UNDERSTANDING SMALL-SCALE FARMERS RESPONSE MEASURES TO DESERT LOCUST INVASION IN AGRICULTURE FIELDS.

A CASE STUDY OF KALUMWANGE FARM BLOCK-KAOMA DISTRICT OF ZAMBIA

A research project submitted to Van Hall Larenstein University of Applied Sciences. A requirement for the Master of Management of Development degree award with specialization in Disaster Risk Management.

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DEDICATION

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LIST OFABBREVIATION

CSO	CENTRAL STATISTICAL OFFICE
DMMU	DISASTER MANAGEMENT AND MITIGATION UNIT
FGD	FOCUS GROUP DISCUSSION
FAO	FOOD AND AGRICULTURE ORGANISATION
FRO	FOOD RESERVE AGENCY
GRZ	GOVERNMENT REPUBLIC OF ZAMBIA
KDAD	KAOMA DISTRICT AGRICULTURE DEPARTMENT
KTC	KAOMA TOWN COUNCIL
KI	KEY INFORMANT
MOA	MINISTRY OF AGRICULTURE
NGO	NON-GOVERNMENTAL ORGANISATION
SLF	SUSTAINABLE LIVELIHOOD FRAMEWORK
USD	UNITED STATES DOLLARS
WB	WORLD BANK
WMO	WORLD METEOROLOGICAL ORGANISATION
ZDA	ZAMBIA DEVELOPMENT AGENCY

ABSTRACT

Kalumwange Farm Block is the largest farm block in the Western Province of Zambia. The farm block is situated in the Kaoma district, and small-scale farmers mainly occupy it. With a size of 100,000 hectares, on average, Kalumwange Farm Block produces over 1,242,000 kilograms of maize. This is in a farming season free from pest infestations in agriculture fields and without the challenges of acquiring farming inputs like seeds and fertilizer. (MOA,2021).

The 2019/20 farming season in Kalumwange Farm Block was faced with an invasion of desert locusts in agriculture fields. Because of this, there was poor crop growth, damage of crops, and low income for small-scale farmers. The objective of this research is to identify how small-scale farmers control and manage desert locust invasions in agriculture fields. The research will recommend to the Kaoma District Department of Agriculture sustainable ways of responding to desert locust outbreaks. Further, the study aims to strengthen small-scale farmer's capacity and skills to ensure food security in Kalumwange Farm Block by using sustainable methods of fighting desert locust invasions in agriculture fields.

The study included semi-structured interviews with five key informants, two focus group discussions, and forty questionnaires for primary data collection. Secondary data was gathered through a desk study. The collected data were analyzed using thematic analysis. The findings showed that small-scale farmers in Kalumwange Farm Block responded to the outbreak of desert locusts using traditional methods (spraying of water mixed with chili in agriculture fields, picking locusts from fields with hands, playing drums to make noise, and make desert locusts leave the farming areas and also praying to ancestral spirits). These methods were not effective in combating the outbreak of desert locusts. In light of the findings, the Kaoma District Department of Agriculture needs to ramp up programs and activities focused on sensitizing small-scale farmers on effective strategies of managing desert locusts outbreaks. Small-scale farmers need to be trained on identifying, controlling, and managing desert locusts in agriculture fields. The study also revealed that the collaboration of stakeholders such as NGOs, small-scale farmers, Cooperatives, and the government was key in winning the battle against desert locust invasions in agriculture fields.

Key concepts: Limitations, Small-scale farmer, Shock, Vulnerability, Response measures, and Capacity.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

The Zambian agriculture sector comprises crops, livestock, and fisheries. There are three broad categories of farmers; small-scale farmers, medium-scale farmers, and large scale farmers. Small-scale farmers are subsistence producers of staple food with an occasional marketable surplus; most farmers in Zambia are small-scale subsistence farmers (ZDA, 2020). Small-scale farmers in Zambia grow their crops on land that ranges from 0.5 to 5 hectares. Maize (Zea mays) is the most widely grown crop in the country as a staple food to over 18 million people. Agriculture in Zambia contributes 21% of the GDP and employs three-quarters of the population, currently at 18 124,891(CSO, 2021). Domestic production comprises maize, sorghum, millet, and cassava, while exports are driven by sugar, soybeans, coffee, groundnuts, rice, cotton, and horticulture produce(MOA,2021).

The agriculture sector in Zambia is the backbone of the rural economy and forms an integral part of the country's poverty reduction strategies for rural households (Chapoto et al., 2018). More than 80% of Zambia's population is dependent on agriculture to provide the primary support for its rural economy (Sebatta et al., 2014).

Zambia's agriculture policies revolve around large input subsidy programs and large-scale government maize procurement through the Food Reserve Agency (FRA), promoting maize production to the exclusion of most other crops. Because of the focus on staple food production and poor access to markets, rural Zambian diets are monotonous and generally lack the diversity required for good nutrition (Kumar et al., 2018). The bad state of feeder roads makes it very difficult for farmers to access markets for their produce. Usually, a huge demand for agricultural produce is the central business district, far from farming communities(Sebatta et al.,2014).

In the last ten years, the agriculture sector in Zambia has had challenges of drought, pest invasions in agriculture fields such as fall armyworms, grasshoppers, and stockborers(FAO,2020). These pests usually affect crop productivity and contribute to challenges of hunger, especially in rural areas(FAO,2020).

The Ministry of Agriculture is responsible for pest control services, irrigation development, agriculture extension services, and agriculture research (MOA,2020). Agriculture extension is the application of new knowledge and scientific research to agriculture through farmer education. All efforts that give farmers, their groups, organizations, and other market actors access to knowledge, information, and technology are called agriculture extensions (MOA,2020).

At the district level, the district department of agriculture plays a critical role in promoting improved farming technology and maintaining and enhancing the agriculture resource base. The department's responsibilities include providing technical assistance in irrigation, farm power mechanization, and land husbandry and disseminating technical and other information to the farming community. Technical information and extension services in crop production, horticulture production, nutrition, and soil fertility are also provided by the Department of Agriculture(MOA, 2021).

However, due to erratic funding from the Ministry of Agriculture to the district departments of agriculture across the country, several programs/activities such as dissemination of agriculture information to the farming community, provision of technical services in irrigation are not done. District agriculture departments lack adequate vehicles, funds, and motorbikes to reach out to communities where farmers are located (KTC,2021).

Zambia's small-scale farmers rely on the government's extension services and farmer input assistance programs administered by the Ministry of Agriculture. These projects attempt to help farmers grow enough crops and ensure food security in the country. The production of maize, the country's staple

food, is high in all the agriculture farm blocks in Zambia (Lubinda, 2014). Agriculture farm blocks cover an average of 100,000 hectares of land in each of the country's ten provinces (KTC,2021).

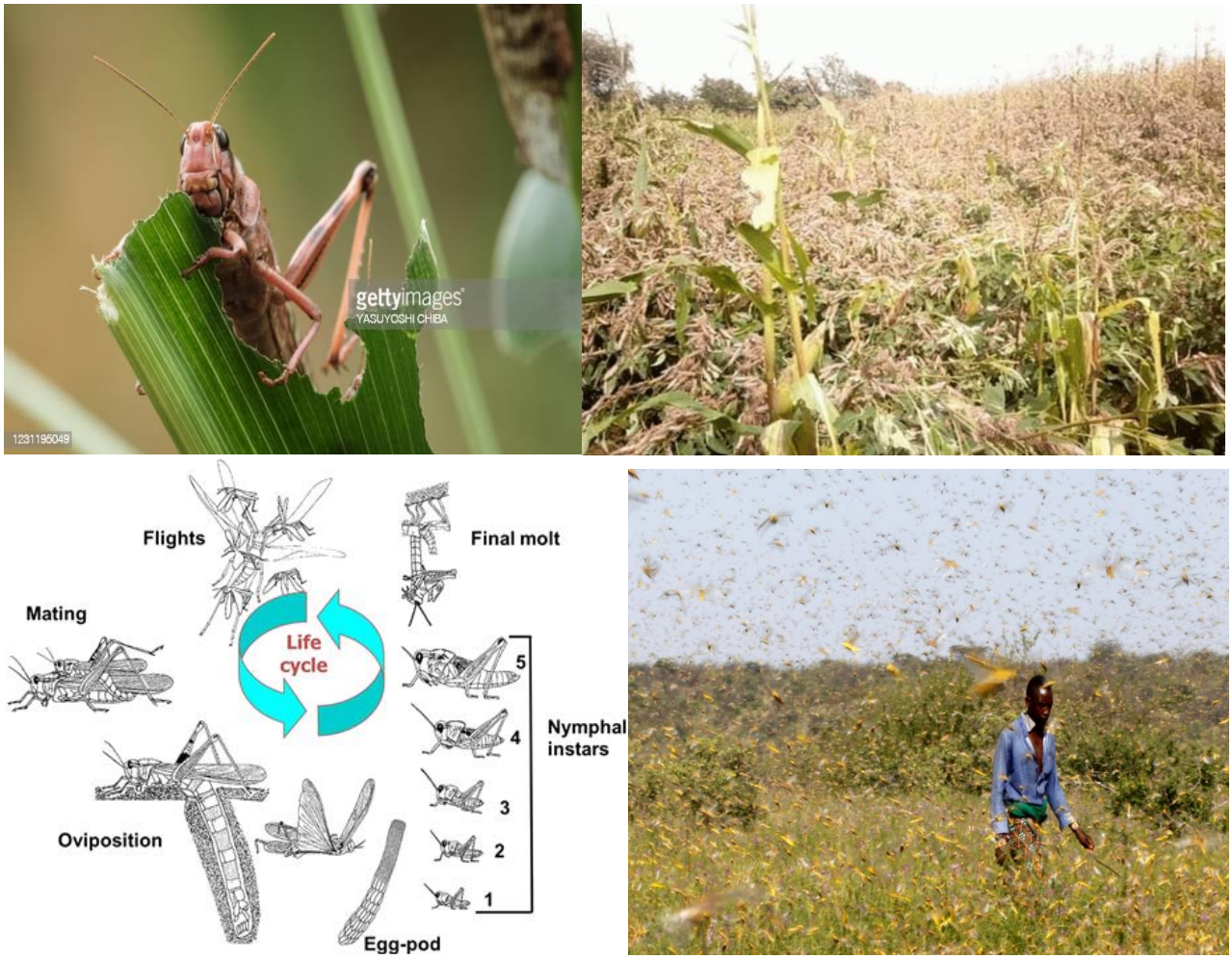
1.1 Background

A Farm Block is a big agricultural area where the government provides backbone infrastructure such as feeder roads, electricity, water for irrigation and domestic use, and communication services to assure high agricultural output yields (MOA,2015). Unlike villages that lack spatial planning, a farm block is a well-planned area with all the necessary facilities and services needed for agriculture to thrive. To achieve the upliftment and involvement of rural people in the agricultural sector, all agriculture farm blocks are situated in rural regions. A farm block gives local farmers quick access to surveyed land for agro-processing. (ZDA, 2020).

Kalumwange Farm Block is the largest Farm Block in the Western province of Zambia, with 100,000 hectares of land. The Farm Block has a total population of 3,791 people, of which 57% are female and 43% are male. The farm block has 621 farms, of which 52% are male-headed, 32% are female-headed, and 16% are child-headed. The death of parents leaves children in charge of the farm, resulting in child-headed families. Kalumwange Farm Block is the largest producer of maize in the western province of Zambia (KTC,2021). In a farming season without invasion of pests in agriculture fields and without challenges of accessing farming inputs, the farm block produces over 1,242,000 kilograms of maize. In the 2019/20 farming season, Kalumwange Farm Block was faced with an invasion of desert locusts in agricultural fields. The desert locusts ravaged crops and pasture, and this affected production yields (MOA,2021). Small-scale farmers had challenges combating the spread of these pests, and the Ministry of Agriculture reported that this was the first time desert locusts invaded agricultural fields in Zambia (KTC,2021). The green vegetation and moist sandy soils of Kalumwange Farm Block provided a favorable condition for desert locusts to live in and spread (MOA,2021)

Because desert locusts are highly migratory and feed on large quantities of green vegetation, including crops, pasture, and fodder, they cause severe crop damage (FAO, 2020). Because of this, desert locusts pose a challenge to small-scale farmer’s food security. The food chain effects might jeopardize farmers' livelihoods, eroding their reserves and pushing them deeper into poverty (FAO,2021).

Figure 1.0 Desert locusts life cycle and in the field.



(FAO, 2019). An agriculture field affected by desert locusts.

According to FAO, 2020, "desert locust (Schistocerca gregaria) is the most destructive migratory pest in the world; they are dense and highly mobile and can form swarms. Desert locusts are ravenous eaters who consume their weight per day; they target food crops and forage." Up to 80 million adult desert locusts can be found in a single square kilometer of swarms, having the capacity to consume the same amount of food as 35,000 people in one day. Swarms of this size represent a severe danger to food security and livelihood. (FAO, 2020).

The desert locust has a fascinating property in that it can entirely modify its physiology and behavior depending on the quantity and other locusts in the area. When there are few locusts, they are in the solitarious phase and act more independently (Hohman et al., 2020). However, when locust populations increase, they congregate in groups and transform into a gregarious state. During the transition phase, the locust is referred to as ***transiens*** . In the "calm" state, the recession phase, most locusts are isolated individuals (solitarious behavior), the overall population level is low, and bands and swarms are typically absent. Solitarious locusts exist naturally and are antisocial creatures that tend to seek isolation. When conditions are suitable and significant rains fall in the seasonal mating grounds, locusts proliferate rapidly, gregarize, and spread over 30 million square kilometers, accounting for 20% of the world's terrain (Hohman et al., 2020).

In the 2019/20 farming season, there was a spread of desert locusts in Tanzania, which shares borders with Zambia. Unfortunately, these pests migrated to Zambia in the Kaoma district, where they found favorable temperatures to live and spread further (MOA,2021). The pests lived on small-scale farmer's maize fields for a period of three to four weeks. There was panic among small-scale farmers who did not know what to do to combat the spread of these pests.

Small-scale farmers in Kalumwange Farm Block perceived desert locusts as grasshoppers and stockborers, which commonly invade agriculture fields in the farm block. Information on desert locusts was the central aspect of vulnerability for small-scale farmers and the district department of agriculture.

The Zambia government did not plan and budget for any invasion of pests in the 2019/20 financial year. Therefore, when the spread of desert locusts occurred in Kalumwange Farm Block, the district department of agriculture and the disaster management and mitigation unit did not respond in time to help quench the outbreak of these pests in farming fields (Lubinda,2021).

1.2 Statement of the Problem

Like many African countries, Zambia is still grappling with the adverse effects of climate change, a considerable decrease in agriculture crop productivity. The increase in the price of farming inputs has made it difficult for small-scale farmers to access them and grow crops on time. The outbreak of desert locusts in the 2019/2020 agricultural farming season in the Kalumwange Farm Block worsened the situation. An annual survey conducted by Kaoma Town Council in January 2021 showed that crop production yield reduced by 56.25% compared to the 2017/18 farming season. This has been attributed to the invasion of locusts in agriculture fields and the price hike in farming inputs(KTC,2021).

The Kaoma district agriculture department has little knowledge of how to combat the invasion of desert locusts in farmers' fields. It is against this background that this research aims to provide information on how small-scale farmers can respond to desert locust invasions in agriculture fields. This information is crucial because it will help small-scale farmers develop sustainable strategies for controlling and managing desert locust invasion by leveraging their existing local knowledge. If desert locusts are not detected on time, they have devastating effects on crops such as maize which the people of Kaoma depend on for livelihood.

The Commissioner for this study is the Kaoma district department of agriculture, where a recommendation will be made on sustainable methods of combating desert locusts invasions in agricultural fields. The problem owner is the Zambian Ministry of Agriculture.

The Kaoma district department of agriculture coordinates all the agricultural activities in the district. The department is responsible for providing any agriculture information to farmers through workshops and meetings. The department offers an interface between the government and farmers.

1.3 Research aim

The research aims to strengthen small-scale farmers' capacity and skills in fighting desert locusts outbreaks by using sustainable methods and ensuring food security in Kalumwange Farm Block.

1.4 Research Objective:

- The researcher seeks to identify how small-scale farmers respond and manage desert locust invasions in agriculture fields in Kalumwange Farm Block. Further, the researcher will then recommend to the Kaoma district department of agriculture how small-scale farmers can sustainably combat desert locusts outbreaks in farming fields.

1.5 Main Research Question

- What are the response measures employed by small-scale farmers to address desert locusts invasions in farming fields in Kalumwange Farm Block in Kaoma district of Zambia?

1.6 Research Sub Questions

1. What are the small-scale farmer's perceptions of the spread of desert locusts in farming fields?
2. How do small-scale farmers respond to the seasonal outbreak of pests such as grasshoppers and stockborers on agriculture fields?
3. What practices do small-scale farmers undertake to combat desert locust invasion in agriculture fields?
4. What limitations do small-scale farmers face in fighting desert locusts invasions in agriculture fields?
5. With whom do small-scale farmers collaborate to reduce desert locust outbreaks in Kalumwange Farm Block?

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter will look into the life cycle of the desert locust and the damage that it causes to maize (Zea mays) crop; further, it will give an overview of desert locust invasion and factors that contributed to its further spread. This chapter will also highlight the effects of climate change on the pest outbreak and the socio-economic impact on small-scale farmers in Kalumwange Farm Block. Also, the response action by the government and small-scale farmers to the spread of desert locusts will be presented.

2.1 Spread of desert locusts in Africa

According to Brader 2006, "on October 20th in 2002, heavy rains fell over a widespread area of West Africa extending from Dakar to the Atlas Mountains in Morocco. Some areas in Western Sahara received more rain in one day than what normally falls in an entire year." Because of this, ecological conditions remained favorable breeding grounds for desert locusts for more than six months. The swarms that formed were not controlled in the outbreaks in Mauritania and Mali. They also migrated to Niger, where two to three generations of breeding occurred from winter 2003 to spring 2004, giving rise to large numbers of locusts and causing an upsurge to develop. The increase, which in this case could be considered a regional plague, spread to twenty-three countries in Africa and the Middle East, and It took nearly two years to bring it to an end, after spending more than $500 million and spraying 13 million hectares bio chemicals (Brader et al., 2006).

According to Krippahi 2019, "in 2018, an intense cyclone season unleashed rain in the immense sandy desert on the southern Arabian Peninsula. The moist sand and sprouting vegetation provided favorable conditions for the locusts to thrive, with massive swarms spreading to Yemen, Saudi Arabia, and Iran." Carried by the wind across the red sea, the locusts made landfall on the Horn of Africa in mid-2019 amid perfect conditions for their production. It was one of the wettest years in decades, with eight cyclones off the east coast. The insects started swarming into Kenya in December 2019, triggering the worst locust outbreak the country has experienced in seventy years (Krippahi 2019).

In 2021, desert locusts invaded key production areas and bread baskets in East Africa, particularly in Kenya, Somalia, and Ethiopia, causing significant crop losses during March to May cropping season, potentially worsening the food security situation (FAO,2021).

2.2 Effects of climate change on desert locusts 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 the variability of its properties that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing or persistent anthropogenic changes in the atmosphere's composition or land use (Abrahim and Ward 2012). Heavy rainfall brought by extreme positive Indian Ocean Dipole (IOD) and the unusual cyclone activity contributed to the 2019/20 outbreak of desert locust. Heavy rain triggers vegetation growth in arid areas where desert Locusts can then develop and reproduce (FAO,2021). In 2019 the warming of the Indian Ocean led to 8 cyclones, the highest number on record, led to one of the wettest October to December rainy seasons in many parts of Africa (WMO, 2021).

2.3 Factors that contribute to desert locust spread

Unusual weather and climate conditions, including widespread and heavy rains since October 2019, contributed to a widespread severe desert locust outbreak, threatening rural food security and livelihood in Africa. This can be seen from the continuous spread of desert locusts in Ethiopia, Kenya, Somalia, and Uganda (FAO,2021). The eggs for these pests hatch between March and April, posing an extreme risk to the following cropping season of the year (WMO, 2020). Increased temperatures and rainfall, especially in East Africa, contribute significantly to the reproduction of insects. According to Abubakr,2020, "desert locusts have been here since biblical times, and recent intense outbreaks can be linked to anthropogenic climate change and the increased frequency of extreme weather events."

2.4 Socio-economic effects of desert locusts

According to Abubakhr 2020, "Desert locusts devour a variety of green plants, including crops, grass, shrubs, and trees, posing a hazard to human and animal food security. The initial wave of infestation damaged 70,000 acres of cropland in Somalia and Ethiopia, as well as 2,400 acres of pasture land in Kenya, before the end of 2019. According to a recent assessment in Ethiopia, locust damaged 114,000, 41,000, and 36,000 hectares of sorghum, maize, and wheat between December 2019 and March 2020, respectively."

Infestations of locusts diminish small-scale farmers' crop productivity and household income. According to Pescaroli and Alexander, 2020, In Africa, particularly East Africa, desert locust outbreaks threaten livelihoods, food security, environment, and economic development in the region (Abubakr et al.,2020). The socio-economic survey conducted by the Kaoma district department of agriculture showed that maize production in the 2019/20 farming season reduced by 56.25% compared to the 2017/18 farming season.

The high costs of farming inputs such as seeds and fertilizer were the cause of the decline in maize output. Small-scale farmers had challenges acquiring farming inputs that year since the government did not subsidize the price of agricultural goods. Furthermore, the district department of agriculture explained that the leading cause of low production was desert locusts invasions in agricultural fields. The desert locusts were not effectively controlled and managed because small-scale farmers lacked information on how to combat them (MOA,2021).

Table 1.0 CEREAL PRODUCTION YIELD IN KALUMWANGE FARM BLOCK

Name of cereal	Yearly production 2017/18 (000 tonnes)	Yearly production 2018/19 (000 tonnes)	Yearly production 2019/2020 (tonnes)	% change in produce between 2017/18 and 2019/2020
Maize	16	8	7	56.25
Wheat	7	6	1	85.7
Rice	11	2	2	81.8

Source: Kaoma district agriculture department, 2021.

From the table above, the impact of desert locusts on small-scale farmer's crop production is severe. Locusts affect livelihood assets such as financial capital due to the low produce of crops. From the 56.25% loss in agriculture produce, 41.3% resulted from desert locusts(MOA,2021).

2.5 Responses to the outbreak of desert locust

The role of disaster risk management in managing shocks such as pest outbreaks need to be prioritized by the Zambian government, small-scale farmers, and NGOs working in agriculture-related areas. A multisectoral approach to pest outbreak response and annual budget allocation is critical in successfully controlling and managing locust invasion (FAO, 2021). A joint assessment carried out by the Food and Agriculture Organisation (FAO) and the World Food Program in Karamoja, Uganda, showed that it would cost between $12 million and $42 million to safeguard and restore livelihood if surveillance and control measures are lacking or ineffective (FAO, 2021).

Since the start of control operations in 2020 and 2021, 10,245 hectares have been treated using pesticides in Somalia's key breeding areas by the government with the direct support of FAO. At the end of 2020, the Ethiopian government sprayed 180,000 hectares of land with insecticide to control the further spread of desert locusts (FAO,2021). Similarly, FAO is working with the government to protect livelihood for 30,000 pastoral and agro-pastoral households in northern and central Somalia by providing 3,600MT of rangeland fodder cubes during the dry season supplement source resources in affected areas (FAO,2021).

The control of desert locusts traditionally relied on synthetic insecticides, and for emergencies, this is unlikely to change. However, growing awareness of the environmental issues associated with acidic control and the high costs of emergency control is expanding the demand for biological control (Abate et al., 2019).

The recent development of effective oil formulations of *Metarhizium anisopliae* spores in Africa and Brazil opens new environmentally safe control operations possibilities. *Metarhizium* biopesticide kills 70% to 90% of treated locusts within 14 to 20 days with no measurable impact on nontarget organisms (Abate et al., 2019).

While desert locust swarms are not found in America or Europe, these insects pose a constant threat to food supplies in some of the world's poorest and driest countries, occupying a large area that stretches from West Africa to the Indian subcontinent. Vulnerable countries use remote sensing technology to identify and eliminate locust breeding areas (Cressman, 2021).

According to Cressman,2021 "today some experts think that drone technology could provide survey and control teams with an inexpensive and efficient method of searching for these destructive insects." CABI and Astral-Aerial have partnered to pilot the use of drones to control the desert locust. The technology works by equipping Unmanned Aerial Vehicles (UAVs), or drones, with specially-designed and calibrated spraying equipment that enables mapping and precision spraying (FAO, 2021).

Locust plagues can be challenging to control in normal circumstances, requiring cooperation across borders (countries affected with locusts) to destroy swarms before they multiply further. Therefore, the involvement of small-scale farmers in the fight against pest outbreaks is essential in safeguarding a country's food security (Kray, 2019).

2.6 Theoretical framework

The vulnerability and capacity analysis (VCA) framework

The study relies on vulnerability and capacity analysis to empower small-scale farmers in Kalumwange Farm Block with the skills needed to combat desert locusts in farming fields effectively. The framework analyses factors that make small-scale farmers vulnerable to desert locusts outbreaks; further, it explores the needs and capacities needed to control and manage them. The analysis also ensures that interventions initiated to address the challenges of desert locusts in agriculture fields meet the needs of small-scale farmers. Small-scale farmers' vulnerability and capacity in the context of the invasion of desert locusts in agriculture fields is very important for understanding the potential impact of such disasters and making choices about how to intervene.

The vulnerability and capacity analysis considers a wide range of environmental, economic, social, cultural, institutional, and political pressures that create vulnerability (Wisner et al.,2004)

	Vulnerability	Capacities
Physical/Material What productive resources, skills, and hazards exist? (Includes land, climate, environment, health, skills, and labor, infrastructure technology)		
Social/Organisational What are the relations and organizations among small-scale farmers in Kalumwange? (Includes formal political structures and informal social systems		

Motivational/Attitudinal How does the community view its ability to create change? (Includes ideologies, beliefs, motivations, experiences of collaboration).		

Source: Levin and Chastre, 2011

Physical/Material

These are usually the most apparent areas of vulnerability, with resources ranging from food to livelihoods. Poor people, according to studies, are more likely to be affected by the crisis due to a lack of savings, income, output, or other resources (Lavin and Chastre, 2011). Poor people are more vulnerable and recover at a slower rate, as evidenced by this. As a result, the VCA is a critical tool for learning what makes people more prone to disasters and why this occurs.

Social/Organisation

This demonstrates how an institution or society manages internal disagreements. Formal and informal political structures, social safety nets, relationships between individuals/small-scale farmers, and processes by which people get things done are all part of its management. (Levine and Chastre, 2011). Poor communities that are well organized and cohesive have a better chance of surviving or recovering from disasters. As a result, the vulnerability and capacity analysis approach can help study social structures before, during, and after a disaster. It also considers how it could have aided those who were affected.

Motivational/Attitudinal

According to Levine, 2011, "Because emergencies can inspire communities to undertake remarkable efforts, groups with strong belief systems or experience in effectively working are better positioned to aid each other." The VCA framework aids in determining the causes of disasters and what may have been done differently to prevent them. The framework aids in determining how crises or natural catastrophes alter people's beliefs. The framework is based on the premise that allowing communities to participate in program design, planning, and management increases community ownership, accountability, and impact. (WB,2019).

2.7 Operationalisation of concepts

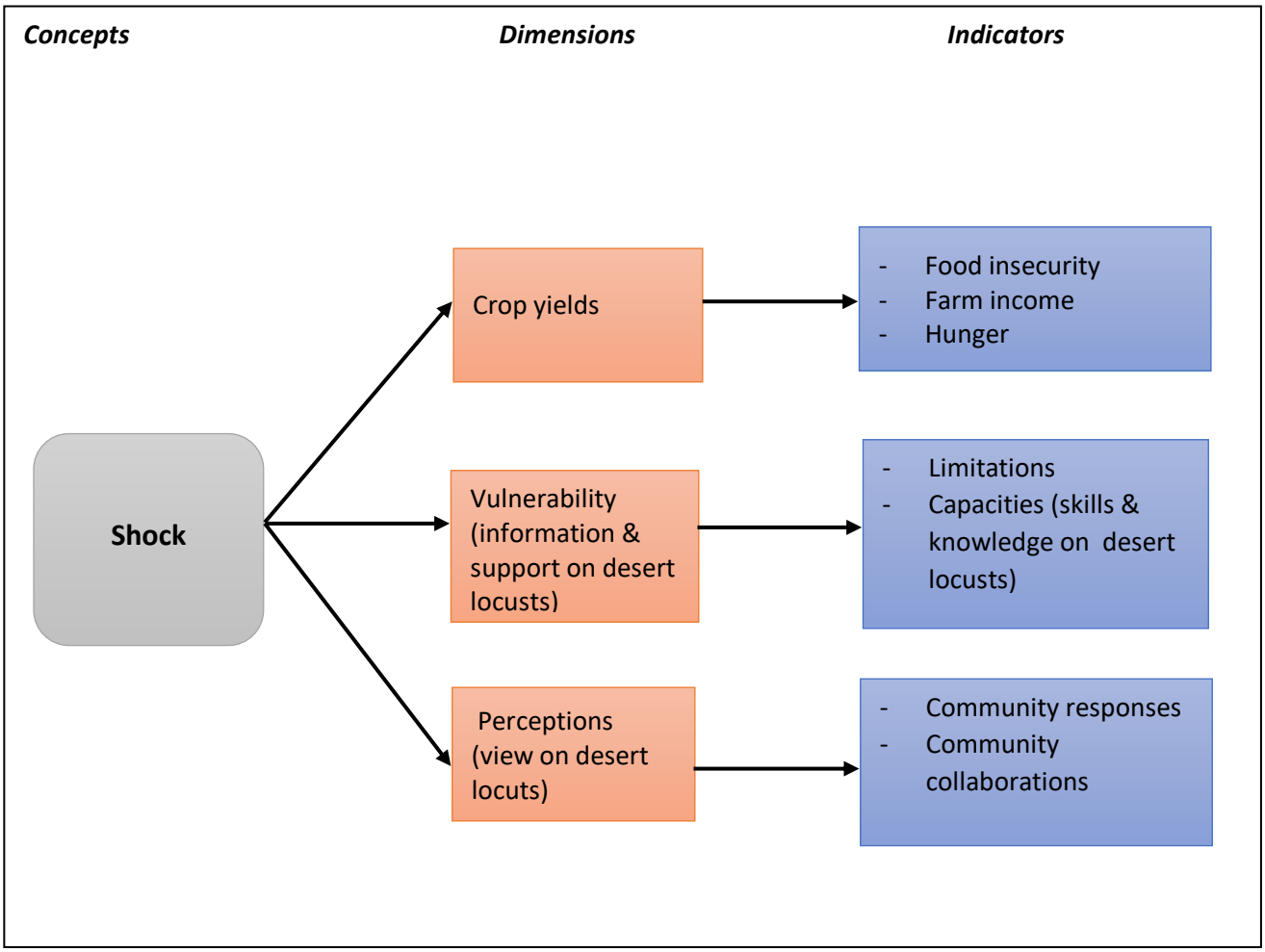
This study developed a conceptual framework to operationalize a theoretical framework based on the reviewed literature about desert locusts invasion in agriculture fields in Kalumwange Farm Block. Amongst many aspects reviewed include small-scale farmer's response measures to desert locusts outbreak through local resources and knowledge, and other organizations support. The Vulnerability and Capacity Analysis matrix was aimed at helping to understand existing capacities amongst small-scale farmers better and providing a starting point in building capacities to control and manage the invasion of desert locusts in agriculture fields.

2.8 Conceptual Framework

To achieve the research goal of strengthening small-scale farmer's capacity and skills in controlling and managing desert locusts outbreaks in farming fields by using sustainable response methods and ensuring food security. Desert locusts attacked the Kalumwange farming community and affected

individual farmer's fields differently. Therefore it was essential to look at how the Kalumwange Farm Block community perceived the problem and responded.

Figure 2.0; Conceptual framework;



Source: This research,2021

Community response

Small-scale farmers have been dealing with a range of shocks, both natural and man-made. They have devised and innovated several local knowledge-based responses to regulate, manage, recover, and prevent future impacts. (Pandey, 2011). When a community is faced with a problem, members often experiment with various solutions that can best solve their problems, depending on the nature of the situation. It's crucial to be patient with the community during difficult times to learn what they can do, how they can do it, and why they're doing it. Also, exploring how to reduce vulnerability to shocks and pressures can be integrated into everyday activities and long-term goals. (Cressman, 2019).

Community collaboration: Refers to a community working together to address the challenges facing them. Communities are crucial to managing risks and disasters. The principal resource available for mitigating or responding to disasters is people themselves and their local knowledge and expertise. Community collaboration helps respond to local problems and needs, capitalises on local knowledge and expertise, and strengthens communities' technical and organizational capacities. External agents

alone cannot deal with the diversity of risks facing vulnerable populations. Local people bring a wealth of resources, especially knowledge and skills, to help reduce risk (Twigg, 2015).

Perceptions: How the Kalumwange Farm Block community/small-scale farmers regards, understands, and interpret the shock they face.

Crop yield : Refers to a standard measurement of the amount of agricultural production harvested yield of a crop per unit of land area.

Limitations: Refers to barriers preventing the Kalumwange Farm Block community/small-scale farmers from effectively winning the fight against desert locusts.

Food security: This exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (DFID,2020).

Hunger: Refers to a condition in which a people/person cannot eat sufficient food to meet basic nutritional needs for a sustained period (FAO,2019).

2.9 Definition of Key Concepts

Livelihood, Small-scale farmer, Shock, Response measures, Vulnerability, and Capacity

Livelihood: A livelihood comprises the capabilities, assets, and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resource base (DFID, 2020).

Small-scale farmer: Refers to a farmer who cultivates on a piece of land less than 6 hectares in size for consumption purposes and access land through the customary land tenure system (Christen and Anderson 2013).

Shock. It is defined as an unexpected event that can destroy assets and do damage to lives and livelihood(DFID, 2015)

Response measures: Refers to any reasonable measures taken by any person, organization, including public authorities, following a disaster, to prevent, minimize or mitigate possible loss or damage or to arrange for environmental clean-up (Cressman,2014)

Vulnerability: The characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effect of a hazard (UNISDR, 2018).

Capacity: The combination of all the strengths, attributes, and resources available within an individual, community, society, or organization that can be used to achieve established goals (UNISDR, 2018).

CHAPTER THREE: METHODOLOGY

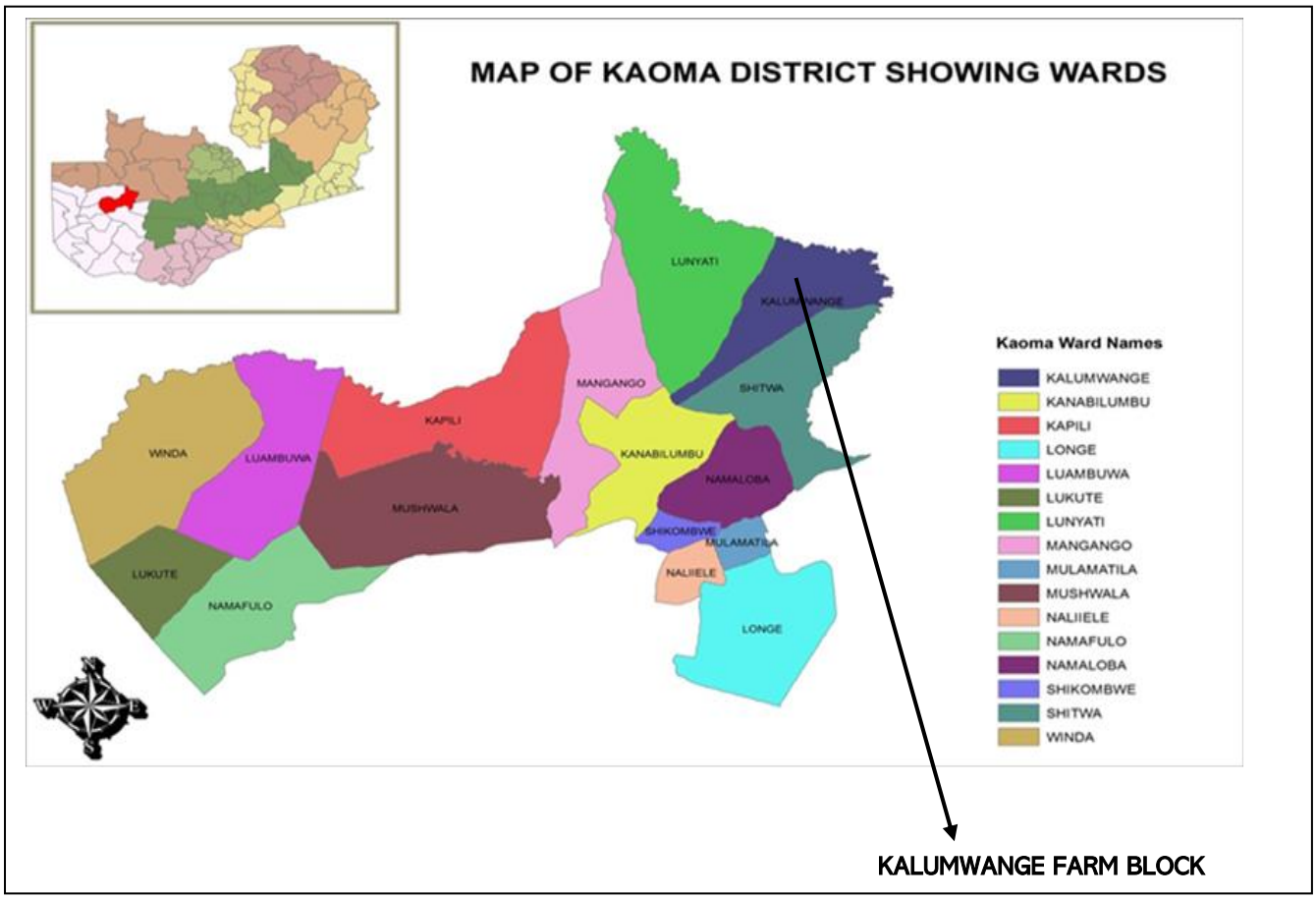
3.0 Introduction

The research strategy and study area are described in this chapter. The chapter also covers the data gathering and analysis procedures and methods that were being employed. Primary data was gathered from a total of 40 respondents (Small-scale farmers) within Kalumwange Farm Block. Interviews from 5 key informants and 2 focus group discussions helped the researcher understand small-scale farmers' response measures to address the challenges of desert locusts invasions in agriculture fields.

3.1 Strategy of the research

The research was done in Kalumwange Farm Block- Kaoma district of Zambia, and the strategy used was a case study. A case study allowed capturing a range of perspectives and gaining a greater understanding of desert locusts in Kalumwange Farm Block. This was important to establish sustainable ways of combating desert locusts.

Figure: 3.0 Map of Kaoma showing Kalumwange Farm Block



Source: Kaoma Town Council 2020

3.2 Research Approach

This research took a qualitative method. A qualitative study is a bridge that helps understand the emotions that drive behavior and the feelings that precede decisions. It helps in gaining an understanding of people's reasons, opinions, motivations, and thoughts.

Two focus group discussions and interviews with five key informants were done to understand desert locusts and how small-scale farmers battled them. Further, a questionnaire was administered to 40 respondents. Two focus group discussions, 40 questionnaires, and interviews with 5 key informants enabled the researcher to gather enough information for analysis. The three methods were necessary to help triangulate the findings. Using Google Scholar and GreenI, secondary data was collected from books, articles, and journals (Laws et al.,2013).

3.3 Data collection and sampling methods

Semi-structured interviews aimed at gathering data on how small-scale farmers respond to desert locusts outbreaks in agriculture fields were conducted with selected key informants. Semi-structured interviews were chosen because they provided the researcher with in-depth information from respondents. In addition, semi-structured interviews allowed the researcher to probe respondents further and collect the necessary data needed for analysis(Laws et al.,2013).

The two focus group discussions were organized and chaired by the research assistant. He also administered the questionnaire to 40 respondents. The researcher conducted the interviews with key informants. The role of the research assistant was to collect and send data to the researcher. The researcher then analyzed the data sent to him.

Convenience sampling method was used to pick 40 small-scale farmers from the Kalumwange Farm Block to complete the questionnaire. The researcher chose this strategy because it allowed him to identify responders in his immediate vicinity. The study was conducted in a farm block where all residents were small-scale farmers. Furthermore, convenience sampling was chosen because it was a less expensive data collection method (Laws et al.,2013). Respondents were close to the researcher.

The respondents chosen for the questionnaire were aged 16-35, 36-59, and 60 years and above. The age group between 16-35 years was the most productive in the farm block. They produced 80 to 100 bags of 50kg maize per acre. They were members of Kalumwange Agriculture Cooperative, and because of that, they provided the researcher with rich information on how they responded to an outbreak of desert locusts. The age group between 36-59 were primarily married couples. They responded to desert locusts outbreaks using two or more local methods. For example, a man would be playing drums to scare the locusts in the field, and a woman would be spraying water mixed with hot chili. Therefore, their selection for the study provided the researcher with more information about how small-scale farmers fought desert locusts. Respondents aged 60 and above were chosen based on their prior experience in fighting pests in agriculture fields. They only felt that the best method to combat desert locusts was to pray to God.

3.4 Key Informants interviewed.

The following were the key informants for this research; the district agriculture coordinating officer, three (one male and two female) agriculture extension officers working in Kalumwange Farm Block, and the chairperson of the Kaoma agriculture association. The aim was to get rich information from the semi-structured interviews with key informants. The data collected was then triangulated with the information collected using questionnaires and focus group discussions (Laws et al.,2013). The reasons for choosing the named key informants for this study are given below;

Kaoma Agriculture Association Chairperson

The role of the association is to provide a platform where small-scale farmers could come together and exchange ideas on best agriculture practices. It offers a chance for farmers to meet in workshops

and meetings and discuss agriculture development programs. The association works with private institutions to help address problems of pests in the entire district. Because of this, the Chairperson of the Kaoma Agriculture Association gave the researcher information regarding institutions that worked with small-scale farmers in addressing the problem of desert locusts invasion in Kalumwange Farm Block.

District Agriculture Coordinator (DACO).

He/she heads the department of agriculture in the district in Zambia. All agricultural developmental programs/activities from the government, Cooperatives, or any stakeholder pass through his/her office before they reach the small-scale farmers. The district agriculture coordinating officer provided the researcher with information on the government's role in addressing desert locusts in the Kalumwange Farm Block. He also explained some limitations small-scale farmers faced in combating the spread of desert locusts in agricultural fields.

Kaoma Agriculture Cooperative Chairperson

The Kaoma Agriculture Cooperative is multisectoral. It is composed of government officers from the district department of agriculture, officers from the Food and agriculture organization, and the food reserve agency. Furthermore, over 90% of small-scale farmers are members of the Cooperative. The Kaoma agriculture cooperative primary purpose is to increase its member agriculture produce and incomes. It helps train farmers to manage their finances. It also helps them access agricultural inputs, farming information, and output market. The chairperson of the Cooperative provided the researcher with information on the Organisations that collaborated with small-scale farmers during the fight against desert locusts. Further, the Cooperative chairperson explained to the researcher how small-scale farmers perceived the outbreak of desert locusts in agriculture fields.

Agriculture Extension Officers

The agriculture extension officers provide an interface between government and small-scale farmers. These are people that work with small-scale farmers daily. They are the first agriculture officers to know the challenges small-scale farmers are facing. They provide technical assistance to small-scale farmers. Agriculture extension officers will provide the researcher with key information on how small-scale farmers usually respond to seasonal pest outbreaks like grasshoppers in agriculture fields.

3.5 Focus Group Discussion

Two focus group discussions were conducted. The focus group discussion aided the researcher in collecting information on different views from male and female respondents regarding how desert locusts were a problem to small-scale farmers in Kalumwange Farm Block. It also gave the researcher information regarding how small-scale farmers worked together with other stakeholders to address desert locusts outbreaks.

The two focus group discussions started with a prayer and ended with God's blessing again. The focus group discussions were minuted, and in each of them, a time keeper was chosen to ensure that the discussion was held just for an hour (Laws et al.,2013). Because, at the time of this study, the Covid-19 health laws in Zambia prohibited people from meeting in groups for more than 60 minutes.

The first focus group discussion comprised 4 males, 4 females. The second focus group discussion had 4 females and 4 males. The focus group discussion was done in an open atmosphere to allow focussed conversations and two-way communication between the discussants and the researcher. The focus group discussions were facilitated by the research assistant and were used to answer the following questions:

- Sub question 1 (What are the small-scale farmer's perceptions of the spread of desert locusts in Kalumwange Farm Block?)

- Sub-question 3 (What practices do small-scale farmers undertake to combat desert locust invasion in agriculture fields in Kalumwange Farm Block?)
- Sub-question 5 (With whom do small-scale farmers collaborate with in fighting desert locusts in agriculture fields?

The information generated was summarised using a predesigned sheet for further analysis. The data from the FGD was collected using a semi-structured group interview guide.

3.6 Data analysis method

For this research, the information obtained from interviews and questionnaires was analyzed using Microsoft word, excel, and Statistical Package for Social Sciences(SPSS). Data was compiled, checked, and analyzed using thematic analysis with simple tables, figures, charts, and frequency distributions generated from SPSS(Laws et al.,2013). The two focus group discussions were done in the local language. Transcription of data was conducted, after which the information was translated to the English language.

3.7 Limitation of the research study

In March 2020, the Zambia government passed a statutory instrument that forbids people from gathering in masses or even in a group of 10 for 60 minutes due to a surge in the cases of coronavirus in the country. Because of this, the researcher had identified 16 people for the focus group discussion to have a meeting for only one hour. The 16 respondents were divided into two, hence having two focus group discussions with 8 respondents each. However, this may have affected the richness and quality of information collected. A group of 15 people per focus group discussion would have provided the researcher with rich information and more insights into how small-scale farmers in Kalumwange fought the outbreak of desert locusts.

Zambia had a general election on August 12th, 2021, in which the new administration was welcomed into the office. The researcher was collecting data in the field during this time, and some respondents confused the researcher's data collection technique for an election campaign. They mistook the researcher for a member of the ruling party. As a result, some respondents may not have been as open to answering study questions as they would have been if it was not an election year. As a result, it is possible that this could have influenced the quality of the information respondents provided. For example, some respondents only opened up towards the end of the discussion; they were still skeptical about the research because they thought it had something to do with national politics. Some people in Zambia are afraid to comment on national politics because of conflicts between the ruling party and those in opposition.

The COVID 19 pandemic measures prevented the researcher from traveling to Kalumwange Farm Block to collect the field data in person. To address the limitation, the research commissioner (KDDA) recruited a research assistant who was familiar with the research community under request from the researcher. The research assistant had extensive data collection experience and could speak the local language. This situation posed a challenge regarding the data quality that might have affected the result of the research. However, the researcher had done everything in his power to prevent it by constantly staying in touch with the assistant, guiding him, and providing clear instructions.

3.8 Research ethics considered.

Respect for respondent's anonymity and their confidentiality was adhered to in this research. The respondent's information was well managed to protect them. Respect for the privacy of the respondents was followed to the latter.

CHAPTER 4: RESEARCH FINDINGS

4.0 Introduction

The study findings are provided in this chapter in numerous theme areas, including the study location, demographic characteristics, a desert locust outbreak, and the method of obtaining agriculture information. The effects of desert locusts in agricultural areas are discussed in this chapter and small-scale farmer's response methods to desert locust invasion in agriculture fields. Further, the chapter examines the Kalumwange Farm Block's small-scale farmers' capacity and vulnerability using the Vulnerability and Capacity Framework.

4.1 Profile of the respondents

Table 4.0 Respondents profile

Age in years	Female	Male	Total	Percentage
16-35 (Youths)	5	7	12	30
36-59 (Adults)	10	12	22	55
60 and above	3	3	6	15
Total	**18**	**22**	**40**	**100**
Percentage	45	55	100	

Source: This research, 2021.

Respondents were grouped into three age categories: youths, adults, and the elderly. 12 (30%) of small-scale farmers fell into the category of the most productive youths. The first focus group discussion explained that the age group between 16-35 years produced 80-100 bags of 50kg maize per acre.

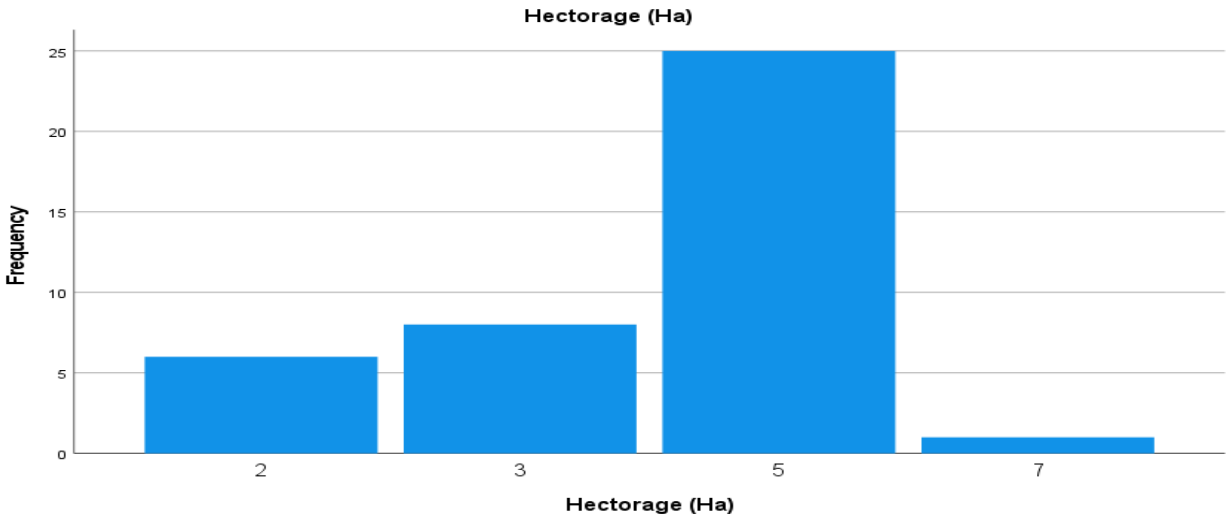
Respondents aged between 36-59 years were 22 (55%) of the total number interviewed. Respondents aged between 60 and above were 6 (15%). According to the first focus group discussion held, this age group was less productive due to their age. Combining the three age groups was necessary for this research because respondents of 60 years and above provided information on whether they had experienced an outbreak of desert locusts before the 2019/20 farming season. They also gave the researcher information on how they responded to common pests that invaded farming fields in the past years.

The age group between 16-35 and 36-59 provided the researcher with information on what could have caused the desert locust outbreak and some local response methods used to combat the pests. This age group also informed the researcher about the stakeholders who collaborated with small-scale farmers during the fight against desert locusts.

4.2 Respondents farm size

The question of the farm size was to ensure that respondents were small-scale farmers, those who cultivated in a piece of land that was less than or not more than farm 5 hectares. This is because small-scale farmers in Zambia are defined as those who grow crops on less than 5 hectares of land (MOF,2021)

Figure 4.0 Respondents farm size by numbers



Source; This research 2021.

Figure 4.0 shows that of the 40 respondents interviewed, 25 had a farm size of 5 hectares, 8 respondents had a farm size of 3 hectares, 6 had 2 hectares, and only 1 had a 7 hectare. The research found that the respondent with a 7-hectare farm was a senior citizen aged 89 and was also a traditional leader within Kalumwange Farm Block. Due to his prominence and contribution to the farm block, he was given an additional 2-hectares of land in addition to his initial 5-hectares. This is how his farm size became 7-hectares. However, this farmer could have affected the average farm size of the farmers because he was included in the analysis. Further, his farm had more crops because of its size.

Table 4.1; Quantity of maize produced by small-scale farmers on average depending on farm size;

Farm size in (Ha)	50kg bags of maize per hectare
1	1x80=80
2	2x80=160
3	3x80=240
4	4x80=320
5	5x80=400

Source; This research, 2021.

Table 4.1; shows the average number of maize produced by small-scale farmers depending on the size of the farm. This was explained in both the first and second focus group discussion held.

Table 4.2 Respondent's farm size by gender.

Respondents Farm Size in (Ha)	Number of the farms	Farm owner (Male)	Farm owner (Female)
7	1	1	0
5	25	21	4
3	8	0	8
2	6	0	6

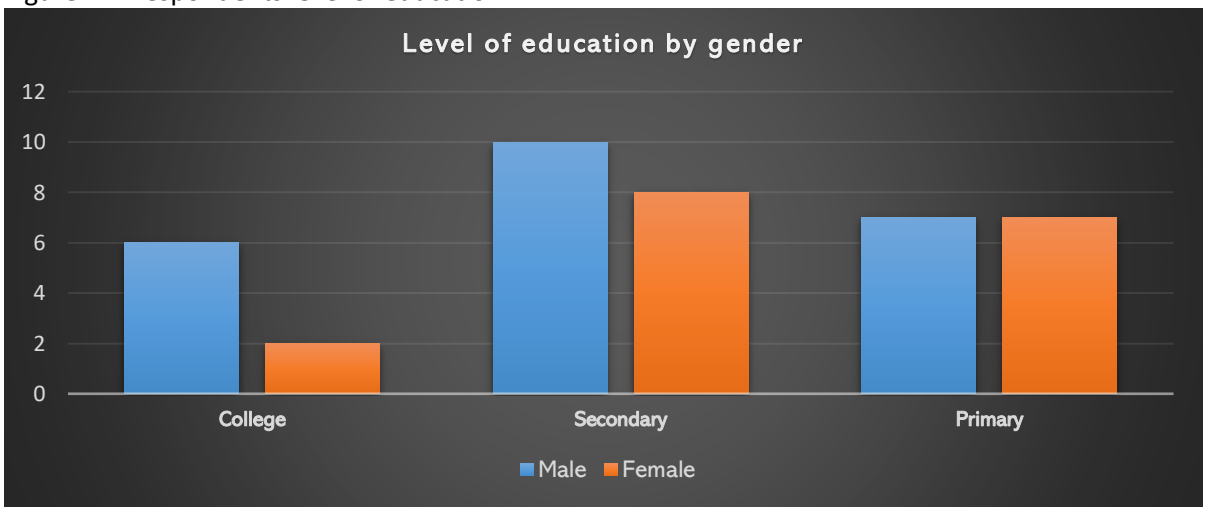
Source: This research,2021

From table 4.2, the research found that out of the 40 respondents interviewed, men had more land compared to women. When respondents were probed further about this, the study found that women had difficulty securing land due to barriers such as land premium fees. Payment to the state was part of the requirement for a small-scale farmer to own land in the farm block. The land premium fee per hectare was $200 (United States Dollars).

The study established that it was difficult for women to find such an amount of money in Kalumwange. Because of this, the number of women who owned land was small. However, an interview held with KI (1) revealed that the government was planning to develop land schemes to lower the land acquisition cost, especially for women. The KI (1) explained that the idea behind the land scheme was to empower women who had challenges raising funds to acquire land and grow their food, even sell and earn income.

4.2 Small-scale farmers level of education

Figure 4.1 Respondents level of education



Source; This research, 2021

Most respondents attained a secondary level of education, representing 18 (45%) of the total number. 14 (32%) had Primary education while 8 (20%) went up to College level. According to KI(2), small-scale farmers with a college education had a farm size of 5-hectares. When probed further about this, the respondent explained that most farmers with a college education were retired civil servants. Therefore when the government paid their benefits, most of them bought land and started farming.

However, in the first focus group discussion, it was emphasized that women were being encouraged to advance their education beyond Primary and Secondary School. The idea was to have an equal educated population of both men and women to contribute to the country's development. The KI(3) explained that,

"Small-scale farmers with a college education usually attend meetings and workshops that we organize for them. The meetings are meant to help them improve their yield. We teach them various farming methods and types of seeds to grow."

Further, the KI (3) explained that *"Small-scale farmers with college education usually have more produce and income than those with primary and secondary education levels."*

4.3 Rate of spread of desert locusts

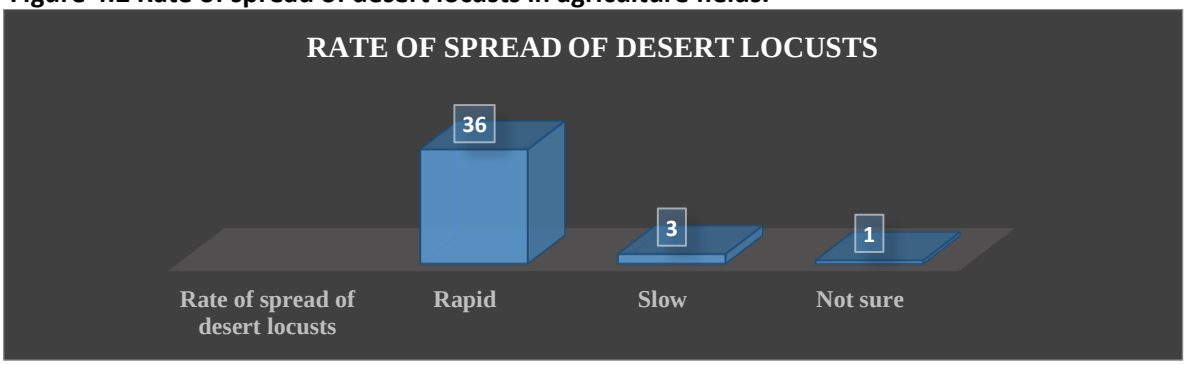
The figure below depicts the perceptions of small-scale farmer's speed at which desert locusts spread in agriculture fields.

Of the 40 respondents, 3 said the spread of desert locusts in agriculture fields was slow because the locusts only affected Kalumwange Farm Block and not the entire district of Kaoma. 1 respondent said they were unsure because they did not know how desert locusts spread. 36 said the spread was rapid because they laid many eggs and could fly very long distances. Further, it was explained that desert locusts only took one day to invade all agricultural fields in Kalumwange.

An interview with KI (2) reviewed that desert locusts spread rapidly between February and March and slower between April and December.

A rapid spread is when desert locusts move in number, cover a long distance in the shortest possible time, and multiply quickly in agriculture fields. However, if small-scale farmers are trained on identifying, controlling, and managing these pests, their rate of spread is reduced. 36 respondents said it was challenging to notice how quickly desert locusts spread in the farming field, *"It was like magic,"* one respondent said. A slow spread of desert locusts in agriculture fields means that they take time to multiply when they invade it because the temperatures may not be favorable for them to reproduce (FAO,2021). Warm to hot temperatures and sandy soil provide a breeding ground for desert locusts to multiply rapidly(Cressman, 2020).

Figure 4.2 Rate of spread of desert locusts in agriculture fields.



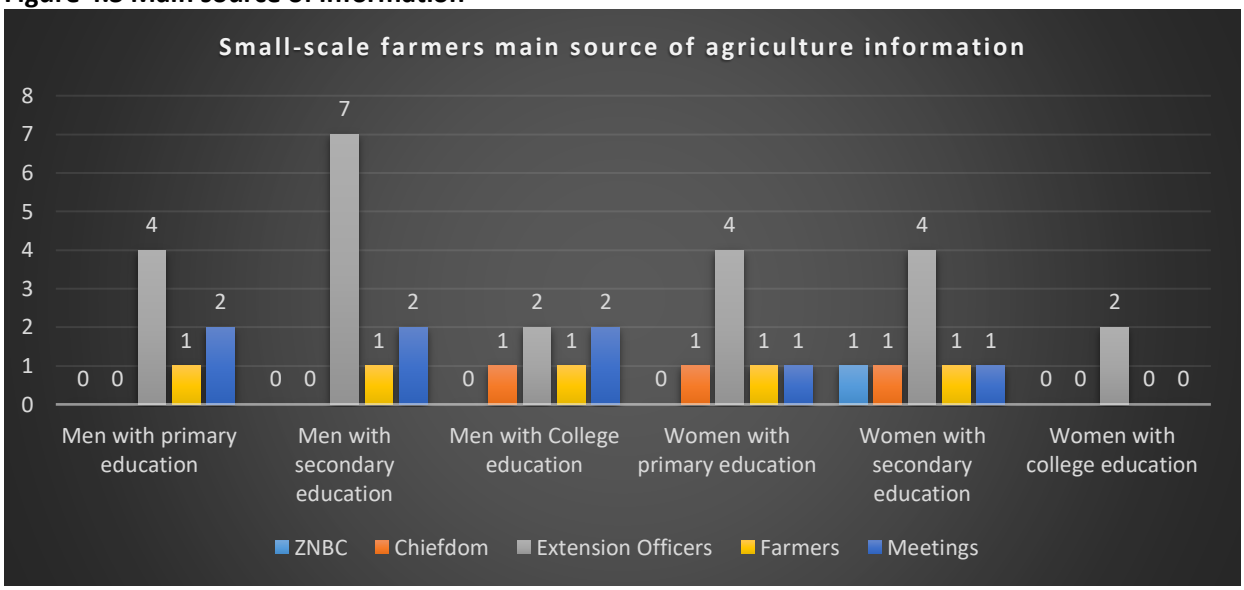
Source: This research, 2021.

According to KI(1), *"Desert Locusts can swiftly increase in number and, within a month or two, begin to concentrate and gregarize, leading to the creation of small groups or bands of wingless hoppers and small groups or swarms of winged adults if not controlled."*

4.4 Small-scale farmers source of agriculture information

Information on new trends in agriculture development is key to ensuring that farmers improve their productivity and practice smart agriculture by avoiding methods that pollute the environment. This research needs to determine where small-scale farmers get their agriculture information concerning fighting pests in farming fields. The role of agriculture extension officers, traditional leaders, and NGOs is key in ensuring that small-scale farmers combat the spread of pests in agriculture fields. The stakeholders ensure that Kalumwange farm Block is food secure and that small-scale farmers find markets where they can quickly sell their produce without challenges.

Figure 4.3 Main source of information



Source: This research,2021

Figure 4.3 shows that agriculture extension officers are the main source of agriculture information for men with primary, secondary, and college education. Furthermore, the figure also showed that women with primary, secondary, and college education obtain most of their agriculture information from extension workers. The study also showed that small-scale farmers and monthly meetings were a source of agriculture information. The information provided was more of guidance; the right time to plant seeds, type of soil that is good for different crops, weather changes, their impact on crops, outbreaks of pests, and how they could be effectively fought.

An interview with KI (2) revealed that the agriculture extension officers provided an interface between the district agriculture department (government) and small-scale farmers. Therefore the information on desert locusts outbreaks or any related pests is expected to be supplied by agriculture extension officers to the small-scale farmers.

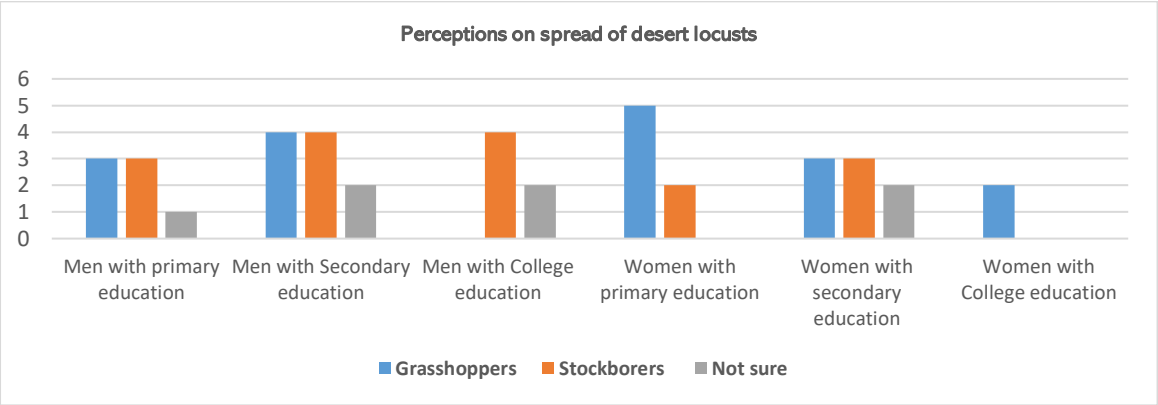
According to KI (5), "*Lack of skills, knowledge, and capacity by agriculture extension officers to fight desert locusts means that small-scale farmers would also fail to win the battle against these pests.*"

In the second focus group discussion, it was explained that; "*women, regardless of the level of education, enjoy attending meetings held by the Kalumwange Agriculture Cooperative. They mostly get agriculture information from there.*"

4.5 Small-scale farmers perceptions of desert locusts

To better understand small-scale farmers' methods in fighting desert locusts in agriculture fields, it is essential to recognize how they regarded and understood the pests. Their view of the pest had a bearing on the response options used to combat it.

Figure 4.4; Small-scale farmers perception of desert locusts



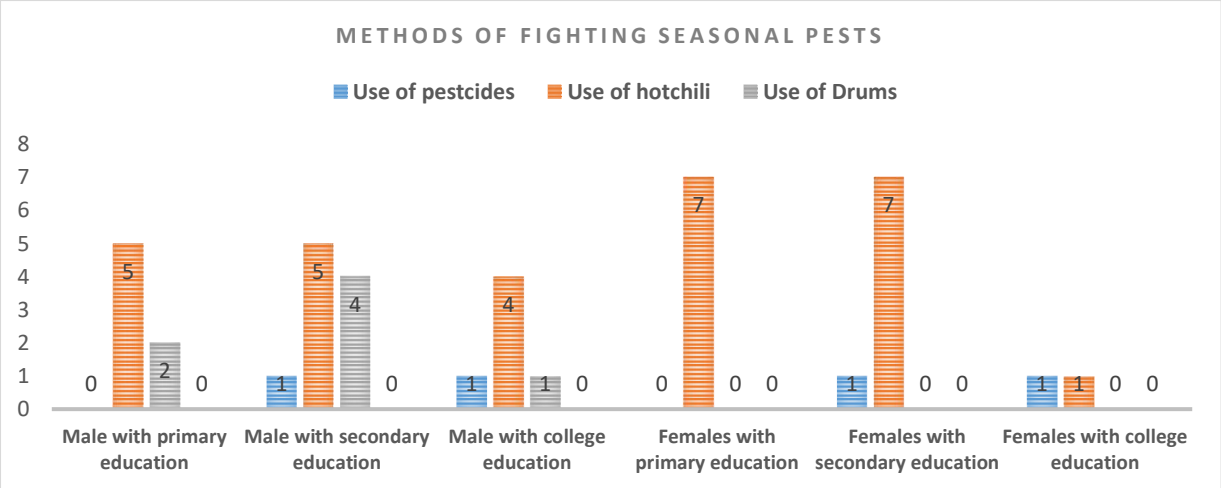
Source: This research,2021

Figure 4.4 shows that the spread of desert locusts in Kalumwange Farm Block was mistaken for grasshoppers and stockborers. Grasshoppers and stockborers usually invade farming fields in the farm block; therefore, small-scale farmers thought they had been invaded by the same pests again. The two focus group discussions explained that this thinking led small-scale farmers to use their local methods to fight desert locusts in farming fields. Further, the KI (3) demonstrated that the local methods used by small-scale farmers to fight desert locusts were those they were using to combat grasshoppers and stockborers in agriculture fields.

4.6 Response measures employed by small-scale farmers to address seasonal pests outbreaks

As earlier explained, small-scale farmers in Kalumwange Farm Block grapple with seasonal challenges of pests such as grasshoppers and stockborers. Therefore, understanding the methods used to address these problems and ensure that they produce more crops is essential for this research. It will provide more insights regarding the response options used to fight desert locusts.

Figure 4.5; Small-scale farmers methods of fighting seasonal pests



Source: This research, 2021.

Figure 4.5 shows that despite their level of education, small-scale farmers use hot chili to address the challenges of pest invasions in agriculture fields instead of recommended biochemicals. Some farmers also use drums and pesticides. An interview with KI (2) reviewed that recommended chemical pesticides were expensive for small-scale farmers to buy and spread the entire farming area. The KI (2) also explained that; *"Sometimes the price of these recommended chemical pesticides fluctuates, a*

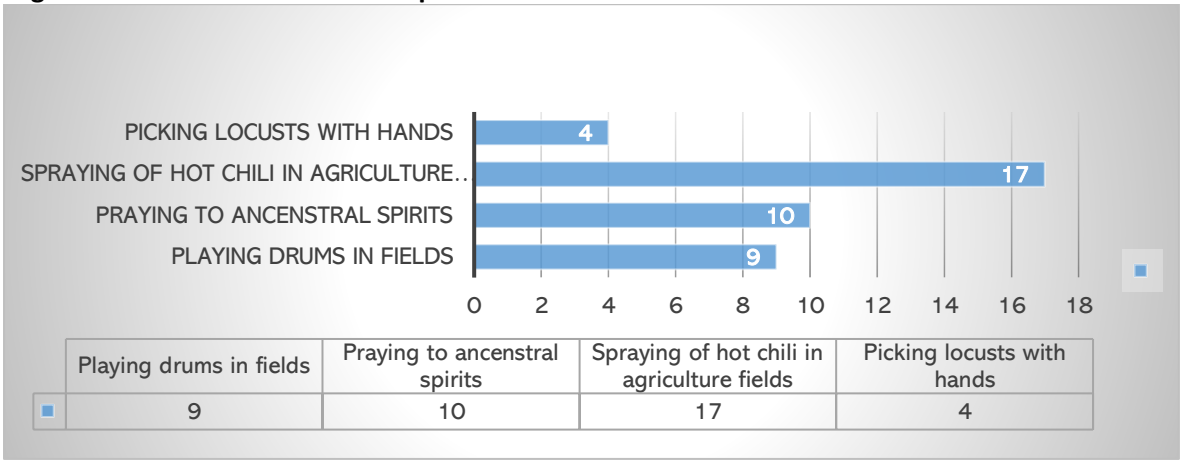
20mils container usually costs $50 to 60 (United States Dollars), and farmers would need 10 to 15 of them to spray a 5 hectares piece of land. Because of this, farmers find them expensive."

The second focus group discussion reviewed that the government, through the Ministry of Agriculture, needed to see the need for subsidizing farming inputs, including chemicals necessary for fighting pest invasions in agriculture fields. The discussion reviewed that most farmers find it challenging to afford these inputs and chemicals because of their high prices. The meeting further highlighted that not all small-scale farmers in the farm block benefit from farmer input support programs that the government was undertaking. Therefore subsidizing farming inputs, including biochemicals for fighting pests, could help farmers improve their yield.

4.7 Local response methods of combating desert locust outbreaks

Small-scale farmer's used local methods to fight the invasion of desert locusts in farming fields. The two focus group discussions explained that small-scale farmers mistook desert locusts for grasshoppers and stockborers, which usually invade their farming areas. Because it was the first time Kalumwange Farm Block and the country recorded an outbreak of desert locusts, Small-scale farmers, agriculture extension officers, and the Kaoma district department of agriculture did not know how to respond to these pests.

Figure 4.6 Local desert locusts response methods



Source: This research, 2021

Small-scale farmers' responses, such as beating drums in agriculture fields and praying to ancestral spirits, were discussed through two focus group discussions and interviews with key informants.

According to the data acquired from respondents, 17 (42.5%) of small-scale farmers sprayed hot chili in their agriculture fields in the hopes of fending off desert locusts. In addition, the study discovered that 10 (25%) of small-scale farmers prayed to their ancestral spirits to help desert locusts leave their farms. Furthermore, according to the survey, 9 (22.5%) of respondents responded by banging drums to scare away the desert locusts. The remaining 4 (10%) small-scale farmers picked the pests and killed them with their hands.

The Agriculture Extension Officer interviewed explained that:

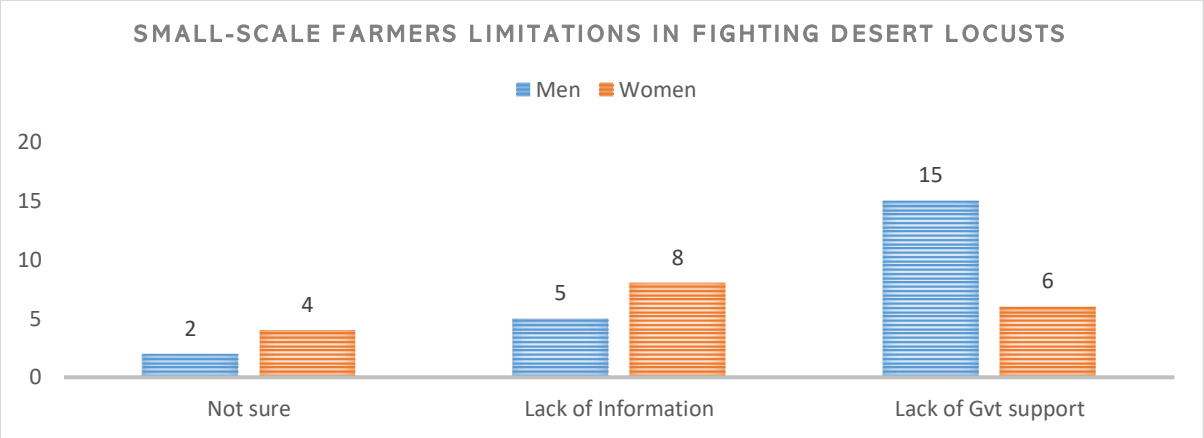
"People here in Kalumwange are very traditional, and it was challenging to convince them that their traditional methods cannot solve the problem of desert locust invasion. Also, you have to understand that this was the first time the outbreak of desert locusts hit us, so people had no information regarding effective ways of combating such a huge outbreak."

During the two focus group discussions, it was explained that no single local knowledge response was effective in combating desert locusts outbreaks. However, it was heard that a combination of prayers to ancestral spirits and spraying chili soaked in water with a traditional broom aided farmers in getting just a few bags of maize from the fields.

4.8 Limitations faced by small-scale farmers in fighting desert locusts

Small-scale farmers did not win the fight against desert locusts invasions due to some challenges they faced**.** The diagram below explains the difficulties faced by the farmers.

Figure 4.7: Small-scale farmers limitations



Source: This research, 2021.

The figure above shows that out of the 40 respondents interviewed regarding the limitations small-scale farmers faced in fighting desert locusts, 15 men and 6 women said they lacked government support. Because when the outbreak of desert locusts occurred, they expected the government to come to their aid, which did not happen. 5 men and 8 women said they lacked information on combatting these desert locusts in agriculture fields. The information was regarding the behavior of desert locusts, how they move, whether they are poisonous, and how they could be removed from farming fields to prevent damage to crops.

Furthermore, the research found that 2 men and 4 women were unsure about the limitations small-scale farmers faced in addressing the challenges of desert locusts in farming fields.

In the two focus group discussions held, respondents explained that it was the government's responsibility through the Ministry of Agriculture to help small-scale farmers when they face pests invasions in agriculture fields. Respondents explained that they felt neglected because the government did not come to their aid when they were grappling with the challenges of desert locusts.

According to the second focus group discussion, *"small-scale farmers thought that the government had information and the means to fight such an outbreak through the Ministry of Agriculture."* Therefore, the Ministry of agriculture was expected to move into Kalumwange Farm Block and assits the small-scale farmers combat desert locusts.

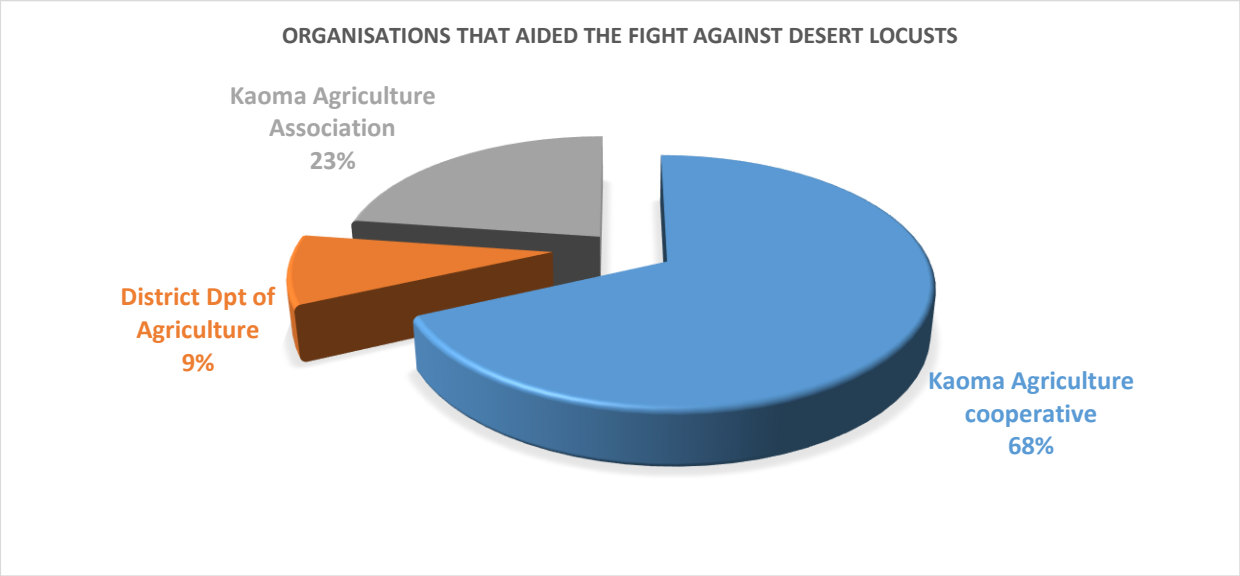
An interview with KI (2) reviewed that the Kaoma Agriculture Cooperative was supposed to train small-scale farmers on how to deal with pests invasions in agricultural areas. The KI (2) said that *"small-scale farmers in Kalumwange are members of the Kaoma Agriculture Cooperative. Therefore the*

cooperative should have seen the need to sensitize and train its members on identifying, controlling, and managing outbreaks of desert locusts and other related pests in agriculture fields."

4.9 Collaborations in the fight against desert locusts

No single group or organization can address every aspect of disasters risk reduction. As both physical and social phenomena, the scale, frequency, and complexity of disasters such as the spread of desert locusts can only be addressed by deploying a wide range of knowledge, skills, methods, and resources. Therefore, controlling and managing the spread of desert locusts must be multi-disciplinary partnerships, enabling organizations, small-scale farmers to share ideas, work more coherently, and win the battle against pest invasions.

Figure 4.8 Organisations that worked with small-scale farmers during the fight against desert locusts



Source: This research,2021

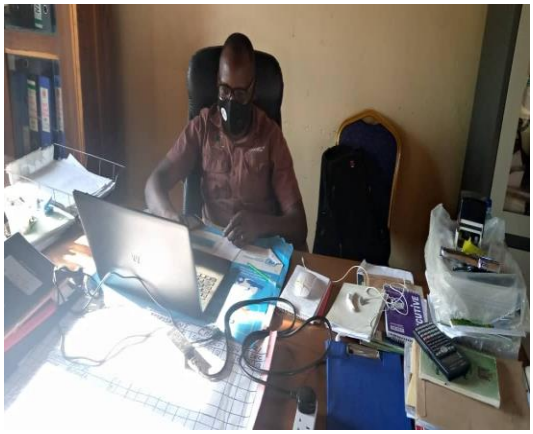
Figure 4.8 shows the organizations that assisted small-scale farmers in their fight against desert locusts in farming fields in Kalumwange Farm Block. 68% of respondents said they collaborated with the Kaoma Agriculture Cooperative, 23% said they worked with the Kaoma Agriculture Association, while 9% said they worked together with the District Department of Agriculture. However, it is essential to realize that the help rendered to small-scale farmers was after desert locusts raved agriculture fields. The assistance was in the form of bags of mealie meal so that small-scale farmers could feed their families. Further, both the Kaoma Agriculture Cooperative and the Agriculture Associated provided some farmers with bags of maize seeds to be planted the following farming season.

An interview held with KI(4) reviewed that the Kaoma Agriculture Cooperative is usually well funded by its cooperating partners such as the Food And Agriculture Organisation and the Food Reserve Agency in the country. Because of this, it was able to reach out to several farmers, especially after desert locusts had left farming areas. Some farmers were given free farming inputs, which they used in the next farming season. The idea was to cushion the impact left by the outbreak of desert locusts that raved crops and pasture.

An interview with KI(1) reviewed that it was challenging for the District Department of Agriculture to quickly come in and help farmers when desert locusts invaded agricultural farms. Because the Ministry of Agriculture usually underfunds the department, it also lacks information on how to control the

further spread of the pests and manage it. It was also the first time desert locusts invaded agriculture fields in Kaoma.

Images 1 and 2 showing interviews with KIs



Key Informant One. ***Key Informant Two***

Images 3 and 4 showing focus group discussion

(First Focus group discussion held at Kaoma Youth Resource Centre)

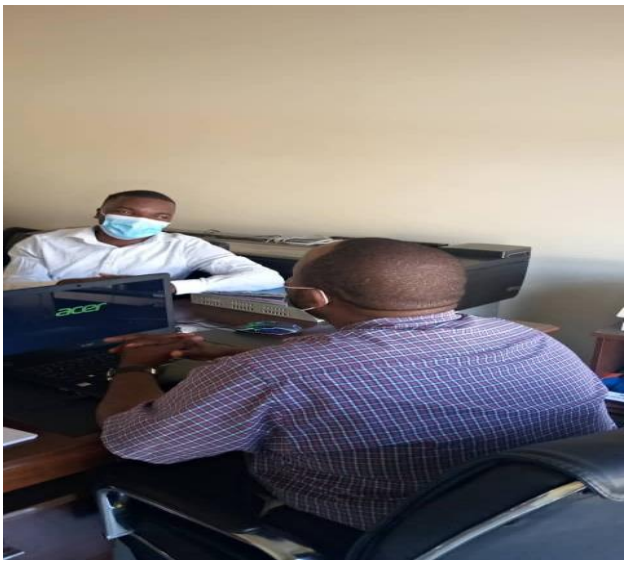
Images 5 and 6 focus group discussion

(Second Focus Group Discussion held at Kalumwange agriculture Camp)

Image 7 and 8.(Second Focus Group Discussion held at Kalumwange agriculture Camp office)

Images 8 and 9

Key informant 3



Key informant 4

Image 10

Key informant 5

Table 4.4 Maize production and income loss in the 2019/20 farming season in Kalumwange Farm Block.

Total maize fields of 40 respondents	Actual yield 50kg bags	Expected yield 50kg bags	Actual income in (USD)	Expected income in (USD)	Income loss in (USD)
318 (Ha)	301	3995	3010	39950	36940

Source: This research,2021 ***NB: 1 Zambia kwacha was 10 United States Dollars as of August 2020.***

From the 40 respondents interviewed, the total maize production in the 2019/20 farming season was expected to be 3,995 kilograms if agriculture fields were not affected by the outbreak of desert locusts. However, due to the attack of these pests, production drastically reduced to 301 kilograms. A total amount of $ 36,940 in income was lost.

According to KI (5), *"The money that was lost could have helped farmers pay tuition fees for their children and also cater for other necessities."*

The second focus group discussion revealed that the loss of agricultural produce and lack of government social safety nets for small-scale farmers affected by pests was a big challenge. Small-scale farmers had difficulty accessing food and income to afford school fees for their children and hospital bills. Kalumwange Farm Block would not have documented incidents of malnutrition and hunger, according to the second focus group discussion, if the government had programs where farmers afflicted by insect infestations were given money to assist them to survive until the next farming season.

The second focus group discussion revealed that the Kaoma District Hospital reported a very high percentage of Malnutrition in Kalumwange in December 2020. The respondents attributed this to the outbreak of desert locusts because it left small-scale farmers with barely anything to eat. Furthermore, the focus group discussion highlighted that small-scale farmers had financial problems buying farming inputs for the 2020/21 season.

Image 11 and 12, pictures of desert locusts in agriculture fields

FAO,2021 (Desert locusts eating corn in agriculture fields)

FAO, 2021. (Image 13 and 14 desert locusts invade agricultural fields)

The Capacity And Vulnerability Assessment Matrix.

During the two focus group sessions, the capacity and vulnerability framework was analyzed. This matrix looked at small-scale farmers' accessible, productive resources, skills and risks, and relationships between organizations and people in the Kalumwange Farm Block concerning fighting desert locusts outbreaks.

	Vulnerability	**Capacity**
Physical/Material What productive resources, skills, and hazards exist?	- Vulnerable to pest outbreaks in agriculture fields (KI & FGD). - Difficulties in accessing farming inputs and equipment like sprayers for fighting pest invasions (FGD). - Challenges in paying for Agriculture Cooperative subscription fees (FGD) - There is a lack of an agriculture skills training center in Kalumwange and the entire district (KI & FGD). - Lack of information on identification, control, and	- Presence of Primary and Secondary Schools in the area where farmers can learn how to read and write(FGD) - Presence of Health facilities in the Kalumwange Farm Block where farmers would go to if the pests pose health challenges to them(FGD &KI) - Availability of trained agriculture Extension Officers (KI) - Presence of Agriculture Cooperative offices and personnel that promotes innovative agriculture practices (KI &FGD)

	management of desert locusts (KI, FGD) - No safety nets for small-scale farmers affected by desert locusts and other common pests from the government (KI, FGD). - The feeder roads leading to the marketplaces are poor (FGD). - Lack of skilled personnel from the department of agriculture and NGOs in Kalumwange with knowledge on how to scientifically combat desert locusts invasions in farming fields (KI, FGD). - Communication network challenges affect the flow of agriculture information among small-scale farmers and the district department of agriculture (KI).	- The area is accessible by the following mode of transport: Bicycle, Vehicles, and Motorbikes
Social/Organizational What are the relations and organization among people?	**Vulnerability** - Lack of early warning systems to pests outbreaks (FGD &KI). - Small-scale farmers lack monitoring and surveillance systems to desert locusts outbreaks in Kalumwange(KI &FGD). - Challenges of accessing funds to pay medical bills when faced with pest invasions (FGD) - Women find it difficult to acquire land due to high land premium fees (FGD & KI). - A lack of community/small-scale farmer's DRM action plans (FGD) - Challenges of women accessing farming inputs (KI & FGD) - Kalumwange Farm Block and the Country lacks a pest control department to effectively manage the outbreak of desert locusts and other common pests that invade agriculture fields (KI).	**Capacity** - Availability of Civic and Traditional Leaders responsible for looking after Small-scale farmers (KI) - Availability of the District Agriculture Department Office that works with small-scale farmers daily (KI) - Availability of Civil Society organizations and faith-based organizations working in agriculture projects in Kalumwange (KI &FGD) - Presence of the Kaoma Agriculture Cooperative (FGD). - Agriculture extension officers as the primary source of agriculture information (Questionnaires & FGD)
Motivational/Attitudinal How does the community view its ability to create change?	**Vulnerability** - Challenges of addressing desert locusts invasion when they happen due to low-income levels and a lack of information on these pests (FGD) - Farmers think the government should protect them against the	**Capacity** - Small-scale farmers are capable of working together when invaded by pests in the agricultural fields (KI & FGD)

	attack of desert locusts and other pests. This is because the government is responsible for ensuring that the country is food secure at all times (FDG).	- Effective community collaboration to challenges of pest invasions (FGD) - Substantial social capital (Churches, families, associations) within the Kalumwange Farm Block (FGD)

Source; This research, 2021

This analysis showed that small-scale farmers in the Kalumwange Farm Block could address challenges of desert locusts invasions when they happen, provided they are aided by the government and cooperative with training on managing such pests. Small-scale farmers need to be trained to prevent and protect farming fields from desert locusts, increase early warning systems, establish contingency and emergency planning, and build back better.

CHAPTER 5: DISCUSSION OF FINDINGS

5.0.Discussion

Chapter five presents the research results analyzed in Chapter four. The chapter also discussed the respondent's profiles and their fight against desert locusts in agriculture fields. The chapter also looked at the rate at which desert locusts spread and invade agricultural areas, the cause of desert locust spread, maize production yield in the 2019/20 farming season, and small-scale farmers' traditional response methods for preventing and controlling desert locust attacks in agriculture fields.

5.1 Respondents Age

Zambia has a World Life Expectancy rating of 160, according to the most recent WHO data published in 2018. Male life expectancy is 60.2, female life expectancy is 64.4, and total life expectancy is 62.3 years (WHO, 2020). In this research, age was a determining factor in how small-scale farmers responded to the outbreak of desert locusts in Kalumwange. The study found that respondents of 60 years and above responded by praying to ancestral spirits so that desert locusts would leave farming fields. It was explained in the two focus group discussions that, in Kalumwange Farm Block, people were more spiritual. Because of myths and misconceptions surrounding the outbreak of desert locusts, some small-scale farmers thought the invasion of these pests was an act of God hence the use of prayers to fight them.

Respondents aged between 16-35 years were playing drums and sprayed hot chili in farming fields. This age group believed that this was the best local way of combating such an outbreak of pests. The researcher believes that when coming up with efficient and effective interventions for tackling an outbreak of desert locust, the age group of small-scale farmers requires consideration because their experience in dealing with similar challenges could be of importance to new methods of handling similar challenges.

5.2 Respondents farm size and gender

The research was aimed at understanding how small-scale farmers respond to outbreak desert locusts in Kalumwange Farm Block. Therefore, respondents needed to be small-scale farmers with a farm size of not more than 5 hectares of land.

According to Chalie W, 2017, "Most workaround crops are done by hand on small-scale farms, which rely on manual labor. Tractors and other technology are rarely used. Compared to traditional industrial farming, this farming method can be described as an extremely effective technique of producing crops, typically exceeding production per land unit." Because 96% of the farmers in Kalumwange Farm Block were small-scale, data for this study had to be gathered from them. The research also wanted to establish the number of women that owned land and produced on it. The research found that more men-owned land than women in Kalumwange Farm Block because of barriers such as land premium fees.

According to Suresh B, 2019 "Agricultural policymakers and development practitioners are responsible for guaranteeing that women fully participate in and benefit from the agricultural development process. Simultaneously, improving gender equality in agriculture can contribute to the reduction of extreme poverty and hunger. For agricultural development to thrive, gender equality would be beneficial." In my view, the Ministry of Agriculture needed to scale up the land scheme policy program so that women could be encouraged to acquire land and produce on it. This would help address the challenges of hunger.

5.3 Small-scale farmers level of education

The research established that 45% of respondents had secondary education while 20% had a college education. 35% of respondents had primary education. This research found that education played a significant role in how small-scale farmers respond to desert locusts outbreaks in Kalumwange Farm. According to KI(2), small-scale farmers who attained Secondary and college education produced

higher agriculture yields than those with primary education levels. When probed further about this, KI(2) explained that small-scale farmers with secondary and college education always attend agriculture training and workshops on improving yields and learning about suitable seeds to grow depending on the farming season. The Ministry of Agriculture organized the training and workshops through extension officers who would facilitate meetings.

In the second focus group discussion, respondents explained that education played a huge role in responding pests related outbreaks in agriculture fields. The respondents explained that small-scale farmers with primary level education or no education continued to use traditional methods to combat outbreaks of grasshoppers or stockbolers. The respondents explained that these small-scale farmers still find it difficult to accept that the effective practice of fighting these pests was through insecticides as prescribed by the Kaoma agriculture department. In Zambia, primary education runs from grade 1 to 7, and secondary education is from 8 to 12. After grade 12, students go to college or university depending on how they performed in grade 12 examinations (MOE, 2021).

5.4 Rate of spread of desert locusts in agriculture fields.

The research found that desert locusts travel in groups and cover a long distance in the shortest possible time. Upsurges and plagues do not occur overnight; they take many months to develop, and during plagues, desert locusts can spread over a 29 million km^2 area, affecting parts of 60 countries (FAO,2019).

The desert locust can wreak havoc on the lives of a tenth of the world's population. It is a threat to local inhabitants' livelihood, income, and food sources. A swarm of 1 km^2 consumes the same quantity of food as 35 000 individuals in one day. In a single day, a multitude the size of Bamako (Mali) or Niamey (Niger) can consume the equivalent of half the population of both countries(FAO, 2019).

Therefore, knowing the speed at which desert locusts spread and multiply in a farming field is crucial because it offers an opportunity for small-scale farmers to understand how quickly they need to respond when there is an outbreak.

5.5 Small-scale farmers access to information on desert locusts and related pests

During the second focus group discussion, it was revealed that agriculture extension officers played a considerable role in disseminating agriculture information to the Kalumwange Farm Block community. An interview with KI (2) showed that agriculture extension officers provided an interface between the government and small-scale farmers.

Agricultural extension officers use various approaches to urge farmers to adopt new, improved farming methods, including farmer study groups, farmer day, demonstrations, lectures, and media informing. Personal engagement with farmers on their farms is the most effective technique (Mkhuki,2020).

5.6 Cause of desert locusts outbreak

According to WMO, 2021, "The rise of desert locusts was aided by high rainfall brought on by the extreme positive Indian Ocean Dipole (IOD) and unusual cyclonic activity. The warming of the Indian Ocean resulted in eight cyclones between 2016-2020, the most ever recorded."

Aside from ocean circulation patterns, climate change is warming the oceans worldwide, resulting in increasingly violent downpours. According to new research from the Arabian Sea, global warming is already intensifying the fall of cyclones. Meanwhile, other researchers have linked climate change to rising droughts and failing rains in Africa, giving a picture of an uncertain future that is virtually and undoubtedly more catastrophic. (Cressman, 2021).

FAO, 2020 also stated that "Unusual meteorological and climate conditions, prevalent and heavy rains since October 2019, have contributed to a significant and extensive desert locust outbreak in Africa. The desert locusts jeopardized rural food security and livelihoods.

5.7 Economic effects of desert locusts outbreaks

Small-scale farmers interviewed in Kalumwange Farm Block had projected revenue of $39,950 in the 2019/20 farming season, out of which $36,940 was lost. This was due to farmer's difficulties in obtaining agricultural supplies such as fertilizer and weed herbicides. The breakout of desert locusts on farm fields, on the other hand, was the primary source of economic loss. Small-scale farmers lacked the information and skills needed to combat desert locusts. They relied on using indigenous knowledge, which was not effective.

In Ethiopia, Kenya, Somalia, South Sudan, Uganda, and Tanzania, 20.2 million people are currently suffering from extreme acute food insecurity because of desert locusts that ravaged agricultural farmlands in 2020 (FAO,2021).

Early estimates reveal that desert locusts destroyed approximately 800 square miles of crops and more than 5,000 square miles of pastureland in Ethiopia alone, as well as the loss of more than 350,000 metric tons of cereal, putting 1 million people in need of food assistance(Cressman,2021). The World Bank estimates that desert locust-related losses, including damage to crops, livestock, and other assets, could add up to $8.5 billion for the East Africa region and Yemen(Cressman,2021).

Desert locusts can cause significant agricultural harm, although the circumstances in which this occurs are improbable. According to historical research, the damage caused by desert locust attacks varies greatly. Serious consequences are uncommon nationally, but they can occur locally for specific population segments (Joffey,2011). According to simulations and actual agriculture statistics, the economic repercussions of a hypothetical uncontrolled pandemic on a national level would typically have minor effects in terms of percent average production and corresponding pricing effects (Joffey, 2011).

According to FAO,2021, "Continuous desert locust invasion has left an estimated one million Ethiopians in need of emergency food assistance. In the 2020 and 2021 outbreak of desert locusts, 390,000 people were the worst hit in Somali, followed by Oromia and Dire Dawa city, Afar, Amhara, Tigray, and the Southern Nations regions."

The risk of infestations and continuous breeding could limit food and fodder availability. The likelihood of an impact on vulnerable households/farms will remain high due to rising food prices. As herders might be forced to move to other areas, the risk of communal conflict over the pasture, grazing land, and rangeland will also increase (FAO,2021).

5.8 Fighting desert locusts attacks using indigenous knowledge

Small-scale farmers tried several local methods to combat desert locusts when farming fields were invaded. Most notable among the indigenous response options explained in chapter four was the use of hot chili. Small-scale farmers would mix hot chili with water and then spray the water in farming fields. Despite this method killing some locusts, it was not effective because crops and pasture were eaten up. The Kaoma district agriculture department did not respond in time to help farmers address the situation. When senior agriculture officers went to Kalumwange Farm Block, desert locusts had already migrated to other places. An interview with KI (4) revealed that when the Kaoma department of agriculture heard about the invasion of desert locusts in Kalumwange, they started consulting the Ministry of Agriculture on how best the outbreak could be fought. The department had no contingency plan on how they could fight such an outbreak.

A discussion with KI (2) highlighted that traditional response methods did not bear any fruits. Thousands of bags of maize were lost by small-scale farmers, and some are still struggling to recover. According to KI (2*); "Unless mitigating techniques to identify and combat the desert locust are applied, the desert locust will continue to pose a danger to Africa's food security."*

The first focus group discussion also explained that small-scale farmers used different methods to fight desert locusts because they did not know with certainty what they were supposed to do.

5.9 Reflection

My research journey began with research proposal development, which was very new to me. As a first-time research proposal developer, handling all my supervisor's critical feedback and comments was not easy. The development of my research questions and problem statement was of specific reference, which I had to revise several times to suit my perceived research idea.

I chose to look at the outbreak of desert locusts infestations in agriculture fields in Kalumwange Farm Block in the Kaoma district of Zambia. This work allowed me to do a desk study and follow what was happening in Kenya, Ethiopia, and Somalia regarding the spread of desert locusts in agriculture fields. The study also allowed me to speak directly to agriculture extension officers, the Kaoma Agriculture Cooperative members, and the district agriculture coordinative officer for the Kaoma district. These people provided me with information regarding how small-scale farmers perceived desert locusts and how they fought them. The conversations took place over the phone because of the COVID-19 pandemic, which prevented me from traveling in person to conduct the research.

As a result of the COVID-19 restriction, I selected a research assistant with whom I worked remotely daily to achieve the research objectives. My selection of him was based on the fact that he had a long-standing experience conducting research involving rural communities and had a practical understanding of their traditions, culture, and norms. Secondly, he had no personal relationship with the people of Kalumwange Farm Block in Kaoma, which probably could have influenced their responses to research questions either positively or negatively.

During my online interviews with key informants, internet connections were poor and frustrating; I had to call more than eight times during an interview. The internet connectivity problems were a potential stumbling block for the researcher to probe further for more information. It was heartwarming for me that all the key informants were willing to solve the network coverage problem by moving to community locations with good network coverage.

The COVID-19 guidelines did not allow the research assistant to hold focus group discussions for more than one hour, and the number of participants was reduced to 8 per session. Having a considerable number of 15 or more participants and holding discussions for about 2 hours could have given the research assistant room to probe further. Also, there were difficulties in mobilizing research participants due to the COVID-19 fear factor and resource constraints in conducting the study. Despite all of these difficulties, the researcher had several opportunities. The smooth community entry, the experience of the research assistant in the research community, cooperation from key informants, and the willingness of the Traditional leaders to mobilize study participants were opportunities that facilitated the research process.

This research made me realize the importance of Community Based Disaster Risk Management (CBDRM). For example, in Kenya, Ethiopia, and Somalia, the CBDRM approach was being employed in the fight against desert locusts infestations. Small-scale farmers in communities were capacity-built on identifying, controlling, managing, and preventing the further spread of desert locusts in farming fields. The involvement of the government and private agriculture institutions, especially the Food And Agriculture Organisation, has been vital in ensuring that the fight against desert locusts was won in these three countries.

Allow me to mention that applied research was a new experience for me. Organizing online meetings with KI, on the other hand, was something I enjoyed doing. It allowed me to learn about the many challenges Zambian Agriculture Departments face. These challenges range from; insufficient central government funding to the district department of agriculture, inadequate agriculture extension officers in some communities, the lack of capacity, skills, and information by small-scale farmers on addressing desert locusts infestations in farming fields.

Because of this study, I have acquired several skills such as time management, working in a team, negotiation, writing, and communication skills. Furthermore, I now understand what it means to work under pressure, working independently on complex projects, and being patient when things don't go your way. This research has taught me that people see things differently, and it is always important to embrace criticisms because they make you grow.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.0 Conclusion

The conclusion and recommendations of this study are outlined in this chapter. The recommendation suggested here focuses on small-scale farmers' strategies of effectively responding to desert locusts outbreaks. The report also outlines what the Kaoma District Department of Agriculture needed to help small-scale farmers in the Kalumwange Farm Block effectively combat desert locust attacks in farming fields.

The Kaoma District Department of Agriculture commissioned the study. The research aimed to understand response measures employed by small-scale farmers in addressing desert locusts invasions in agriculture fields in Kalumwange Farm Block in Kaoma district of Zambia.

The findings showed that the outbreak of desert locusts resulted from climate change, particularly the increased rainfall brought on by the extreme positive Indian Ocean Dipole (IOD) and unusual cyclonic activity. Further, the warming of the Indian Ocean resulted in eight cyclones between 2015-20, the most ever recorded.

The study established that small-scale farmers in the Kalumwange Farm Block responded to an outbreak of desert locusts in agriculture fields by spraying water mixed with chili, praying to ancestral spirits, playing drums to make noise so that desert locusts would fly away. Furthermore, some small-scale farmers responded by handpicking desert locusts in agriculture fields. The research discovered that small-scale farmers' response options to desert locust attacks were based on local knowledge and how the community responded to seasonal attacks of grasshoppers and stockborers.

The study established that small-scale farmers in Kalumwange lacked the strength, skills, and knowledge to effectively manage desert locusts infestations in agriculture fields. The farmers had no information regarding conditions that make desert locusts multiply in number and measures that could be put in place to fight them. Furthermore, the study found that small-scale farmer's crop productive yield was hugely affected and a total amount of **$ 36,940** was lost from the 40 farmers interviewed. This led to food insecurity, challenges of funds to pay for medical bills, and school fees for children. The loss of crop productivity negatively affected farm income; therefore, small-scale farmers had challenges buying farming inputs (seeds, sprayers, fertilizers) for the next agriculture season.

According to the study, small-scale farmers were limited by a lack of social safety nets from the government (funds, seeds, bags of fertilizer) for those affected by desert locust attacks. Also, it was found that the considerable limitation for small-scale farmers was knowledge on desert locusts, mainly because it was the first time the infestation of these pests occurred in Kaoma.

The research further explains that desert locust remains a source of concern and a potential danger to household food and financial security. Therefore, small-scale farmers, stakeholders, and the government must work together to control and manage the outbreak of these pests in agriculture fields.

6.1 Recommendations

In light of the findings and conclusion of this study, the Kaoma District Department of Agriculture needs to ramp up programs and activities focused on practical strategies for managing desert locusts outbreaks. Small-scale farmers, the Kaoma District Department of Agriculture, and the Ministry of Agriculture need to adopt the recommendations below.

6.2 The Ministry of Agriculture

- Because desert locusts are migratory, it is advised that the Ministries of Agriculture in countries prone to desert locust invasion collaborate and monitor the weather and ecological conditions regularly. They must also maintain a close eye on locust activity and issue timely alerts. The Ministry of Agriculture needs to realize that changes in breeding sites for desert locusts can be monitored using satellite images.

- It was established that when the outbreak of desert locusts occurred in Kalumwange Farm Block, the Kaoma District Department of Agriculture had no information on how small-scale farmers could effectively address this challenge. Therefore it is recommended that the Ministry of Agriculture formulates a well-funded national pest control center and then decentralize them to districts prone to desert locusts outbreaks. This will aid effective collaboration and response to desert locusts between the government and small-scale farmers.

6.3 Kaoma District Department of Agriculture

- Agriculture extension officers from the District Department of Agriculture work with small-scale farmers, providing them with information and advice on various agricultural issues. Because of this, agricultural extension officers' capacity building and training in desert locust control, monitoring, and early warnings are critical. The capacity building on desert locusts and other pest infestations in agriculture fields need to include all age groups, young and older. Women and children who, in most cases, are more vulnerable to disaster impacts need to be trained on how they can manage to fight outbreaks of desert locusts in agriculture fields.

- The study discovered that small-scale farmers mistook desert locusts for grasshoppers and employed grasshopper-fighting techniques to combat desert locusts. Because of this, it is recommended that small-scale farmers be trained on how to identify, control and manage desert locusts invasions in agriculture fields. In addition, as part of early warning forecasts, the Kaoma Department of Agriculture must supply small-scale farmers with information on locust development and migration monthly. This could be done through monthly meetings which the department holds with the farmers.

- The research established that the local methods used to combat desert locusts were not effective, and eventually, farmers lost food and income. Therefore it is recommended that the Kaoma District Department of Agriculture conducts agriculture sensitization meetings on methods that could help small-scale farmers address the challenges of desert locusts in agriculture fields. Spraying with recommended bio-pesticides has so far proved to combat outbreaks of desert locusts in east Africa. Therefore, the Ministry of Agriculture needs to make these biochemicals available and also subsidize their prices for small-scale farmers to afford them. However, only trained personnel/small-scale farmers should spray these pesticides in farming fields because they are harmful to the human body.

- Due to limitations faced in combating desert locusts, small-scale farmers are encouraged to set up a consumer shop that would stock seeds for different crops and farming implements that support fighting desert locusts(Sprayers, bio-chemicals, magazines on pests, etc.). The availability of these equipment types will provide information on desert locusts and strengthen small-scale farmer's capacity to fight desert locusts. When small-scale farmers are knowledgeable about breeding grounds, movements, and behavior of desert locusts, it will help them prevent further spreading of pests once they attack an agriculture field.
- The district department of agriculture is encouraged to provide refresher training to camp extension officers to equip them with supplementary knowledge and skills about desert locusts. If these people are trained, they will pass on the information to small-scale farmers during their weekly engagements. This will help build small-scale farmer's skills and capacity in fighting desert locusts.
- Because small-scale farmers did not have information on desert locusts when the outbreak occurred, it is suggested that the Kaoma district department of agriculture make publications about desert locusts through posters, newsletters that can be shared with both extension officers and small-scale farmers to increase awareness on desert locusts

6.4 Small-scale Farmers

- Collaboration of NGOs, the government, the Kalumwange community is critical in ensuring that outbreaks of desert locusts are combated.
- The research showed that small-scale farmers in Kalumwange Farm Block lack access to social safety nets (funds, seeds, fertilizer). Therefore small-scale farmers, through their Agriculture Cooperative representatives, should lobby for these safety nets from the government. This would help cushion the impact of hunger often left after an outbreak of desert locusts.
- The research found that most women obtain their agriculture information from meetings with the Kalumwange Agriculture Association. Therefore, representatives of the Kalumwange Agriculture Association must research more on desert locusts and share information with farmers in their monthly meetings.

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ANNEX A

Maize production and income loss in the 2019/2020 farming season in Kalumwange Farm Block.

Respondents Maize Field (Ha)	Actual Yield 50Kg bags	Expected Yield 50Kg bags	Actual Income in USD	Expected Income in USD	Loss in USD
5	10	100	100	1000	900
5	9	100	90	1000	910
5	9	120	90	1200	1110
5	8	98	80	980	900
5	6	96	60	960	900
5	7	80	70	800	730
5	8	97	80	970	890
5	8	100	80	1000	920
5	6	100	60	1000	940
5	7	111	70	1110	1040
5	7	87	70	870	800
5	7	100	70	1000	930
5	7	100	70	1000	930
5	9	100	90	1000	910
5	9	87	90	870	780
5	11	84	110	840	730
5	11	91	110	910	800
5	12	120	120	1200	1080
5	13	76	130	760	630
5	12	88	120	880	760
5	13	83	130	830	700
5	11	98	110	980	870
5	10	100	100	1000	900
5	11	100	110	1000	890
5	10	100	100	1000	900
7	25	100	250	1000	750
3	4	400	40	4000	3960
3	6	58	60	580	520
2	4	88	40	880	840
2	5	87	50	870	820
3	3	99	30	990	960
3	2	93	20	930	910
3	3	87	30	870	840
2	3	56	30	560	530

3	2	87	20	870	850
3	3	87	30	870	840
2	2	67	20	670	650
2	1	89	10	890	880
2	3	88	30	880	850
3	4	93	40	930	890
Total 318	**Total 301**	**Total 3995**	**Total 3010**	**Total 39950**	**Total 36940**

ANNEX B

Data Collection tools

(1) Semi-Structured Interviews with key informants

Interviewers Name	
Location of interview	
Interview number	
Date of interview	
Start time	
End time	

Section One: Demographic Information

Name of community……..

Age of interviewee:…….. Gender: ……..

How long have you worked in Kaoma district? a) Native b) Less than 10 years c) Over 10 years

Part 1: Pest outbreaks in Kalumwange Farm Block

- What are some of the most prevalent pests found in Kalumwange Farm Block's agriculture fields?
- What is the impact of these pests on agricultural production?
- When there is no insect invasion in agriculture fields, how does crop yield fluctuate across seasons?
- What impact does the insect outbreak in Kalumwange Farm Block have on small-scale farmers' livelihoods?

Part 2: Small-scale farmer's pest outbreak responses

- In the event of a pest infestation, how do small-scale farmers respond?
- In the event of a pest infestation, how do small-scale farmers react?
- What are some of the challenges small-scale farmers encounter in combating locust infestations?
- How do small-scale farmers overcome the obstacles mentioned above?

Part 3: Solutions to the desert locust invasion by small-scale farmers

- What effect does the outbreak of desert locusts have on crop yield in agriculture fields?
- In KFB, how do small-scale farmers deal with desert locust outbreaks?
- What limitations do small-scale face in combating desert locusts outbreaks?

- When it comes to responding to the outbreak of desert locusts in KFB, with whom do small-scale farmers collaborate with?
- What role do these parties play in the fight against desert locusts?
- What role does the government play in the fight against the desert locust outbreak?

(2) FOCUS GROUP DISCUSSION GUIDE

- 8 participants
- 2 sessions
- 60 minutes long each

All responders' perspectives will be valued, and respondents will be free to express themselves. They will be urged to respect one other's opinions and refrain from interrupting, raising their voices, or shouting.

Time	Description
5 min	**Introduction (names, activities engaged)** • Would you mind introducing yourself and describing your farming activity? • Have you been farming in the Kalumwange Farm Block for a long time?
20-25 min	**Getting familiar with how small-scale farmers respond to pests** • In the KFB, how often are do pests invade agricultural fields? • What are some of the most common pests found in KFB's agricultural fields? • How do you handle infestations of these pests? • When pests infest crops in fields, how long do they stay? • What impact do these pests have on agricultural productivity?
15-20 min	**Small-scale farmer's responses to desert locust outbreaks.** • What is the average length of time that desert locusts dwell in agricultural fields? • What impact do desert locusts have on crop output in agricultural fields? • How do you handle outbreaks of desert locusts? • In the event of a desert locust outbreak, how do you handle it? • When you're dealing with desert locust outbreaks in agricultural fields, which stakeholders do you work with? • In fighting desert locust outbreaks, how effective is this engagement with the stated stakeholder?
5 min	**Concluding remarks**

(3) UNDERSTANDING SMALL-SCALE FARMERS RESPONSES TO DESERT LOCUST INVASION IN THE 2019/20 FARMING SEASON IN KALUMWANGE-KAOMA DISTRICT OF ZAMBIA

INDIVIDUAL FARM QUESTIONNAIRE

Farm Identification Details **Questionnaire Serial No:……..**

Name of Farm Block: …… Name of Zone: ……
Name of Farm Owner …… Age: …… Sex: ……..
Name of enumerator:…….. Date of enumeration:……..

(A) DEMOGRAPHIC CHARACTERISTICS

i) What is the size of your family or farm?
   a) 1 to 4, b) 5 to 11, c) 12 to 19, d) >20
ii) What is the status of your marriage? (Please mark your answer.)
   a) Married, b) Single, c) Divorced, d) Widow, e) Widower
iii) What is your educational level? (Kindly tick your answer)
   a) Primary, b) Secondary, c) College, d) University, e) Other……
iv) What is your primary source of revenue? (Kindly tick your answer)
   a) Farming, b) Remittance, c) Business, d) Formal employment, e) Other……

(B) SMALL-SCALE FARMERS SOURCE OF FARMING INFORMATION

i) Where do you get information about farming? (Tick your answer)
   a) ZNBC radio, b) Extension Officer's, c) Chiefdom, d) Fellow farmers, e) Meetings
ii) Which one do you regard to be your primary source of agricultural information?
   a) Meetings, b) Agriculture field day, c) Workshops and training, d) Other ……..
iii) Is this information reliable?
   a) Yes. Reason……..
   b) No. Reason ……..
   c) Not sure
iv) Do you tune in to ZNBC radio one every Tuesday at 7:45 p.m. for farming programs?
   a) Yes, b) No,
v) Do you have any experience with desert locusts?
   a) Yes, b) No
vi) If you answered yes to question (v) above, how do you identify desert locusts?
   ……..
vii) Do you have any concerns about the desert locust outbreak?
   a) Yes. Reason:……
   b) No. Reason:……
   c) Not sure.
viii) In Kalumwange Farm Block, how quickly did desert locusts spread through the fields?
   a) rapid spread, b) slow, c) d) I don't know
ix) What do you think caused the spread of desert locusts in Kalumwange Farm Block's agriculture fields in the 2019/20 farming season?

   ……..

x) What role did local knowledge play in the fight against the desert locust outbreak?
   ……

xi) What safeguards have you put in place to ensure that the spread of desert locusts is controlled and managed today?

……

……

Support To Small-Scale Farmers On The Fight Against Desert Locusts

i) Is there any assistance small-scale farmers receive from the outbreak of desert locusts in agriculture fields?

a) Yes, b) No, c) I don't know.

ii) If you answered yes to question (i) above, who gives the support?

……

iii) Who did you work with when you were fighting desert locust outbreaks?

……

iv) In the fight against desert locusts, who do you anticipate to assist you?

……

Community problem-solving skills in Kalumwange Farm Block

i) In the battle against desert locusts, what role did traditional leaders play?

……

ii) What is the Kalumwange Farm Block community's strategy for dealing with shocks

……

……

Kalumwange Agriculture Association

i) Are you a member of the Kalumwange Agriculture Association?

a) Yes, b) No

ii) If your answer in question (i) is Yes,
Are there benefits of joining the Kalumwange Agriculture Association?

……

……

Pesticides for fighting desert locusts

i) Are you familiar with the chemical insecticides used to kill desert locusts?

a) Yes, b) No, c) Not sure

ii) Have you ever used these pesticides before, if you responded yes to question I above?

a) Yes, b) No

iii) How do you get these pesticides if you responded yes to question I above?

……

……

iv) Is it difficult for you to access these pesticides? If you responded yes to question (I)

……

……

v) What is the most effective approach to combat desert locusts, in your opinion?

……

……

END

MANY THANKS FOR YOUR TIME

ANNEX C PARTICIPANTS OF THE FOCUS GROUP DISCUSION

(They are all residents of Kalumwange Farm Block)

List of respondents

Respondents	Occupation	Age	Education	Sex	Organisation	Position
FGD 1	Small-scale farmer	29	College	F	KFB Cooperative	Member
FGD2	Small-scale farmer	31	College	F	KFB Cooperative	Chairpeson
FGD3	Small -scale farmer	41	College	F	KFB Coopeartive	V. Chairperson
FGD4	Small-scale farmer	19	Secondary	F	KFB Coopeartive	Member
FGD5	Small-scale farmer	28	Secondary	F	KFB Cooperative	Treasure
FGD6	Small-scale farmer	56	Primary	F	KFB Cooperative	Member
FGD7	Small-scale farmer	48	Primary	F	KFB Coopeartive	Member
FGD8	Small-scale farmer	51	Primary	F	KFB Coopeartive	Member
FGD9	Small-scale farmers	38	College	M	KFB Cooperative	V. Treasurer
FGD10	Small-scale farmer	71	College	M	KFB Cooperative	Secretary
FGD11	Small-scale farmers	58	illiterate	M	KFB Coopeartive	Member
FGD12	Small-scale farmers	61	Secondary	M	KFB Coopeartive	V. Secretary
FGD13	Civil servant	51	College	M	Ministry of Agriculture	Officer
FGD14	Civil servant	42	College	M	NGO	Officer
FGD15	Civil servant	39	Kalumwange	M	Ministry of Agriculture	Officer
FGD16	Small-scale farmers	29	Kalumwange	M	NGO	Officer