers sale representative
The agro-dealer represented private sectors involved in the supply chain of agricultural chemicals, fertilizers, seeds farm equipment. The company was considered as potential source of information on how the private sector work with farmers in addressing challenges associated with pest and disease control

3.4.3 Focus Group Discussion (FGD)
It was conducted using questions or certain experiences that were more pronounced during individual household interviews. The focus group interview aimed at collecting different views from both male and female participants on how and why the pest was a problem and relevance of collective effort in pest management or if any suggestions to deal with the pest better.
The FGD comprised of; two lead farmers even though the initial plan was to have both male and female but only males turned up and could not be sent back. Lead farmers were exposed to trainings in various farming practices and were found useful in sharing their knowledge and experiences.

Two small-scale farmers provided independent views as they practiced conservation farming as a livelihood strategy. The group also had three executive co-operative members (one male and two female) and were instrumental in sharing experiences especially on collective responsibilities in their farming.

Two women club members were also engaged and provided their views because in most instances women's voices were suppressed in public debates. The engagement of male and female young farmers helped to harness ideas from youths on how local knowledge was shared to them on maize production with regards to pest management.

How the FGD Proceeded
An opening prayer was offered by a volunteer, self- introduction was done, after which an agenda and house rules were proposed and adopted. The group also adopted mixed language which meant that use of local language "Bemba" and some English which was subjected to interpretation for the sake of detailed clarity. One member volunteered to be a time keeper and all participants were recorded in attendance register.
During discussions some questions required detailed participation to bring out more information hence formation of mini-groups provided equality and equitable participation by all members. Each member was privileged to some presentation on behalf the mini-group. There were serious questions from the rest of participants. Two different ice-breakers by participant were performed as way of refreshing to gain higher concentration for the next activity.

As a facilitator my main role was to moderate the proceedings so that the main objective of the discussions was achieved.

3.5 Ethical considerations

During data collection, ethical dilemmas were experienced since data collection was done during harvesting of maize and most small-scale farmers were guarding their farm produce against post-harvest losses as well as preparing for surplus maize marketing. In that regard, time was a very scarce farmers' resource. Therefore, every single minute was properly utilised by making appointments with interviewees in advance so that they re-schedule their daily activity calendar to accommodate time for interviews. Some respondents gave personal sensitive opinions about mismanagement of public resources by those charged with leadership responsibilities in Pambashe co-operatives society. Such situations were managed by upholding highest level of confidentiality, withholding names during data analysis neither mentioned anything which easily disclosed their identity in the report.

Conducting research in very familiar environment with small-scale farmers I have worked with over 4 years was such as great challenge to because even some respondents were not too sure about my role despite introductory remarks. However, applied research was a new experience to me and that made the whole processing of research new. On the other hand,it was an advantage to me because talking to farmers, community members and organising meetings through appoints really helped and my good relation with farmers in the district.

Table 2: Summary of Methodology

SUB-RESEARCH QUESTION	METHOD	SAMPLE SIZE	ATTAINMENT OF OBJECTIVE	WHERE AND HOW IT RELATES TO CRF
What are factors causing rapid spread of fall army worm among small-scale farmers?	KII, FGD, IHHI	30 IHHI, 6 KII, 1FGD (11members)	Information was collected that provided factors causing rapid spread of fall army worm among small-scale farmers	It related to community competence. What factors were contributing to rapid spread of fall army worm?
What are farmers' practices being carried out by small-scale farmers to counter FAW occurrences?	IHHI, FGD, KII	30 IHHI, 1 FGD (11 members) and 6KII	Information on farmers' practices being carried out by smallholder farmers to counter FAW occurrences.	That related to community competence. What actions that small-scale farmers are taking in the fight against FAW?
What are the limitations facing small-scale farmers in the fight against fall army worm?	KII, FGD and IHHI	30 IHHI, 1 FGD (11 members) and 6KII	Information on limitations facing small-scale farmers in the fight against fall army worm.	That related to Community competence. Challenges that community could be facing in solving their problems.
How are stakeholders in agriculture sector (e.g. farmer organisations, agro-input suppliers) influencing control of fall army worm?	KII, FDG and IHHI	30 IHHI, 1 FGD (11 members) and 6KII	Information was collected concerning stakeholders in the agriculture sector and how they influenced the control of fall army worm.	Both social capital and community competence. How does support from organisations help communities build resilience?
How is government through ministry of agriculture engaging small-scaler farmers to prevent, control or manage fall army worm pests?	KII, FDG, IHHI	30 IHHI, 1FGD (11 members) and 6KII	Information about government's role through ministry of agriculture on how it engaged small-scale farmers to prevent, control or manage fall army worm pests.	Social capital and community competence. Did communities receive expecting social support?

3.6 Data analysis

The Data compiling started right in the field alongside collection of data and that provided self-check about response variations. Clarification was immediately sought about the software or program used in the analysis. In that regard, data analysis was computed using Microsoft Excel which generated descriptive statistics. Data analysed included both qualitative and quantitative which have been presented in tables, charts and graphs form to describe findings that provided answers to research questions. I realised that descriptive analysis was not an easy task, making sense of what was said and providing an explanation to what was not said.

The views of the focus group discussions were analysed and reported as a single unit coming from one group. This means that no single view was reported as the views of a participant or individual.

4 CHAPTER FOUR: RESEARCH RESULTS

This chapter describes the research area and analysis of data collected from 30 individual household interviews, 6 key informant interviews drawn from across the Kawambwa district and one focus group discussion with 11 members drawn from within Kanengo agricultural camp. Research findings provide answers to research questions.

Kanengo agricultural camp is located 65 kilometres North-East of Kawambwa district along the main tared road from Kawambwa town centre to Luwingu district in the Northern province of Zambia. The camp as shown in appendix 1 is sub-divided into 5 zones for administrative purposes of which this research or study was conducted in zone 4. Each zone is made up villages and there are 10 villages doted across the camp. The camp has 620 households with a total population of 4783 while the total number of registered small-scale farmers are 992 of which 420 are female. Kanengo agricultural camp has 6 registered farmers' organisations found in all the zones and the study zone has Pambashe co-operative society and Kanengo information centre under the auspices of Zambia National Farmers Union (ZNFU). The major crops grown in the camp are Maize, cassava and groundnuts for both food and income security.

4.1 Demographic characteristics

During data collection, 30 individual household heads who belong to small-scale farmers that cultivate less than 5ha of land were interviewed using a semi-structure questionnaire.

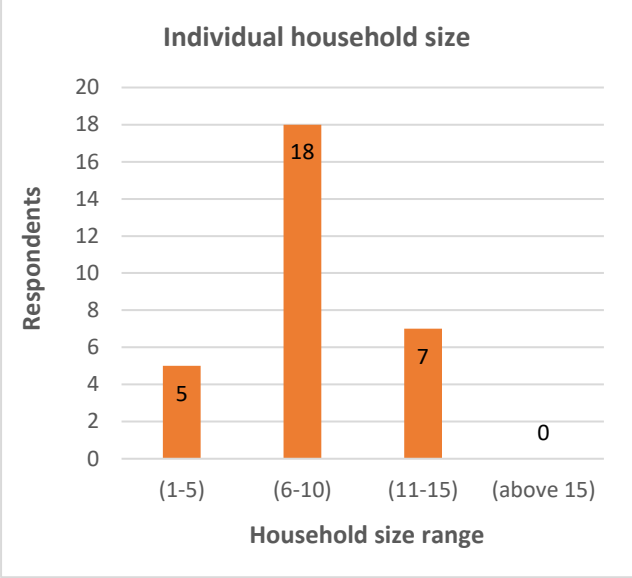
Table 3: Age of respondents by gender

Age group (Years)	**Male**	**Female**	**Total**	**Percentage**
Youths (18 – 35)	6	3	9	30
Adult-mid age (36 – 55)	14	5	19	63
Old people (Above – 55)	1	1	2	7
Total	**21**	**9**	**30**	**100**
Percentage	70	30	100	

Source: Own research data, (July 2019)

The age was classified in terms of youths, adult-mid age and the old people as shown in table 1. It shows that 63% of respondents were in the category of adult-mid which is relatively a productive age while the most productive age group had 30% respondents and the less productive age had only 7% respondents. It is also gratifying to note that out of all the respondents 30% were female and 70% were male which attained minimum threshold concerning women participation in developmental programs as indicated in chapter three under sample selection.

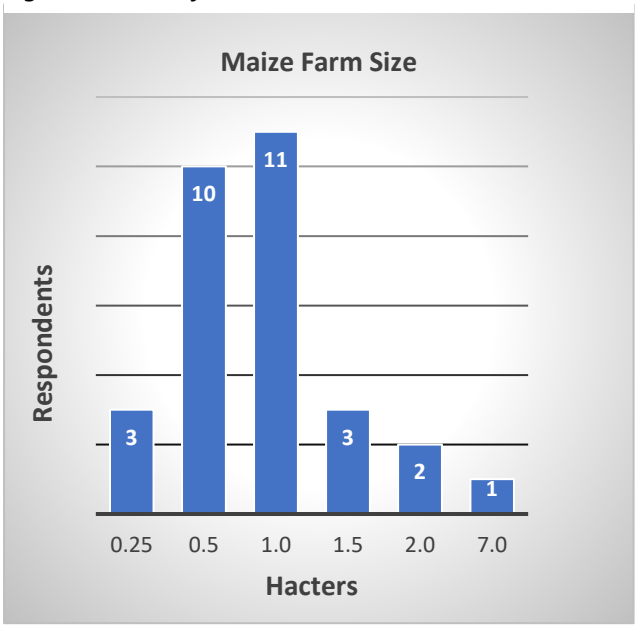
Figure 7: Individual household size



As indicated in figure 7; in terms of household size, majority of the respondents had their household size ranged between 6 and 10 while 7 respondents had the largest size which ranged between 11 and 15 members. The smallest household size with less than 5 household members was from 5 respondents. The size of a household was found to be very important in communities because small-scale farmers practiced substance farming which is highly dependent on family labour and households with relatively bigger family size had higher chances of combating the pest by using different methods that required human labour.

Source: Own research data, (July 2019)

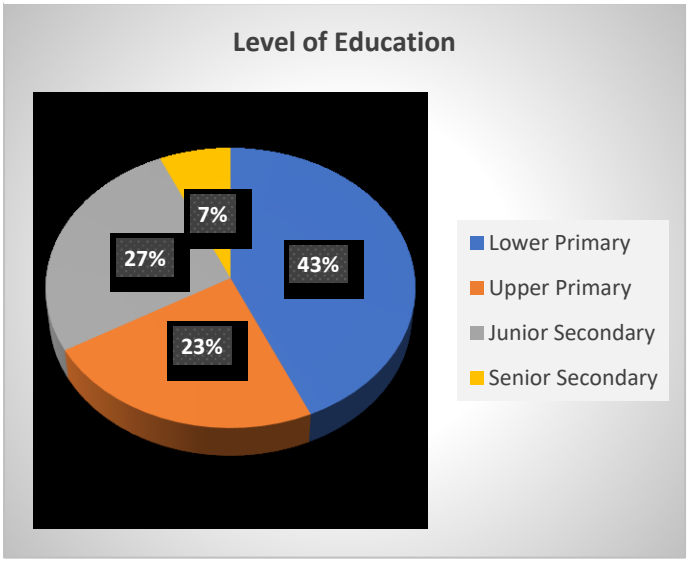
Figure 8: Maize farm size



All the respondents interviewed were small-scale farmers and cultivated less than 5ha of land except for one who registered 7ha because had combined with the spouse land of 2ha. In Kanengo, it was found that men had absolute right to land ownership because according to the respondents it's a man who should have control over land while only a few women had control under special circumstances but that was not a common practice. When probed about farm size, respondents indicated that they only register land size which was under cultivation, other than that they vast land which was not open for farming, such an arrangement was referred as land reserves for future use especially by the young generation and those not yet born.

Source: Own research data, (July 2019)

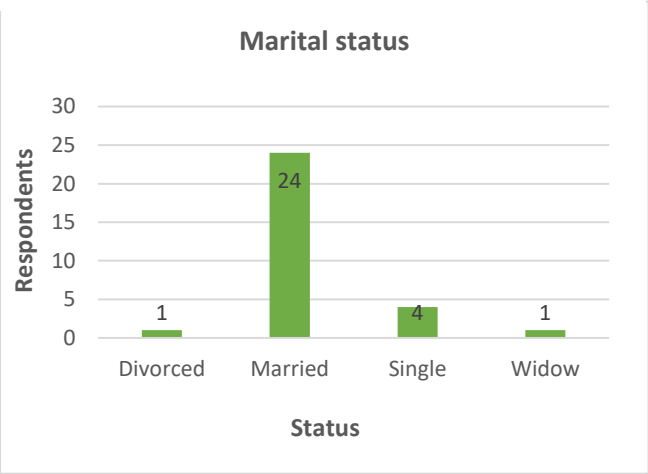
Figure 9: Respondents' education level



Source: Own research data, (July 2019)

Majority of the respondents went up to lower primary representing 43% while only 23% went up to upper primary school. For secondary school majority attained junior secondary representing 27% and 7% reached senior secondary. According to the education system in Zambia, both primary and secondary schools are categorised as out lined by Simposya, (2002) full primary is 7 years, divided in 4 years lower and 3 years upper. Junior secondary or basic, is 9 years i.e. add 2 years above Gr. 7 while full Secondary is 12 years i.e. Junior is 2 years above Gr.7 and senior is 3 years above Junior.

Figure 10: Respondents' marital status



Source: Own research data, (July 2019)

Figure 10 shows that out of total number of 30 respondents; 24 were married, 4 were single while 1 was divorced and the other one widowed. According to social and cultural arrangements of communities in Kanengo agricultural camp, marriages are based on traditional norms, beliefs and values. For example, it was easier for a woman to be divorced or remain single as a widow rather than a man because people believed that a man could not take care of himself but needed a wife to support him with cooking and other household chores.

Some interviewees explained that Young men qualified for marriage once they were cable of doing some work like farming, fishing, hunting to provide food for the family while young women were ready for marriage any time after their initiation ceremonies into adulty women. This study found out that from 70% of male respondents there was no one who was single. Furthermore, the higher percentage of married respondents was explained that culturally households with both husband and wife were regarded to be the strength and dignity of communities which meant that the more a community had married people the more dignified it became.

4.2 Predisposing factors to fall army attacks among small-scale farmers

Table 4: Rate of FAW pest

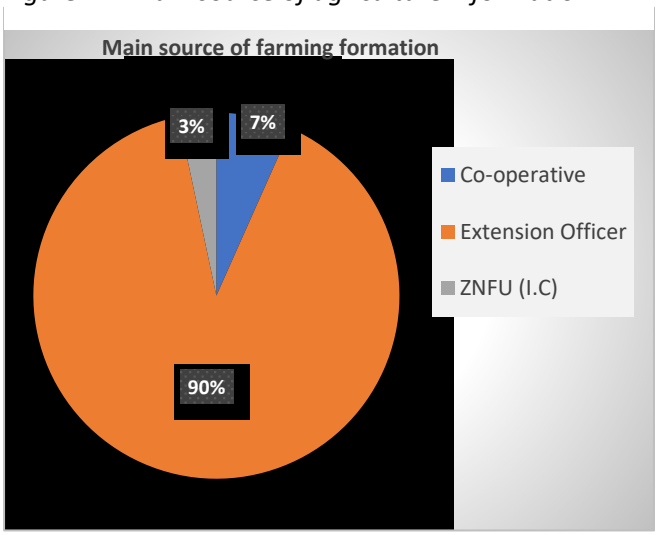
Rate of spread	Individual Respondent	Percentage
Rapid	22	73
Slow	8	27

Source: Own research data, (July 2019)

Table 4 shows respondents' perception on the level of fall army worm spread among small-scale farmers and factors contributing to such a level of spread. From the total number of 30 respondents who were interviewed, 73% indicated that the spread was rapid because the fall army worm laid many eggs and could fly long distances, some said they lacked sprayers and chemical pesticides while others said that mono cropping of maize on the same piece of land and recycling of seed by planting seed obtained from previous harvest. It was also explained that late acquisition of farming inputs (maize seed and fertilizer) under government support program led to late planting, poor maize field hygiene due to poor weeding, plant spacing and intercropping. Drought was another serious factor because it was associated with higher temperatures and humidity which favoured mating, laying of more eggs and flying to new places and that maize was highly prone to FAW attack. However, 27% of respondents indicated that the pest spread was slow because it was difficulty to identify it during early stage of invasion while others said that they lacked knowledge about the spread of the pest and its behaviour.

As indicated under literature review above coping strategy of an individual is highly influenced by his or her access to new information and knowledge. As part of the interview I asked small-scale farmers about their main sources of information, knowledge and advice to improve their livelihoods.

Figure 11: Main source of agriculture information

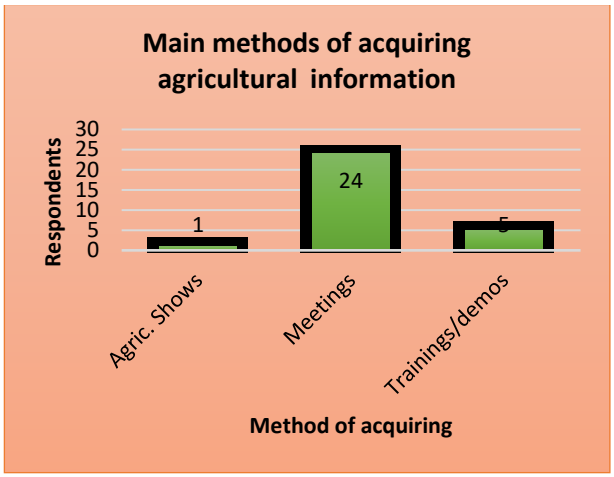


Source: Own field data, (July 2019)

Majority of the respondents up to 90% indicated that their main source of agriculture information was through the camp extension officer while 7% said it was through co-operatives and only 3% said information centre under the Zambia national farmers' union (ZNFU). It was also explained about reliability of the same information that respondents accessed as majority of respondents explained that there were positive results whenever they implemented what they discussed during meetings with the camp extension officer. Similar explanations by some key informants that agricultural information shared by the camp officer was improving small-scale farmers outputs

such yields, pests and disease reduction and access to market information. One of the key informants provide similar explanation about camp extension workers as being competent, skilled and knowledgeable in agricultural programs because he was familiar with the college curriculum where the officer obtained his training. While during the focus group discussion on the reliability and trustworthy of agriculture information received through the extension officer, the group confirmed about improvement in production and productivity as well as being a link between the farming community and the government.

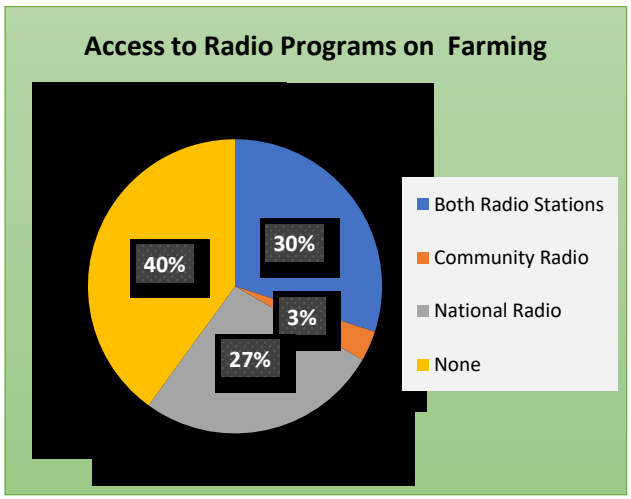
Figure 12: Methods of acquiring information



Out of 30 households interviewed about their main methods of acquiring agricultural information for improving their livelihoods, 80% of them indicated that meetings were the main methods while 17% respondents indicated that trainings coupled with demonstrations were found effective because of practical component which improved implementation of acquired skills on their individual farms and 3% indicated to have learnt and shared farming experiences during exhibitions at agricultural show. When asked about reliability of information accessed within the community through different methods as.

Source: Own research data, (July 2019)

Figure 13: Access to Radio programs



Majority of small-scale farmers interviewed had access to radio information about farming; 30% accessed both national and community radio stations. However, 27% and 3 % of respondents accessed national and community radio stations respectively. From the total respondents about 40 percent did not have access to radio information on farming due to several reasons such as lack of radio cassettes, agricultural programs were aired when they had no time to listen to the radio stations as well as lack of radio batteries while others talked about poor radio channel receptions. During FGD the group was quick to explain

Source: Own research data, (July 2019)

Advantages that communities in Kanengo agricultural camp had in terms of accessing mobile phone networks from all the three mobile service providers. Community radio, can provide the platform for the public dialogue through which people can define who they are, what they want, and how to get it, at the same time building long-term capacity to solve problems in ways that lead to sustainable social change and development (Restrepo-, Fraser and Restrepo-estrada, 2002). The group explained that for those community members who had phones with radio facilities where able to access radio programs at any given time. During individual interviews, one female respondent stated categorically that;

"We need the old system where we use to listen to radio programs in communities specifically listening to agricultural programs from the radio facilitated by agriculture office. This would step up agriculture information dissemination to rural communities especially using community radio stations like Radio Lukwanga… ***Twapapata mukwai mukabebukisheko kuba mucilile abakuntashi*** meaning that please go and remind those people in authority who are above you"

4.3 Economic Effect of FAW invasion on maize production

Table 5: Maize yield and income for 2018/2019 farming season

Maize Field (Ha)	Actual Yield (50kg bag)	Expected Yield (50kg bag)	Actual income (ZMK)	Expected income (ZMK)	Income loss (ZMK)
1	60	80	6600	8800	2200
1	80	100	8800	11000	2200
1.5	70	100	7700	11000	3300
1	50	90	5500	9900	4400
1.5	50	80	5500	8800	3300
0.5	12	22	1320	2420	1100
0.5	3	20	330	2200	1870
0.5	25	30	2750	3300	550
1	40	80	4400	8800	4400
7	325	500	35750	55000	19250
2	165	200	18150	22000	3850
2	150	180	16500	19800	3300
1	40	80	4400	8800	4400
0.5	12	40	1320	4400	3080
1	45	80	4950	8800	3850
1	30	25	1650	3300	1650
1	50	150	5500	16500	11000
1	33	100	3630	11000	7370
0.5	34	62	3740	6820	3080
1	80	100	8800	11000	2200
1.5	80	130	8800	14300	5500
0.25	32	25	3520	2750	-770
0.5	50	100	5500	11000	5500
1	50	100	5500	11000	5500
0.25	6	25	660	2750	2090
0.5	30	50	3300	5500	2200
0.5	18	40	1980	4400	2420
0.5	18	50	1980	5500	3520
0.5	30	50	3300	5500	2200
0.25	15	20	1650	2200	550
22	**1683**	**2709**	**183480**	**298540**	**115060**

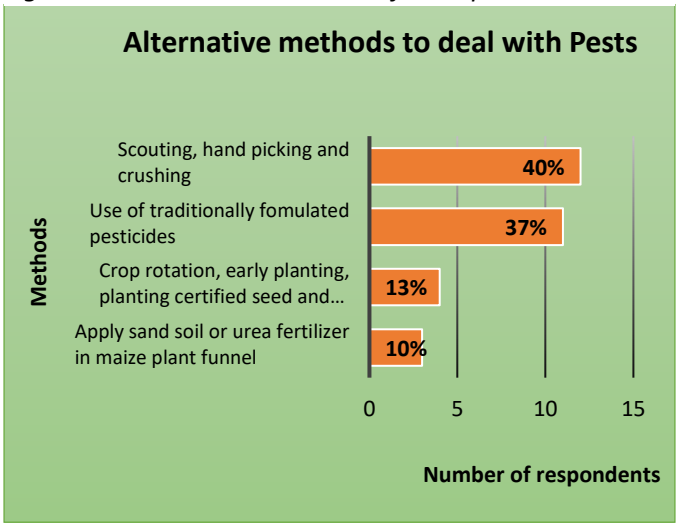
Source: Own research data, (August 2019).

The table above, shows reduction in maize yield from 2018/2019 farming season for all household heads that were interviewed except for one respondent who had a marginal increase of 28% in maize

yield and income respectively. The respondent explained that the increase was attribute to early planting, use of certified maize seed, early weeding, early insect scouting and crushing use of locally formulated plant pesticides and had been practicing crop rotation since 2016 farming season when the pest was first reported. However, the rest of the respondents had varying yield losses and income with an average of 57 x 50kg bags and K3,941 respectively. The yield reduction was mainly attributed to fall army worm attack, late planting, dry spells and poor soils due to mono-cropping. During interviews with the camp extension officer he explained that the camp aggregate production trends indicated maize yield (appendix 2) increase but most households in communities recorded reductions (Table 5).

4.4 Coping strategies to FAW attacks by small-scale farmers

Figure 14: Alternative methods of FAW pest control



Source: Own data, (July 2019)

Source: (Rwomushana,et al, 2018)

Figure 14 shows that out of 30 individual respondents interviewed on alternative farming practices in the fight against fall army worm pest, 40% of them explained that they used pest scouting, handpicking and physically crushing the pest to death. Others explained that the method helped to deal with the pest in its larva stage of life cycle.

About 37% respondents explained that they were using conventional or traditionally formulated pesticides which they applied in maize field because of the availability of raw materials. Meanwhile 13% of respondents explained that they used crop rotation, early planting of certified maize seed and keeping the field weed free because of access to information about the alternative methods of control other than chemical pesticides.

Only 10% of respondents mentioned that they applied sand soil or urea fertilizer inside the maize plant funnel where the pest had a tendency of hiding even though urea fertilizer was reported to be damaging plants and caused deformed maize cobs. While when a similar subject was brought to the attention of key informants for discussion; key informant interviewee (KII 003) said as an option; a few small-scale farmers were always on the lookout for any possible pests and kept their maize fields clean through weeding and adherence to crop spacing in order to uphold high level of field hygiene. KII 002 explained another alternative practice as;

"Small-scale farmers do cut the affected funnel of the maize plant which later on regrows even though this method is less effective because snipping causes injury to the plant resulting into stress, stunted growth and smaller cob formation which reduces yields."

While (KII004) said a few farmers were implementing good post-harvest management practices such as disposing off the infested crop residues by burying or burning where possible. He also said that some farmers were involved in information sharing about alternative methods pest control.

Figure 15: Focus Group Discussion

It was much more interesting when the same subject matter was brought under discussion during the focus group discussion because it was detailed and much more elaborated; the group explained about small-scale farmers' practices such as physical pest scouting. The group explained that the method of scouting was too involving and require proper timing if someone had to see the pest. When it's raining or too cold the pest hibernates and difficult to find tiny one. Higher temperatures expose the pest and crushing of the pest using fingers is can be achieved.

Source: Own research data, (July 2019)

"This calls for careful opening of the maize plant funnel until the pest is found and crushed to death and the method is only effective when the pest is much more visible."

The group felt that there was no single method that effectively dealt with the pest, rather the combination of different practices from local knowledge proved to deal with the pest much better.
In this study, it was found that most small-scale farmers were using traditionally formulated pesticides. An explanation from one individual respondent, also confirmed during FGD explained that materials were chili and *tephrosia vogelii* (locally known as ubuuba) pounded together for thorough mixing, soaked in water and then sprayed using a traditional broom. If properly used, the formulated pesticide was effective even though it required a lot of raw materials. Similarly a study done in Kenya by Kamau, (2018) indicates that combination use of plants kill pests as well as provide nutrients to maize crop. He further reveals that such plants are chillies, garlic, stinging nettles, tithonia, neem and lantana camara.

4.5 Challenges faced by small-scale farmers in combating FAW pest

During individual respondents' interviews, some respondents explained that; there was lack of clear and well elaborated information in communities on the characteristics and behaviour of the pest that would enable small-scale farmers to make practical and well-informed decisions.

While key informants revealed that there was too much over dependence on government by small-scale farmers because most of them viewed the pest as a governance issue which always needed government intervention. During individual interviews, most of them explained that; such tendencies disadvantaged them because in most cases government's support if available was not always on time and could not cater for every farmer such as chemical pesticides as well as other subsidised farming inputs like seed and fertilizer.

Local leaders in most instances could not do anything in relation to community mobilisation as revealed during individual household interviews which limited how information about the pest was being shared in the communities. Some respondents explained that there were leadership gaps to spearhead community-based approaches in combating the fall army worm pests.

Bearing in mind that the fall army worm pest was relatively new in Zambia and that most farmers were caught off guard, there was an aspect of lack of knowledge among small-scale farmers on how to

overcome the pest using different methods of control. Therefore, an aspect of trial and error was the order of the day among small-scale farmers until such a time when they established the methods that were seemingly workable. In their "own farm research" most small-scale farmers even though could not scientifically explain the science behind their local knowledge practices; the use of botanical or herbal pesticides in combination with other practices like weeding, crop rotation, intercropping or handpicking and crushing were found helpful in reducing effect of pest invasion on maize.

4. 6 Capacity and Vulnerability Matrix by the FGD

The focus group discussion laboured to establish what could have contributed to outbreak of the pest and its spread while the group also came up with capacities existed among the affected small-scale farmers and communities.

Table 6: CVA for Kanengo Agricultural Camp

Physical/Material what productive resources, skills and hazards exists?	**Vulnerability**	**Capacities**
	-Lack of shops where to buy farming inputs, e.g. Chemical pesticides, fertilizers or certified seeds. -Inadequate protected sources of safe and clean drinking water. -Poor feeder roads linking productive areas e.g. individual farms in the farming block and other neighbouring villages. -Poor communication network (constant breaking down, on and off such as Airtel, MTN, Zamtel networks. -Lack of Hydro Electrical Power (No connections to the National grid). - Hiding of available resources, skills and expertise by community members	- Availability of both primary and secondary school - Availability of health facilities e.g. clinic with qualified staff -Availability of skilled manpower e.g. agricultural officer, Teachers, Health personnel, Community development officer. -Availability of local skill, hunting, fishing, local beer brewing, bicycle repairing, harmer mill operators, - Availability of solar generated power. - Availability of harmer mills with one industrial solar powered and five diesels powered. -Access to tarred main road linking three main towns i.e. Kawambwa, Mansa and Luwingu -Access to road transport by bicycle, motor bike and motor vehicle. -availability of storage sheds with capacities of over 500 metric tons Availability of co-operative houses.
Social/Organisational what are the relations and organisations among people?	**Vulnerability**	**Capacities**
	-Arguments at the expense of development among members of the community. -Selfishness among community members. -Lack of faithfulness in sharing success stories among community members. -selfishness among community members	- Availability of registered farmer organisations. - Commitment of community members to the needs of the organisation. -Availability of traditional leaders who provide guidance on community peace and stability. - Access to communication facilities increased close contacts and strengthened social capital among community members.

		- Access to government facilities such as schools, clinics, tractor and its implements. - most community members were related either by marriage, blood or clan which increased bond of social capital.
Motivational/attitudinal How does the community view its ability to create change?	**Vulnerability** - some community members are afraid of negative outcomes for their actions. - Threats from community members exhibited towards those perceived to be hard working. - Low education levels among community members -Some community members were too lazy to work, had a dependency syndrome by looking for handouts. - Failure to pay co-operative membership fee and shares. - High level of corruption in the community especially among leaders in different organisations or groups.	**Capacities** - Access to education facilities such as academic schools, farmer field schools, farmer study circles, trainings in agriculture production and marketing. -Available farmer organisations which are registered as legal entities and have members with mutual benefits. -Community result oriented projects encourage members to work even much harder e.g. exhibitions during agricultural shows, self-help projects -Availability and access to market for most agricultural produce and farming inputs within the district. - Availability of locally trained farmers to help fellow farmers such as lead farmers, contact farmers, seed growers. - Practicing and use of advanced farming inputs and equipment such as industrial solar harmer mill.

From the discussion above, it was interesting to learn from the mini-groups presented on some of the available skills that existed in communities such as carpentry, bricklaying, tyre mending, motor bike and bicycle repair. Others were, tailoring, weaving, hunting and fishing. It was shocking to learn that even witch craft was among problem solving skills that was used to silence trouble makers in communities.

All these were found to be useful in communities in times of need and that was also explained during individual household head interviews. However, it was also noted that in most cases witch craft was used as an act of jealous which usually caused divisions in communities.

The study revealed that communities in Kanengo agricultural camp were engaged in addressing challenges almost on daily basis similar to literature which explains that problem solving skills; enable communities to build capacities to analyse hazards and stresses, improve hazard prevention and protection, increase early warning and awareness, establish contingency and emergency planning and building back better (Norris *et al.*, 2008).

Figure 16: Respondents' awareness of stakeholders

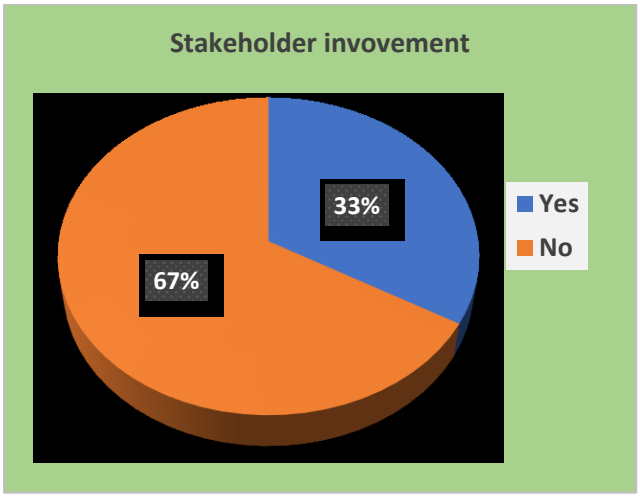


Figure 6 shows small-scale farmers awareness on the involvement of stakeholders in the fight against fall army worms. 67% of the respondents indicated being not aware about stakeholders' support. While those with awareness 33% explained that the major stakeholder they knew about was government through ministry of agriculture and its staff. However, during the FGD, the group explained several stakeholders such as ministry of education, community development, some NGOs implementing health related programs.

Source: Own research data, (July 2019).

During key informants' interviews, the respondents highlighted some stakeholders such as farmers' organisations, community and local leaders and the private sector

In conclusion, it was found that the main source of agriculture information including FAW was the camp extension officer and the main channel of information delivery was through meetings. Majority of the respondent explained that they used local knowledge in combating the pest and this include formulation and application of plant herbicides, physical crushing of the pest, use of sand and urea while those who could have used chemical pesticides indicated that it was in 2016 farming season when government provided. Results also show that the economic effect of the pest was evidenced by its contribution to yield reduction and income loss.

5 CHAPTER FIVE: DISCUSSION

This chapter discusses research results as analysed in chapter four. It discusses factors causing rapid spread of the pest, stakeholder involvements in the fight against FAW, farmers' practices used by small-scale farmers and limitations faced. The chapter ends by discussing government engagement of SSF in the fight against FAW pest.

5.1 Factors causing rapid spread of the FAW pest

The fall army worm is a migratory pest FAO, (2017) from USA and it is known to have caused extensive damage of maize crop. Therefore, the study investigated about how the pest was spread among small-scale farmers in Kanengo agricultural camp.

5.1.1 Characteristics of the fall army worm pest

Some individual households interviewed explained that the FAW pest lays a lot of eggs within a short period of time and fly long distances. This makes the increase in the number of pest as supported by Sage-el, (2017) and the life cycle of 21 days is very short in which female ones start to lay eggs, Loftin, Lorenz and Corder, (2016) and FAO, (2017) talk about the same. While during focus group discussion, it was further explained that; the FAW pest has several plants/crops it can survive on, especially that during the planting season almost all the small-scale farmers grow maize and increase chances of spread to other areas with maize crop. I believe that understanding the life cycle of the pest is key, it would be easier to holt further spread of the pest because such information help to disturb its life cycle even by agronomic practices like crop rotation, intercropping and field hygiene.

5.1.2 Availability and access to information about the FAW pest

Information sharing is one of the key factors in promoting social change and development because people have their individual perceptions about their situation. Restrepo, et al., (2002) explains that what is required for change and development is a collective perception of the local reality and of the options for improving it. During my interviews, some individual respondents explained that lack of knowledge among small scale farmers on how to overcome the pest using different methods of control was another recipe for increased devastation of maize by the pest. Sustainable management of FAW pests by FAO, (2017) indicates that several other communication mechanisms like pictures of pest, posters showing life cycle, newsletters, brochures and radio announcements for awareness creation are also key in ensuring that as many farmers as possible are aware of the available options. Similarly, this study revealed that small-scale farmers who lacked information (27%) or did not have a wider source of information thought the spread was slow because they did not know how the pest spread. To me this, indicates that; with access to correct and reliable information, small-scale farmers can better understand their problems and make informed decisions for action. Other than that, the affected would remain undecided about their fate.

5.1.3 Community action and problem solving

Farming practices that small-scale farmers used, and how they maintained level of field hygiene influenced the rate of pest spread. Some interviewees explained that continuous growing of maize crops on same piece of land increased pest build up in terms of eggs laid on crop residues and below soil surfaces. According to the study on sustainable agriculture in East Africa; pest and disease life cycle are broken by planting different crops, (Kamau, 2018). I am equally in support that crop rotation and intercropping are some of the environmentally practices that can reduce not only level of pest and disease but improve soil fertility (Ratnadass *et al.*, 2012). Many respondents including key informants indicated that small-scale farmers rarely practised crop rotation because they avoided the cost of bush clearing to open new fields, lacked access to other certified seed like beans and cassava while some were comfortable with the idea of growing one crop on the same piece of land. It was also noted that most small-scale farmers were planting late because of receiving inputs late e-voucher subsidies which increased chances of pest build up. Maize that was planted late usually caught up with dry spells and as such, the pest build up is higher as explained by as Rwomushana *et al.,* (2018) due

to higher temperatures and humidity making the pest to flourish and lay more eggs as well as fly from one place to another.

5.1.4 Weather variability due to climate change

Drought, floods and pest infestation have resulted in a decrease in crop production (SADC, 2019). Since drought is associated with high temperature as well as low humidity favoured mating of male and female FAW pest. During interviews some farmers pointed out that in the past they never used to experience serious dry spells which had become common. The national agricultural extension and advisor services strategy reveals that Zambia has not been spared from increasingly prolonged drought periods (MoA, 2016). Another literature on vulnerability assessment report (SADC, 2019) indicates that factors like drought and floods were affecting allocation of scarce resources to fight the pest invasion.

5.2 Farmers practices to counter FAW occurrences

Small-scale farmers in Kanengo agricultural camp were not unexceptional to the use of traditionally formulated pesticides, chemical pesticides and mechanical methods of pest control as well as some agronomic practices that reduced pest build up.

5.2.1 Use of local knowledge in dealing with the pest

Others (Kuteya and Chapoto, 2017) resorted to use different drastic measures such as detergents. Studies conducted on sustainable management of fall army worm pests in North America particularly in Mesoamerica reveal that; many of these smallholder farmers apply ash, sand, or soil into the whorls and report significant control of FAW, while other farmers report using soap solutions or local botanical mixtures, (FAO, 2017). In cross pollinating ideas and practices from diverse regions and different small-scale farmers on the use of local knowledge in the fight against fall army worm indicates that small-scale farmers were generally more into integrated pest management practices which overtime have been found to be much more sustainable and cost effective. Furthermore, this is in agreement with a study by Kumela *et al.*, (2019) conducted in Ethiopia and Kenya on small scale farmers' knowledge, perception and management practices of the new invasive fall army worm in which about 14% of female farmers in Ethiopia mentioned using handpicking while about 39% of the female farmers in Kenya mentioned traditional control methods such as adding soil to plant whorl, drenching tobacco extracts to damage plants.

In my view, small-scale farmers' local knowledge in combating fall army pest is mainly founded on the principles of integrated pest management approach. According to FAO of the United Nations, (2018) Integrated pest management (IPM) is a science-based, common-sense approach for reducing populations of disease vectors and public health pests. The organisation explains that IPM uses a variety of pest management techniques that focus on pest prevention, pest reduction, and the elimination of conditions that lead to pest infestations. It simply means (1) don't attract pests, (2) keep them out, and (3) get rid of them, if you are sure you have them, with the safest, most effective methods.

5.2.2 Use of collective effort to deal with the FAW pest

Collective effort was mostly exhibited in farmers' organisation such as co-operatives through which most extension services were channelled. Most interviews including key informants confirmed that small-scale farmers joined co-operatives to access government support and other developmental programs. Sharing of farmers' experiences about the pest attack were commonly through community meetings, on-farm demonstrations, field-days and agriculture shows. However, there were no collective efforts that pointed to fight against the pest other than when government intervened through mass spraying, even though Ibrahim and Ward, (2012) argues that collaboration at community level is an essential element that provides farmers platforms for exchange of ideas, information and experiences.

5.3 Limitations facing small-scale farmers in the fight against fall army worm

There are several limitations to combat fall army worm pests, however what is being presented in this section are issues that were considered during interviews where as other factors were captured under different questions.

Nearly all respondent explained had used chemical pesticides because government provided in 2016 when the pest was first reported. However, respondents explained that most small-scale farmers did not continue using chemical pesticides in the following years because they could not afford to buy. In addition, it was explained that women especially female headed households concerned about risk of chemical poisoning because of other household roles like cooking, taking care of children made it difficult for them to use chemical pesticides. During FGD, it was explained that concerns which were raised by women were common in 2016 when government provided the chemical pesticides. However, IAPRI quarterly bulletin by Kuteya and Chapoto, (2017) reveals that small-scale farmers were over-dependant on government to continue providing them chemical pesticides even when they can afford. In my view, farmers have the right to choose when to spend their money, if alternative methods are working out for them at a least cost and do not harm the environment then they need support to do it even better. I also found that most respondents went only up lower primary school, therefore feel that due to their illiteracy level, it's difficult for them to convince learned people on why they make such choices like use of plant pesticides un like chemical pesticides.

5.4 Stakeholders involvement in the control of fall army worm

Most farmers interviewed explained that they did not know any stakeholders other than officers from ministry of agriculture. However, some of them identified agro-dealers who were supplying farming inputs in the district as important stakeholders even though they quickly explained that most of them were seasonal agro-dealers. This study found out that majority of small-scale farmers about 67% did not know about stakeholders because there was lack of contact with individual small-scale farmers or communities.

Zambia has a private sector driven economy (Kuteya and Chapoto, 2017) therefore, government cannot do everything it takes to manage the pest but instead would need other players as its revealed in a study on impact and implication of fall army worm in Africa by Rwomushana, et al., (2018) successful control of FAW in Africa requires coordinated action from multiple stakeholders, operating within an enabling framework set by national governments and regional or international institutions. I also support that combating the pests requires collective efforts including communities which are affected. Literature about fostering resilience by engaging similar minded stakeholders by Heijmans, (2013) notes that communities alone cannot solve all their risk problems. Heijmans also explains that because village authorities do not operate at the appropriate administrative level to address the underlying risk factors. This is evident that there is need for holistic approach in the fight against fall army worms, vertical connections with authorities and powerholders either central government, local government, private sector or community authorities because their influence is important in problem solving.

5.5 Government involvement of SSF in combating fall army worm

According to literature from FAO, (2017) when the pest was first reported in Zambia as an immediate action government supplied to small-scale farmers chemical pesticides, sprayers and other protective clothing to combat the pest. Chemical pesticide distribution was accompanied by hands on training through demonstrations to the affected small-scale farmers. Although chemical pesticides play an important role in managing pests such as the fall armyworm, they can also pose unacceptable risks to human health and the environment (Fruits, Organic and More, 2013). Other than risks associated with chemical pesticide use, Kamau, (2018) argues also that some chemical pesticides are too expensive

for the small-scale farmer who can alternatively use plant pesticides. It is government view to continue supporting small-scale farmers in conservation agriculture (MoA, 2016).

Despite unclear explanation from individual interviewees on how government involved small-scale farmers in the fight against the fall army worm paste, government has deliberate policy through ministry of agriculture to provide extension services to small-scale farmers. This study found that majority of respondents including key informants confirmed that agriculture information shared by extension staff proved to improve crop production and productivity when properly implemented by end users. Furthermore, all the individual household head respondents were beneficiaries of the farmer input support program in which farming are subsidised under e-voucher system. Small-scale have been supported with maize market through Food Reserve Agency (FRA). Once farmers are empowered, they buy other legume seeds for crop rotation, buy farming in puts and plant early.

The fight against fall army worm demands collective efforts from all stakeholders who are engaged in the agriculture sector including government. From the discussion in this section, there is no one single method that can effectively combat the pest but the correct use of several methods in combination would has been found to be effective.

6 CHAPTER SIX: CONCLUSION AND RECOMMENDATION

This chapter discusses how research findings answer the main research question and the sub-questions which were asked. It considers the conclusion drawn from the results and discussions from which the recommendations for further action are based. The chapter also looks at contribution to knowledge and suggestion for further investigations to improve small-scale farmers' coping strategies to the outbreak of fall army worm pests.

6.1 Conclusions

The objective of this research was to investigate what was done by small-scale farmers as coping strategy to prevent, control or manage fall army worm outbreaks in Kawambwa district in order to make recommendations to the Zambian government through ministry of agriculture on how to improve resilience capacities to prevent, control and manage the pest. The main research question was; "What measures are being employed to combat fall army worm outbreaks by farmers of Kawambwa district in Luapula province of Zambia?" To get answers to this main question, sub-questions were formulated to enable the researcher find answers which subsequently addressed the objective of the research.

Based on the findings and discussions, it has been established that among many other factors that contributed to rapid spread of the pest among small-scale farmers in Kawambwa district included; late acquisition of farming inputs especially maize seed and fertilizers which resulted into late planting. Late planting increased chances of pest build up because it was usually associated with dry spells. Dry spells are associated with higher temperatures and humidity which are suitable for pest build up. It was found that the fall army worm thrived more under such weather conditions in terms of feeding, laying of eggs and flying longer distances to different places.

This study establishes that the farmers' practices done by small-scale farmers were related local knowledge based which were similar with integrated pest management (IPM) approach because there was little reliance on chemical pesticides except when government provided in 2016, even though that did not cater for every small-scale farmer that was affected.

The other challenges found in this study associated with chemical pesticides were too expensive for a small-scale farmer, non-availability within the reach of small-scale farmers, in ability to read and write since most respondents went only up to lower primary school. Risks of chemical poisoning for women who had additional household roles of cooking and looking after the family especially children.

The use of urea which is a top-dressing fertilizer was found to cause deformation of maize cobs and that the method was not sustainable because urea was expensive given the market price per bag. Small-scales endeavoured to share information on pest invasion, its characteristics and possible ways of preventing, controlling or managing it in their own way during co-operative and community meetings.

Government support was recorded when the pest was first reported in 2016, it supplied chemical pesticides and early maturing seed with alongside on-farm demonstrations or short trainings on how to use the chemical pesticides and sprayers. In the following farming season, there were no such kind of support apart from subsidising of farming inputs under the farmer input support programme where eligible small-scale farmers could redeem chemical pesticides at will. However, government continued supporting small-scale farmers with agriculture information sharing through the camp extension officer.

In conclusion, the fall army worm pest remains a source of concern and potential threat to household food and income security and that its prevention, control or management requires collective effort of the affected small-scale farmers, stakeholders and the government. Furthermore, there is no single method to combat the pest but rather demands combination use of different methods practiced by small-scale farmers based on local knowledge including handpicking, crushing, use of sand soils as well

as formulated plant pesticides. The science-based methods include crop rotation, intercropping, early planting, weeding and use of certified seed and fertilizer. Information sharing about the pest is an important component to in combating the pest.

6.2 Recommendations

In view of the findings and conclusions established in this research, the following recommendations are made aimed at building small-scale farmers' resilience capacities to combat the FAW pest and be able to improve household food and nutrition security, household income and the wellbeing of rural communities.

6.2.1 To small-scale farmers

Small-scale farmers are encouraged to practice early planting, crop rotation, intercropping, weeding to provide field hygiene because this will disturb life cycle of the pest and reduce the risk of regular outbreaks while improving soil fertility.

Small scale farmers are advised to continue being on the lookout for pest presence in order to take decisive measures to prevent damage and prevent further spread.

Small-scale farmers are encouraged to set up co-operative consumer shops that can stock seeds for different crops and farming implements and equipment which support combating of the pest.

6.2.2 Community leaders

Community leaders like village headmen, sub-chiefs, counsellors, and lead farmers are encouraged to improve on their leadership roles about awareness creation about the pest, good natural resource management like forests, water and environment that would support combating of the FAW pest. By providing good leadership, community member will easily participate voluntarily in taking measures that will combat the pest.

6.2.3 To government

Ministry of agriculture in Kawambwa district is recommended to re-package extension messages on integrated pest management (IPM) which are tailored for small-scale farmers in the district to combat the fall army worm pest.

The district office is encouraged to provide refresher trainings to camp extension officers to equip them with more knowledge about the new pest.

The district office through the department of national agriculture information service is advised to develop extension messages about the life cycle, spread, damage, preventive and control measures of the pest which can be disseminated, during farmers meetings, agriculture shows and any other farmers forum.

The department can as well make publications about the pest through posters, newsletters that can be shared with the camp extension officers, lead farmers to increase awareness about the pest.

The district office is encouraged to take keen interest to assess the traditionally formulated plant pesticides in order to standardise it and be able to use even knap sack sprayers during application unlike use of brooms.

6.2.4 Stakeholders

Stakeholders like District Farmers Union and District Co-operative union are encouraged to improve their interactions with small-scale farmers and develop activity plans which support combating of the pest. This is because the two unions represent small-scale farmers affaires and interests in different ways.

Agro-dealers selling farming inputs are encouraged to set up permanent shops in communities and stock a variety of inputs that support the combating of the best so that small-scale farmers can access in puts of their choice at any given time of the year.

Lastly but not the least, further research is recommended on the best plant species that can be combined to formulate plant pesticides to effectively deal with the fall army worm pest.

REFERENCES

Bosher, L. and Chmutina, K. (2017) 'Disaster Risk Reduction', *Disaster Risk Reduction for the Built Environment*, pp. 21–44. doi: 10.1002/9781119233015.ch2.

Central Statistical Office (CSO) [Zambia], M. of G. (2014) 'Gender Status Report - Zambia 2012 - 2014'.

DFID (2016) 'WHAT IS RESILIENCE ?', (May).

Douglas, H. (2010) 'International Encyclopedia of Civil Society', (January), pp. 0–8. doi: 10.1007/978-0-387-93996-4.

FAO (2017) 'Sustainable Management of the Fall Armyworm in Africa FAO Programme for Action', (October).

FAO (2018) 'Fall Armyworm in Africa : Situation & Programme', (April).

FAO and ECOWAS Commission (2018) *National gender profile of agriculture and rural livelihoods-Ghana*. Available at: http://www.fao.org/3/a-i6997e.pdf.

Farming Systems Association of Zambia (2009) 'Agricultural water management national situation analysis brief', *Sectoral Development Strategies*, (August), pp. 1–4. Available at: http://awm-solutions.iwmi.org/Data/Sites/3/Documents/PDF/Country_Docs/Zambia/Situation Analysis Brief Zambia.

Food and Agriculture Organization of the United Nations, F. A. O. (2018) *Integrated management of the Fall Armyworm on maize*. Available at: http://www.grainsa.co.za/upload/FAO---FAW-Guide.pdf.

Food and Security Organization of United nations. (2017) 'Sustainable Management of the Fall Armyworm in Africa FAO Programme for Action', (October). Available at: http://www.fao.org/3/a-bt417e.pdf.

Fruits, W., Organic, I. and More, F. (2013) 'Health Risks of Pesticides in Food What Fruits and Vegetables have the most'.

GRZ-MOA (2016) 'Second National Agriculture Policy', p. 2016.

Heijmans, A. (2013) 'Handbook Resilience 2.0 for aid practitioners and policymakers'.

Hossain, A. (2013) 'Community Participation in Disaster Management : Role of Social Work to Enhance Participation', 9, pp. 159–171.

Ibrahim, M. and Ward, N. (2012) 'From Vulnerability to Resilience : A handbook for programming design based on field experience in Nepal From Vulnerability to Resilience : A handbook', p. 72.

Kamau, P. (2018) 'Importance of crop rotation in organic farming Plant sweet potatoes to take advantage of the rains', (154).

Kasina, M. (2017) 'Satus of Fall Army Worm in Western Kenya'.

Katsaruware-Chapoto, R. D., Mafongoya, P. L. and Gubba, A. (2017) 'Responses of Insect Pests and Plant Diseases to Changing and Variable Climate: A Review', *Journal of Agricultural Science*, 9(12), p. 160. doi: 10.5539/jas.v9n12p160.

Kumela, T. *et al.* (2019) 'Farmers' knowledge, perceptions, and management practices of the new invasive pest, fall armyworm (Spodoptera frugiperda) in Ethiopia and Kenya', *International Journal of Pest Management*. Taylor & Francis, 65(1), pp. 1–9. doi: 10.1080/09670874.2017.1423129.

Kuteya, A. N. and Chapoto, A. (2017) 'E-Voucher Performance and Recommendations for Nationwide

Rollout during the 2017 / 18 Farming Season', (89), pp. 1–8.

Levine, S. and Chastre, C. (2011) 'Nutrition and food security response analysis in emergency contexts', *Humanitarian Policy Group*, (December), p. 10. Available at: http://www.fao.org/emergencies.%5Cnhttp://www.cosv.org/download/centrodocumentazione/SicurezzaAlimentare.pdf.

Loftin, K., Lorenz, G. and Corder, R. (2016) 'Managing Armyworms in Pastures and Hayfields', pp. 1–6. Available at: https://www.uaex.edu/publications/PDF/FSA-7083.pdf.

Maxwell, D. *et al.* (2013) 'Response Analysis and response choice in food security crises: a roadmap', 44(73), pp. 1–34. Available at: www.odihpn.org.

MoA (2016) 'The National Agricultural Extension & Advisory Services Strategy', *Training manual*, (January).

Ngoma, J. (2008) 'EFFECT OF CLIMATE CHANGE ON MAIZE PRODUCTION IN ZAMBIA .'

Norris, F. H. *et al.* (2008) 'Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness', *American Journal of Community Psychology*, 41(1–2), pp. 127–150. doi: 10.1007/s10464-007-9156-6.

Nwankwo, N. (2008) 'The Role of Local Leaders in Community Development Programmes in Ideato Local Government Area of Imo State : Implication for Extension Policy', 12(2), pp. 63–75.

OXFAM (2012) 'PARTICIPATORY CAPACITY AND VULERABILITY ANALYSIS A PRACTITIONER ' S GUIDE', (June).

Pandey, B. and Okazaki, K. (no date) 'Community Based Disaster Management : Empowering Communities to Cope with Disaster Risks Bishnu Pandey and Kenji Okazaki'.

Patterns, B. and Occurrence, S. (2017) 'ACAPs Thematic Report: Armyworm outbreak in Africa - Fall Armyworm outbreak', pp. 1–4.

Ratnadass, A. *et al.* (2012) *Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: A review*, *Agronomy for Sustainable Development*. doi: 10.1007/s13593-011-0022-4.

Restrepo-, S., Fraser, A. C. and Restrepo-estrada, S. (2002) 'Community Radio for Change and', 6370(200212), pp. 69–73.

Rwomushana, I., Bateman, M., Beale, T., Beseh, P., Cameron, K., Chiluba, M., Clottey, V., Davis, T., Day, R., Early, R., Godwin, J., Gonzalez-Moreno, P., Kansiime, M., Kenis, M., Makale, F., Mugambi, I., Murphy, S., Nunda. W., Phiri, N., Pratt, C., Tambo, J. (2018) 'Fall Armyworm : Impacts and Implications for Africa Evidence Note update, October 2018', (October), pp. 1–53. doi: 10.1564/v28.

SADC (2019) 'Vulnerability Assessment Committee Results 2019 RVAA', p. 19.

Sage-el, K. (2017) 'Tanzania - United Republic of Fall Armyworm in Tanzania and East Africa'.

Schipper, E. L. F. and Langston, L. (2015) 'A comparative overview of resilience measurement frameworks approaches', (July).

Simposya, W. K. (2002) 'Educational System in Zambia', (October 1964), pp. 129–140.

Bosher, L. and Chmutina, K. (2017) 'Disaster Risk Reduction', *Disaster Risk Reduction for the Built Environment*, pp. 21–44. doi: 10.1002/9781119233015.ch2.

Central Statistical Office (CSO) [Zambia], M. of G. (2014) 'Gender Status Report - Zambia 2012 - 2014'.

DFID (2016) 'WHAT IS RESILIENCE ?', (May).

Douglas, H. (2010) 'International Encyclopedia of Civil Society', (January), pp. 0–8. doi: 10.1007/978-0-387-93996-4.

FAO (2017) 'Sustainable Management of the Fall Armyworm in Africa FAO Programme for Action', (October).

FAO (2018) 'Fall Armyworm in Africa : Situation & Programme', (April).

FAO and ECOWAS Commission (2018) *National gender profile of agriculture and rural livelihoods-Ghana*. Available at: http://www.fao.org/3/a-i6997e.pdf.

Farming Systems Association of Zambia (2009) 'Agricultural water management national situation analysis brief', *Sectoral Development Strategies*, (August), pp. 1–4. Available at: http://awm-solutions.iwmi.org/Data/Sites/3/Documents/PDF/Country_Docs/Zambia/Situation Analysis Brief Zambia.

Food and Agriculture Organization of the United Nations, F. A. O. (2018) *Integrated management of the Fall Armyworm on maize*. Available at: http://www.grainsa.co.za/upload/FAO---FAW-Guide.pdf.

Food and Security Organization of United nations. (2017) 'Sustainable Management of the Fall Armyworm in Africa FAO Programme for Action', (October). Available at: http://www.fao.org/3/a-bt417e.pdf.

Fruits, W., Organic, I. and More, F. (2013) 'Health Risks of Pesticides in Food What Fruits and Vegetables have the most'.

GRZ-MOA (2016) 'Second National Agriculture Policy', p. 2016.

Heijmans, A. (2013) 'Handbook Resilience 2.0 for aid practitioners and policymakers'.

Hossain, A. (2013) 'Community Participation in Disaster Management : Role of Social Work to Enhance Participation', 9, pp. 159–171.

Ibrahim, M. and Ward, N. (2012) 'From Vulnerability to Resilience : A handbook for programming design based on field experience in Nepal From Vulnerability to Resilience : A handbook', p. 72.

Kamau, P. (2018) 'Importance of crop rotation in organic farming Plant sweet potatoes to take advantage of the rains', (154).

Kasina, M. (2017) 'Satus of Fall Army Worm in Western Kenya'.

Katsaruware-Chapoto, R. D., Mafongoya, P. L. and Gubba, A. (2017) 'Responses of Insect Pests and Plant Diseases to Changing and Variable Climate: A Review', *Journal of Agricultural Science*, 9(12), p. 160. doi: 10.5539/jas.v9n12p160.

Kumela, T. *et al.* (2019) 'Farmers' knowledge, perceptions, and management practices of the new invasive pest, fall armyworm (Spodoptera frugiperda) in Ethiopia and Kenya', *International Journal of Pest Management*. Taylor & Francis, 65(1), pp. 1–9. doi: 10.1080/09670874.2017.1423129.

Kuteya, A. N. and Chapoto, A. (2017) 'E-Voucher Performance and Recommendations for Nationwide Rollout during the 2017 / 18 Farming Season', (89), pp. 1–8.

Levine, S. and Chastre, C. (2011) 'Nutrition and food security response analysis in emergency contexts', *Humanitarian Policy Group*, (December), p. 10. Available at:

http://www.fao.org/emergencies.%5Cnhttp://www.cosv.org/download/centrodocumentazione/SicurezzaAlimentare.pdf.

Loftin, K., Lorenz, G. and Corder, R. (2016) 'Managing Armyworms in Pastures and Hayfields', pp. 1–6. Available at: https://www.uaex.edu/publications/PDF/FSA-7083.pdf.

Maxwell, D. *et al.* (2013) 'Response Analysis and response choice in food security crises: a roadmap', 44(73), pp. 1–34. Available at: www.odihpn.org.

MoA (2016) 'The National Agricultural Extension & Advisory Services Strategy', *Training manual*, (January).

Ngoma, J. (2008) 'EFFECT OF CLIMATE CHANGE ON MAIZE PRODUCTION IN ZAMBIA .'

Norris, F. H. *et al.* (2008) 'Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness', *American Journal of Community Psychology*, 41(1–2), pp. 127–150. doi: 10.1007/s10464-007-9156-6.

Nwankwo, N. (2008) 'The Role of Local Leaders in Community Development Programmes in Ideato Local Government Area of Imo State : Implication for Extension Policy', 12(2), pp. 63–75.

OXFAM (2012) 'PARTICIPATORY CAPACITY AND VULERABILITY ANALYSIS A PRACTITIONER ' S GUIDE', (June).

Pandey, B. and Okazaki, K. (no date) 'Community Based Disaster Management : Empowering Communities to Cope with Disaster Risks Bishnu Pandey and Kenji Okazaki'.

Patterns, B. and Occurrence, S. (2017) 'ACAPs Thematic Report: Armyworm outbreak in Africa - Fall Armyworm outbreak', pp. 1–4.

Ratnadass, A. *et al.* (2012) *Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: A review*, *Agronomy for Sustainable Development*. doi: 10.1007/s13593-011-0022-4.

Restrepo-, S., Fraser, A. C. and Restrepo-estrada, S. (2002) 'Community Radio for Change and', 6370(200212), pp. 69–73.

Rwomushana, I., Bateman, M., Beale, T., Beseh, P., Cameron, K., Chiluba, M., Clottey, V., Davis, T., Day, R., Early, R., Godwin, J., Gonzalez-Moreno, P., Kansiime, M., Kenis, M., Makale, F., Mugambi, I., Murphy, S., Nunda. W., Phiri, N., Pratt, C., Tambo, J. (2018) 'Fall Armyworm : Impacts and Implications for Africa Evidence Note update, October 2018', (October), pp. 1–53. doi: 10.1564/v28.

SADC (2019) 'Vulnerability Assessment Committee Results 2019 RVAA', p. 19.

Sage-el, K. (2017) 'Tanzania - United Republic of Fall Armyworm in Tanzania and East Africa'.

Schipper, E. L. F. and Langston, L. (2015) 'A comparative overview of resilience measurement frameworks approaches', (July).

Simposya, W. K. (2002) 'Educational System in Zambia', (October 1964), pp. 129–140.

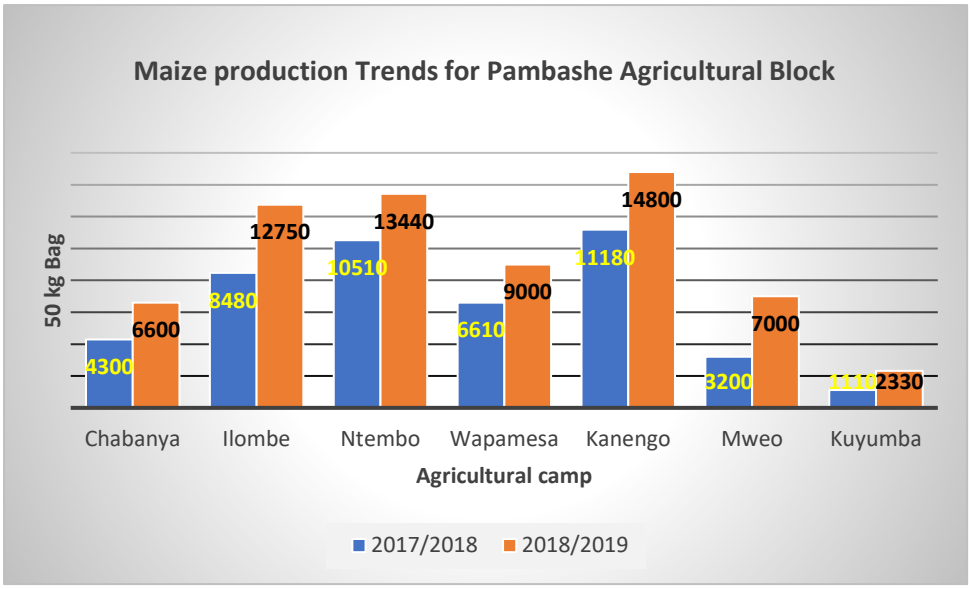
APPENDICES

Appendix 1: Camp profile for Kanengo agricultural camp

ZONE	NO. OF VILLAGES	NUMBER OF HOUSEHOLDS	TOTAL POPULATION	NUMBER OF FARMERS BY GENDER			NAME OF FARMERS GROUPS	MAJOR CROPS GROWN	REMARKS
				M	F	T			
1	2	196	1,176	120	64	184	Chilando co-operative	Maize, cassava, Groundnuts	
2	3	373	1,865	128	88	216	Lengwe Kapenya co-operative and Mapalo Women club	Maize, cassava, Groundnuts	
3	1	58	348	49	56	105	Shapela Women club	Maize, cassava, Groundnuts	
4	**2**	**115**	**810**	**189**	**129**	**318**	**Pambashe co-operative and Kanengo Information Centre**	**Maize, cassava, Groundnuts**	**Study/ Research Zone**
5	2	74	584	86	83	169	N/A	Maize, cassava, Groundnuts	
Total	**10**	**620**	**4783**	**572**	**420**	**992**			

Source: Kanengo Agricultural Camp, (2019)

Appendix 2: Maize production trends for Pambashe Agricultural block



Source: Kanengo agricultural camp, (2019).

Appendix 3. Photos from the field

Photo session during Focus Group Discussion

Key informant interview

Above is Individual household head interviews below are agro-dealer shop and maize marketing

ASSESSMENT OF SMALL-SCALE FARMERS' COPING STRATEGIES TO FALL ARMY WORM OUTBREAKS

IN KANENGO AGRICULTURAL CAMP OF KAWAMBWA DISTRICT IN LUAPULA PROVINCE- ZAMBIA

FOCUS GROUP DISCUSSION (FGD) PARTICIPANTS ATTENDANCE LIST

S/N	NAME OF PARTICIPANT	SEX	VILLAGE	ORGANISATION/CO-OPERATIVE	POSITION
01	Lwenga Luciuno	M	Kanengo	Pambashe Co-operative	Lead Farmer
02	Kabole Catherine	F	Kanengo	Pambashe Co-operative	Member
03	Chikwa Kombe Danny	M	Shapela	Pambashe Co-operative	Member
04	Mwansa Mary	F	Shapela	Shapela Women Group	Treasurer
05	Mwansa Ndokosha	M	Shapela	Pambashe Co-operative	Member
06	Chilobwa Stephen	M	Kanengo	Pambashe Co-operative	Member
07	Musonda Phillip	M	Kanengo	Pambashe Co-operative	Member
08	Besa Ntalasha Gabriel	M	Shapela	Pambashe Co-operative	Lead Farmer
09	Kaoma Chikoko Patrick	M	Shapela	Pambashe Co-operative	Secretary
10	Katebe F. Bertha	F	Kanengo	Pambashe Co-operative	Member
11	Mwape Kingstone	M	Shapela	Young Farmers Club (ICU-ZNFU)	Member
12	Matutu M. Bwalya	M	Wapamesa Agric. Camp	Ministry of Agriculture	Camp Officer
13	Sinkanyika Moses	M	Kanengo Agric. Camp	Ministry of Agriculture	Camp Officer
14	Muyunda K. Given	M	Ntembo Agric Camp	Ministry of Agriculture	Camp Officer
15	Zaza M. Florence	F	Kawambwa District	Ministry of Agriculture	DAIO
16	Musonda P. Steven	M	Kawambwa District	VHL University/Ministry of Agric.	Researcher

DAIO – District Agriculture Information Officer
IC – Information Centre
ZNFU – Zambia National Farmers union

ASSESSMENT OF SMALL-SCALE FARMERS' COPING STRATEGIES TO FALL ARMY WORM OUTBREAKS

IN KAWAMBWA DISTRICT OF LUAPULA PROVINCE- ZAMBIA

KEY INFORMANTS INTERVIEW QUESTIONNAIRE

Questionnaire serial No.

District code: …….. District name: ……

Constituency code: …… Constituency name: ……

Ward code: …….. Ward name: ……..

Name of respondent: …… Sex: ……

Organisation's name:……..Position:……

Name of enumerator: …….. Date of enumeration: ……

What is your education level?

a. [Primary] b. [Secondary] c. [College] d. [University]

How long have you been working/living in the district?

[< 5years] b. [5-10years] c. [>10years]

SECTION A.

SMALL-SCALE FARMERS' PERCEPTION ON THE RAPID SPREAD OF FALL ARMY WORM

3. Do you think the outbreak of the fall army worm pest is a source of concern to small scale farmers and why do you say so?

4. How is the spread of fall army worm among small-scale farmers? a. [rapid] b. [slow]

6. What do you think is contributing to the spread of the pest among small-scale farmers at that rate?

7. In your own opinion, what do you think can best help reduce the spread of the pest among small-scale farmers?

8. How do small-scale farmers access information about farming?

9. Is the information accessed trusted and why do you say so?

SECTION B.

PRACTICES BEING CARRIED OUT TO COUNTER FAW OCCURRENCES.

10. What practices are individual small-scale farmers doing about the pest?

Before the occurrence of the pest

During the occurrence of the pest

After the occurrence of the pest

11. What practices is the community doing about the pest?

Before the occurrence of the pest

During the occurrence of the pest

After the occurrence of the pest

SECTION C.

LIMITATIONS IN THE FIGHT AGAINST FALL ARMY WORM

12. What do you think are limitations that small-scale farmers are facing in the fight against FAW pests?

13. What do you think are limitations facing the community in fighting fall army worm attack?

14. In your own opinion, what would be the best approach for the community to fight the FAW pest?

SECTION D.

STAKEHOLDERS INVOLVED IN AGRICULTURE SECTOR INFLUENCING CONTROL OF FALL ARMY WORM.

Who are the stakeholders in the agriculture sector supporting the fight against fall army worm?

16. What form of support do small-scale farmers receive from each of the above-mentioned stakeholders?

17. How do small-scale farmers access chemical pesticides?

18. What challenges are associated with chemical pesticides among small-scale farmers?

19. In the absence of chemical pesticides, what other farming practices are small-scale farmers implementing in the fight against fall army worms?

SECTION E

GOVERNMENT ENGAGEMENT OF FARMERS IN THE FIGHT AGAINST FALL ARMY WORM PESTS.

20. Does the government involve small-scale farmers in the fight against the fall army worm?
21. If your answer for question 20 is [Yes], how does the government involve small-scale farmers in the fight against fall army worm out break?

22. What do you think would be best way to fight fall army worm pests:

(a) By individual small-scale farmer?

(b) By the community?

END:

THANK YOU FOR YOUR COOPERATION

ASSESSMENT OF SMALL-SCALE FARMERS' COPING STRATEGIES TO FALL ARMY WORM OUTBREAKS IN KANENGO AGRICULTURAL CAMP OF KAWAMBWA DISTRICT IN LUAPULA PROVINCE- ZAMBIA

INDIVIDUAL HOUSEHOLD INTERVIEW QUESTIONNAIRE

Questionnaire serial No. ☐

FARM IDENTIFICATION

District code: …… District name: ……

Constituency code: …… Constituency name: ……
Ward code: …… Ward name: ……
Agric. block name: …… Agric. camp name: …… Zone: ……
Farm code: …… Name of the farm: ……
Name of the farm owner: …… Sex: ……Age:……
Name of enumerator: …… Date of enumeration: ……

DEMOGRAPHIC CHARACTERISTICS

1. What is your household size?
   a. [1-5] b. [6-10] c. [11-15] d. [>15]
2. What is your marital status? Please tick

a. [Married] b. [Single] c. [Divorced] d. [Widow] e. [Widower]

3. How is the sex composition in your household? Please indicate the number.
   Adult male [ ] Adult female [ ] Male teenager [ ] Female teenager [ ]
   Male children [ ] Female children [ ]
4. What is your education level? Please tick
   a. [Primary] b. [Secondary] c. [College] d. [University] e. [Any other……]
5. What is your main sources of income? Please tick
   a. [Farming] b. [Remittance] c. [Formal employment] d. [Business] e [Others……]

SMALL-SCALE FARMERS' SOURCE OF INFORMATION.

6. Where do you mainly access information about farming?
   a. [Fellow farmers] b. [Extension officer] c. [Co-operative] c. [Others……]
7. Which one is your main method of acquiring information about farming?
   a. [Trainings/Demos] b. [Meetings] c. [Farm forum] d. [Agric. show] e. [Others……]
8. Is your main source of information about farming reliable and why do you say so?
   a. [Yes]
      Reason……
   b. [No]
      Reason……
9. Do you have access to radio programs about farming? a. [Yes] b. [No]
10. If your answer in 9 is [Yes] can you mention the radio stations? Are you aware about the Fall Army Worm (FAW) pest? a. [Yes] b.[no]

11. If your answer in 11 is [Yes], how do you identify the pest?
    .....
12. Are you concerned about the FAW pest and why?
    a. [Yes]
       Reason: .....
    b. [No]
       Reason: .....
13. How is the spread of the pest among small-scale farmers? A. [Rapid] b. [Slow]
14. If your answer in 14 is [Rapid spread], what do you think is contributing to rapid spread of the pest among small-scale farmers?
15. How is local knowledge helping you do deal with the Fall army pest?
    Prevention.....
    Control.....
    Management.....
16. Given that the pest has been re-occurring since it was first reported, what has been your actions during the following?
    Before the occurrence of the pest in maize fields
    During the outbreak of the pest in maize fields
    After the outbreak of the pest

RECEIVED AND EXPECTED SOCIAL SUPPORT BY SMALL-SCALE FARMERS TO COUNTER FAW OCCURRENCES.

17. Do you receive any form of support about the FAW pest? a. [Yes] b. [No]
18. If your answer in 18 is [Yes], who renders support?
    .....
    .....
    How is support rendered: .....
    .....
    .....
19. Do you use collective effort in the fight against fall army worm? a. [Yes] b.[No]
20. If your answer in 20 is [Yes], how do you use collective effort?
21. Do you expect any other support in the fight against FAW? a. [Yes] b. [No]
22. If your answer in 22 is [Yes], where do you expect support to come from and what kind of support?

COMMUNITY ACTION AND PROBLEM-SOLVING SKILLS.

23. Do you experience any form of agricultural related shocks or stresses? a [Yes] b [No]
24. If your answer in 24 is [Yes], what kind of shocks or stresses do you experience?
25. How do you deal with the above-mentioned shocks or stresses?
    As an individual .....
    .....
    As a community.....
    .....
26. What is your opinion on the best way to deal with shocks or stresses as a community?
27. What role do local leaders play in dealing with the above shocks and stresses?
28. What actions is the community taking to counter fall army worm outbreaks?

FARMER'S GROUPS OR ORGANISATIONS AS SOCIAL SAFETY NET

29. Do you belong to any farmers' organisation and why?
    a. [Yes].....
    b. [No].....

30. If your answer in 30 is [Yes], what kind of contributions do you offer to the organisation as a member?

31. What kind of benefits do you receive from your organisation as a member?

32. STAKEHOLDER PARTICIPATION IN AGRICULTURE

33. Are there any stakeholders supporting the fight against FAW in the district that you know? a. [Yes] b. [No]
34. If your answer in 33 is [Yes], who are the stakeholders supporting the fight against FAW pest in the district?
35. What kind of support do you receive that deals with FAW?
36. What do you think can be the best way to support you in the fight against FAW?

ACCESS AND UTILISATION OF CHEMICALS AND EQUIPMENT

37. Are you aware about chemical pesticides? a. [Yes] b. [No]
38. Do you use chemical pesticides in maize production? a. [Yes] b. [No]
39. If your answer in 38 is [yes], where do you buy/access the chemical pesticides from?

Do you have access to sprayers and protective equipment? a. [Yes] b. [No]

40. If your answer in 40 is a. [Yes], where do you access the equipment for spraying from?

In the absence of chemical pesticides what other ways do you use to deal with the pest?

41. How do you share the information about alternative measures with your fellow farmers?
42. What do you think can be best way to fight the FAW pest?

END:

THANK YOU FOR YOUR COOPERATION

ASSESSMENT OF SMALL-SCALE FARMERS' COPING STRATEGIES TO FALL ARMY WORM OUTBREAKS IN KANENGO AGRICULTURAL CAMP OF KAWAMBWA DISTRICT IN LUAPULA PROVINCE- ZAMBIA

INTERVIEW GUIDE FOR FOCUS GROUP DISCUSSION (FGD)

RELATES TO INFORMATION & COMMUNICATION AND COMMUNITY COMPETENCE.

1. Why is the fall army worm pest a source of concern in farming?
2. What factors are contributing to rapid spread of fall army worm?
3. What actions are small-scale farmers taking in the fight against FAW?

RELATES TO COMMUNITY COMPETENCE AND SOCIAL CAPITAL.

4. What challenges are small-scale farmers facing in relation to the use of chemical pesticides?
5. What are Challenges facing communities in the fight against fall army worm pests? What are Challenges facing communities in the fight against fall army worm pests?

RELATES TO SOCIAL CAPITAL AND COMMUNITY COMPETENCE.

6. How does support from organisations help communities to overcome FAW pests?

RELATES TO SOCIAL CAPITAL AND COMMUNITY COMPETENCE.

7. What social support are communities receiving or expecting in the fight against FAW pests?
8. How does the community mobilise resources in the fight against FAW pests?

RELATES TO INFORMATION AND COMMUNICATION

9. Where do small-scale farmers access information about farming?
10. How do they access this information about farming?
11. What do you think would be best way to fight fall army worm among small-scale farmers?

Other activities during the FGD

Farmers to come up with the financial status for Pambashe Multi-purpose co-operative society from both shares and membership as well as other sources of funds in order to discuss how the co-operative can use its available resources in the fight against FAW pests?

During the FGD, participants to come up the process of formulating traditional pesticides and how it is applied in the fight against FAW pests.

Participants to list actions that the community is taking in the fight against FAW pests during the following stages;

a. Before the pest sets in the maize field
b. When the pest has sets in the maize field
c. After the pests has sets in the maize field

Indicating the advantages/opportunities that the community has in the fight against FAW pests