The effects of a land reform program on smallholder farmers' livelihoods and availability of edible insects for food and nutrition security

The case of the Zvimba and Mhondoro districts of Zimbabwe

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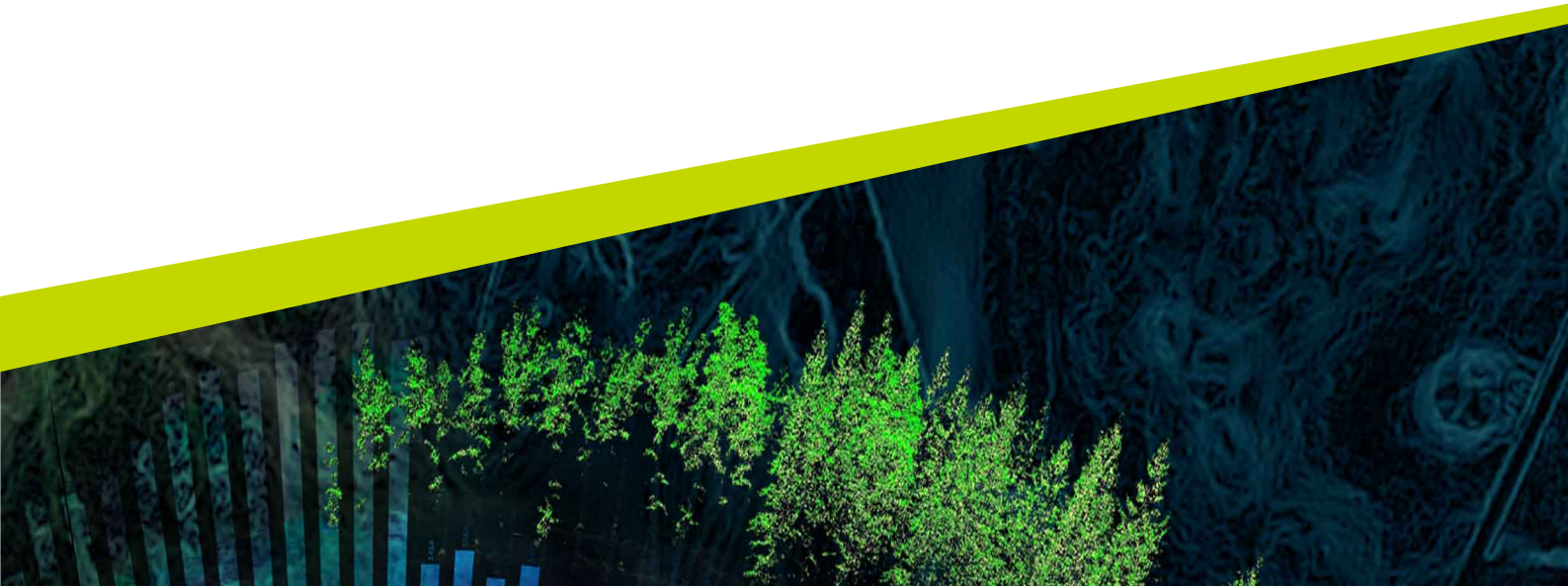

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Abstract

Edible insects are an important source of nutrition for rural populations in many parts of the world, including Zimbabwe. This research examines the contribution of edible insects to the livelihoods, food and nutrition security, and the strategies and mechanisms that can be implemented to ensure the preservation and better management of the environment and edible insects in Zvimba and Mhondoro districts. Case study analysis was incorporated into the study's mixed-method approach. 43% of the respondents who eat insects, do so because they enjoy the flavor, while 33% cite the insects' nutritional value, and 24% eat them for the novelty factor. More than half of all respondents in both districts said they liked eating insects as a relish, snack, or in combination with other relishes; another 20% said they liked eating insects as a relish and in combination with other relish dishes, and 22.2% said they liked eating insects only as a relish. Most respondents perceived a decline in edible insects' availability. Despite this, both communities have developed sophisticated processing and preservation methods to make them accessible even outside of the peak insect-harvesting season. Both A1 (farmers with fields which are up to 37ha) and communal farmers have seen a decline in edible insects over the past few years, with 13% of that decline attributable to agricultural pest control and veld fires. The findings of the research can help lay a foundation for engaging different stakeholders, including communities, in developing solutions for sustainable edible insect management in support of food and nutritional security.

Keywords: Communal and resettled communities; Edible insects; Food Security; Natural habitat, land use.

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Abbreviations

SLU	Swedish University of Agricultural Sciences
Agritex	Agriculture Extension Services
EMA	Environmental Management Agency
ESAP	Economic Structural Adjustment Programme
FAO	Food and Agriculture Organisation of the United States
FTLRP	Fast Track Land Reform Programme
IMF	International Monetary Fund
CUT	Chinhoyi University of Technology
A1 Farm	Smaller Zimbabwe resettlement farm type of size up to 37 ha
A2 Farm	Larger Zimbabwe resettlement farm type of size up to 318 ha.

1. Chapter One

1.1 Introduction

According to FAO (2013), it is estimated that the global population will reach nine billion by 2050. This will increase the demand for food from the available agroecological base. Pressure on the environment, agricultural land, water resources, forests, fish supply, biodiversity, and an increased need for food and nutrition requirements among the growing population is critical (ibid). Edible insects are viewed as complementary sources of protein, and many countries have already stepped-up efforts to integrate them as valuable food resources (van Huis et al., 2017). Edible insects provide nutrients essential to humans and animals (van Huis et al., 2013; Mohammed et al., 2015). Consumption of edible insects is traditional in many African countries (van Huis, 2003). More than 2000 species of insects are suitable for human consumption worldwide (van Huis, 2013). Edible insects can contribute to food security, particularly in countries where food insecurity is common. Edible insect farming has a comparative advantage in low greenhouse gas emissions. The insects have a high capability of transforming low-value by-products into high-quality foods. It is important to note that using edible insects is a significant opportunity in food systems. Hence, the need to commercialize all markets, including domestic and traditional ones. Baiano (2020) further added that edible insects are considerably more sustainable as compared to other sources of animal protein while at the same time reducing pressure on the environment.

1.2 The role of edible insects in Africa

Harvesting and consumption of edible insects are widespread throughout the African continent, with some 209 species being consumed either as delicacies or as essential components of a daily diet (DeFoliart, 1999; Kelemu et al., 2015). According to Bequaert (1951), consumption of insects is particularly important in Africa as insects are ready sources of proteins and essential nutrients, especially as an unfavorable climate limits restrictions on traditional animal husbandry. Illgner and Nel (2000) noted that the consumption of insects is not just a coping strategy in times of crisis but also a preferable habit by local tribes due to the delicacy of insect species such as termites (Musundire, 2021). Early accounts from Africa note that caterpillars and winged termites were the most popular insects. A Swedish naturalist Anders Sparrman, who visited the Cape in the late 1770s, detailed how the Khoi-San people in Southern Africa

ate insect larvae, caterpillars, termites, locusts, snakes, and certain spiders (Bodenheimer, 1951). Insects such as termites are either eaten raw or roasted (DeFoliart 1999; Illgner and Nel, 2000). There has been an emergence of modern recipes and the inclusion of insects as ingredients in a diversity of formulated food products in recent times.

The world is under pressure due to the growing human population. It possesses several challenges in food production, availability, accessibility, stability, and utilization as critical pillars of sustainable food security. The more significant impact is on the environment (Huang et al., 2020), which is expected to stretch to meet the global food requirements. Meyer-Rochow (1975) stated that there is enough food produced to counter starvation and malnutrition. The consumption of traditional edible insects would go a long way in ensuring reduced incidents of malnutrition in many countries of the world, especially in areas where such insects are already part of the culinary tradition (Cappelli et al., 2020). The impact and implications of climate change have been heavily felt in the primary food security production systems, especially regarding crop and livestock production (Burgess, 2018). Hence, the exploration and manipulation of other food protein reserves are essential in supplementation of the world's food systems. As further added by Pimentel and Burgess (2018), what worsens the situation is that food system production and increased population growth has put pressure on the environment and reduced its ability to maintain a healthy, sustainable ecosystem. Overall, edible insects provide a much-needed source of protein in most African countries, which can be termed free and natural protein. Ayieko (2010) further added that edible insects play a pivotal role in Africa, supplying macro and micronutrients and their linkage to improved health and better management of chronic diseases. Therefore, edible insects are a critical part of the equation in their contribution to solution providers to ensure food and nutrition security in the African region and beyond.

1.3 Common edible insects in Zimbabwe

Edible insects are consumed by more than 80% of the Zimbabwean populace (Dube et al., 2013). Mopane worms and termites are the most popularly consumed edible insects in Zimbabwe (Gardiner & Gardiner, 2003; Musundire et al., 2016). Furthermore, other types of edible insects consumed in Zimbabwe include grasshoppers, crickets, termites, ants, and beetles, to mention a few. FAO (2015) highlighted that many communities still face food insecurity despite the abundance of natural resources and insects that can help them alleviate the problem of food and nutrition security. Food insecurity is also common in urban areas, and the consumption of edible insects is limited in the urban environment.

Furthermore, rural communities are well vested and well enriched in terms of knowledge of edible insects' collection, methods of preservation, and consumption (Riggi et al., 2016). In Africa and other developing countries in general, there is a tendency to abandon edible insects in urban communities, especially the young people who have westernized traditional diets and consider the consumption of edible insects as primitive. Hence, such communities have been disadvantaged in terms of manipulating such important food reserves (Dube et al., 2013) due to the westernization of edible insects, which is an essential source of nutrition security.

However, it is important to note that the impact and implications of climate change have not spared the edible insects' compartment of the food security system in general; it has indeed been heavily affected. In Zimbabwe, the availability and abundance of edible insects have been heavily affected by the land reform program, characterized by heavy deforestation for firewood and intensification of land for cultivation. Heavy deforestation has significantly reduced the growing population of edible insects, according to Ramos-Elorduy (2006), especially uncontrolled harvesting of insects. Edible insects are a source of nutrition and livelihood. The communities in the semi-arid region of Zimbabwe heavily rely on edible insects as a source of livelihood and income generation. Women and children have traditionally been involved in harvesting edible insects (Kozanayi and Frost, 2002). Still, men are often involved as they are attracted by income-generating opportunities from selling the dried mopane worm (Stack et al., 2003).

1.4 Problem Statement and Justification of the study

The Zimbabwean land reform program was projected to enhance food security and livelihoods for disadvantaged black people. Due to poverty and poor agricultural systems, the program put the environment under pressure and heavily degraded the environment. The situation necessitated and accelerated food and nutrition security problems, including the unavailability of edible insects. Much of agriculture was focused on land intensification rather than inputs to increase output per given area, but this led to an increase in land use, which affected many species. Among them are mopane worms, which were available in Zimbabwe but are now facing extinction, especially the cutting of mopane trees in areas like Zvimba and Mhondoro, yet edible insects are an important natural food and supplement nutrition to the local community, especially in the rural setup. As accorded by Chingono (2019) and Moyo (2011), the land reform program harmed the country's economy especially zeroing down on the natural ecosystem since Zimbabwe is an agro-based economy. Craig (2004) and Kawewe (2000) further added that there had been a decrease in the total farm output, which has increased instances of starvation and famine. According to Nick (2003) and Munangagwa (2009), increasing poverty levels have increased the informality of farming operations and environmental degradation among the farmers who received redistributed land. These agricultural practices have led to the cutting down of trees, which are critical for housing edible insects. Especially considering that edible insects are an important natural source of climate-friendly protein sources, a cheap source of nutrition, and hence the need to safeguard to ensure sustainability as a source of food, nutrition security, and livelihoods.

1.5 Specific objectives

The specific objectives of the study are as follows;

- To assess the contribution of edible insects to the livelihoods, food, and nutrition security of the different households in the Zvimba and Mhondoro districts of Zimbabwe.
- To identify strategies and mechanisms that can be implemented to promote the preservation and better management of the environment and edible insects.

1.6 Research Questions

- What is the contribution of edible insects to the livelihoods, food, and nutrition security of the different households in the Zvimba and Mhondoro districts of Zimbabwe?
- Which strategies and mechanisms can be implemented to ensure the preservation and better management of the environment and edible insects?

1.7 Limitations

Zimbabwe is a neighbour to other stable economic countries but the context in Zimbabwe is rather unique to most African countries. It is a country that is not in a war, but it has all the characteristics of a war situation. The cost of simple things like traveling by bus, or even having the resources to collect data, was costly. As a researcher, I had to be prudent and innovative in undertaking my research. In the same vein, while the land reform was a national program, the study was only conducted in two districts to get a deep understanding of the impact of the land reform in terms of the abundance and availability of edible insects. However, the research findings may not be as broad, but there are key lessons learned that apply to other parts of the country and different contexts.

1.8 Thesis Outline

The thesis is divided into six chapters. The first chapter is the introduction, which reveals the importance of how edible insects influence food security and people's livelihoods. It also provides information on the role of common insects in Sub-Saharan Africa, narrowing it down to Zimbabwe, which is being eaten to account for their food, nutrition security, and livelihoods. It introduces the fast-track land reform program and its impact on the natural habitats of edible insects. It further outlines the problem statement and objective delimitations.

Chapter 2 presents the literature review related to the research background of the study from other scholars' publications regarding edible insects, land reform, and food security. It further provides contextual knowledge of Zimbabwe. Further, it provides historical background to the

study and reviews the literature on land reform program schemes implemented since independence and livelihood activities farmers carry out for survival.

Chapter 3 presents the theoretical framework that will guide the discussion of the findings in the research, especially in terms of the presentation of the research findings.

Chapter 4 discusses the research methodology and the research process in terms of the research paradigm, research design, study population, sampling procedures, research instruments, and data collection procedures. In addition to that, a justification of the research design must adopt limitations, reliability, and validation of the data. The chapter will be concluded with ethical considerations and data analysis.

As a result, the findings of this research, both descriptive and interpretive, will be discussed in this chapter. The findings will be discussed in line with the justification and findings from the literature review. Thus, it is critical to note that the conceptual and theoretical frameworks will be used to analyze the findings in this research.

Chapter 6 discusses the findings and presents the conclusions and recommendations of the main results of the research. Thus, taking a retrospective view of whether the objectives of the study were achieved. This chapter concludes the research and makes recommendations regarding the community and areas that might need further investigation, reflecting the study's limitations.

2. Literature Review

2.1 Introduction

The chapter focuses on the literature review related to the research background of the study from other scholars' publications regarding land reform, agricultural government policy, and edible insects, including their contribution to food security. It further provides the contextual background of Zimbabwe, historical background to the study, and reviews the literature on land reform program schemes implemented since independence and livelihood activities farmers carry out for survival. It will further explore the role of edible insects in food and nutrition security in Zimbabwe.

2.2 Zimbabwe Land Reform Setting

2.2.1 Zimbabwean Government's agricultural and economic production policy from 1980

FAO (2003) outlines the fact that three main policy initiatives led to the direct and indirect compromise of the natural environment of Zimbabwe. Firstly, is the "growth with equity program pursued by the Zimbabwean government between 1980 and 1990. This program was enacted to redress the colonial legacy by supporting small-holder farmers. The high degree of government involvement in the agricultural sector before independence was seen as a way toward achieving food self-sufficiency as well as food security (Musona, 2016). However, by the year 1986, the government took some measures to encourage production through export incentives, which included Export Retention Schemes and Export Revolving Funds (http://www.ieomsociety.org/ieom2020/papers). The Zimbabwean government also stimulated export production indirectly by setting up a relatively low price for the traditional maize crop, which pushed indigenous black farmers to shift towards cash crops such as tobacco and coffee that fetched higher prices and had a ready export market (FAO, 2003). According to the same report by FAO (2003), the intensive production of cash crops involves the use of a significant number of agrochemicals which have residual effects on the soil and the atmosphere.

During the early 1990s economic crisis, the Zimbabwean government embarked on World Bank and International Monetary Fund (IMF) inspired structural economic reform strategies known as the Economic Structural Program (ESAP) (Musoma, 2016). This was a five-year

neo-liberal market-driven policy measure that was premised on the idea that markets should control the economy. The policy began to be implemented in the country in March 1991. Liberalization and agricultural marketing de-regularization brought in many opportunities for export agriculture, especially for cash crop production, tobacco production included. Many measures designed to protect domestic industries were removed to have the local industry compete and become efficient in the international market. These measures could have been part of why tobacco production increased between 1990 and 1995. Despite the immense economic benefits, tobacco production has an environmental downside in that the curing process of the crop requires firewood, which poses a threat to natural forests where trees are readily available for timber (Musoma, 2016).

2.2.2 Land Reform Program of Zimbabwe

Following the Lancaster House Agreement of 1979, there was a transition to an internationally recognized majority rule in 1980. The United Kingdom (former colony) ceremonially granted Zimbabwe independence on April 18th, 1980. According to Thomas (2019), immediately after the Lancaster House agreement, the land was distributed to the black majority in Zimbabwe under the willing seller and willing buyer arrangement. Indeed, the beginning of terror regarding high environmental degradation necessitated the impact and implications of food insecurity and poverty in Zimbabwe, including the economic meltdown.

The program's targets were intended to alter the ethnic imbalance of land ownership (Matondi, 2012). Inequalities in land ownership were inflated by a growing overpopulation problem, the depletion of over-utilized tracts, and escalating poverty in communal areas, which were paralleled with the under-utilization of land on commercial farms. However, the predominantly white commercial sector employed over 30% of the paid labor force and accounted for 40% of exports (Dreschler, 2002). Its principal crops included sugarcane, coffee, cotton, tobacco, and several varieties of high-yield hybrid maize (Peter, 2000). Both the commercial farms and the subsistence sector maintained large cattle herds, but the former furnished over 60% of domestic beef (Behnke, 2008). In sharp contrast, the life of typical subsistence farmers was difficult, and their labor was poorly rewarded. As erosion increased, the ability of the subsistence sector to feed its adherents diminished to an alarming degree. In the year 2000, the government of Zimbabwe introduced the Fast Track Land Reform Program, which generally became known as the Fast Track Land Resettlement Program (FTLRP) (Peter, 2000). The farms known as Fast Track Farms were divided into the A1 model (for the benefit of the poor) and the A2 model (for the benefit of the resource-rich commercial farmers).

2.2.3 Description of A1 and A2 farm types under the Zimbabwe Fast Track Land Resettlement Program.

Table 1: Description of the Farm types in Zimbabwe (A1 and A2)

A1 Farm	A2 Farm
Small to average landholding of up to 37 Hectares for cropping and grazing land.	Very large land expanses of up to 318 Hectares for cropping and grazing land.
Farms are mostly dependent upon the government for the provision of tillage and other equipment, and agricultural inputs.	Farms are mostly self-sufficient with tillage, irrigation, and harvesting infrastructure.
Production targeted at mostly food security but also cash crops such as tobacco and cotton is highly prevalent.	Highly specialized, cash crop production, including cereals and high-value crops.
Landholders have limited access to on-farm investment capital, hence the heavy government reliance.	Landholders are self-sufficient individuals with access to loans and finance.

2.2.4 Communal farming

The communal land ownership scheme is characterized by the land under customary tenure, where land rights are acquired and held according to customary law (Peter, 2000). The only access to and use of grazing land is communal in the strict meaning of the word; the rest of the land is owned by traditional leaders, while families have full access to utilize it according to their needs. The land is effectively stated land because it is held in trust by the president, with management rights given to the Rural District Council and traditional leaders. There are several thousand communal areas in Zimbabwe, averaging 0.6 acres per family; sizes differ marginally in the agroecological regions (Peter, 2000).

2.3 Implementation of the Land Reform and the decade after the program

During the Land Reform by the Zimbabwean Government, official government documents outlined that the identification of land for forced acquisition under the Land Reform program was, in theory, led by the National Land Identification Committee, chaired by the vice-president's office. Four government ministries were officially involved: Lands, Agriculture, Rural Resettlement; Local Government, Public Works, and National Housing; Rural Resources and Water Development; and Environment and Tourism. Practically, the Ministry of Local Government, Public Works, and National Housing was central to the process. Provincial Land Identification Committees (PLIC) were set up and chaired by the provincial administrator. The PLIC committees spearheaded implementation after a technical committee had shortlisted and evaluated the applications. The Land Identification Committee structure was duplicated at the district level, and the committees were chaired by the district administrator (DA). Representatives of the rural district councils (RDCs), traditional and community leaders, and

the War Veterans Association were all members of these committees (GoZ, 2001). The ZANU-PF Party chairpersons were also represented from the local to national level. Farm owners would appeal to the Provincial Land Identification Committees whenever they believed official criteria were not followed. Possible negotiation of modifications to the acquisition process would ensue.

In the implementation of the land reform program, the UNDP (2002) noted with concern the fact that, because the "fast track" process of resettlement was undertaken so rapidly, short-circuiting legal procedures and lacking sound development objectives, the land reform was likely to defeat the original agricultural productivity goals of the resettlement program. The same report also gloomily predicted that the settlers, who mostly were poor, did not have the resources to invest in the land productively. There was minimal government support to assist new settlers. The absence of legal security and government assistance could leave them vulnerable to hunger and displacement (ibid.).

One settler who was given land highlighted to Human Rights Watch how they later discovered that the same land had been reallocated to other people in the weeks after he tried to go back to his plot. He was not given any proof that the land was allocated to him. He despairingly indicated, "I felt duped as I became certain that there was some kind of disorder and there was no proper responsibility for the process." (HRW, 2001). A UNDP (2002) technical evaluation assessing the fast-track land reform program in late 2001 outlined that "the availability of roads, schools, clinics, boreholes, and other essential infrastructure was lagging much behind within resettlement areas" and that making available essential public infrastructure within a reasonable timeframe "will be virtually not possible on the government's past track record and its current implementation capacity."

Therefore, the UNDP evaluation concluded that the scope of the Fast Track was not implemented on a sustainable basis, citing the following reasons:

(a) The settlement timetable was excessively short and impractical.

(b) The government or any other partner has injected no adequate resources to finance the necessary support services, such as energy sources; and

(c) Settlement interference, including interference with and overexploitation of natural fauna and flora species.

In support of the assertions above, one women's rights activist commented that the fast-track process meant that "you are just moving poverty from one location to another." HRW (2001).

A case study was undertaken by Zembe et al., (2014) to get a picture of the land reform's effects on the natural environment. The research analyzed aerial photographs and vegetation maps for Eastdale farms in the early 1980s and late 1990s. The farms were forcibly acquired by the government under the Land Reform program and redistributed to indigenous settlers. The data clearly showed thick, dense vegetation cover in the Eastdale A1 model farm before the land reform with minimal disturbance of the natural ecosystems. Research results showed that Eastdale Farm was largely dominated by various types of vegetation species and a typical savannah woodland ecosystem, which was thriving before the Land Reform project. There was heavy deforestation immediately after the land reform program. The resettled farmers focused more on cutting down trees for sale and seriously burning grass in land preparation. The overexploitation was attributed to the unavailability of alternative energy sources by the settler

farmers and their need to use the tree resources for construction and other uses. The conclusions were based on aerial photographs and vegetation maps at the same site after the land reform program.

2.4 Edible Insects and Food Security

Gibson (2012) and Ayala (2017) define food security as when an individual or a household is physically, socially, and economically able to access safe and nutritious food to meet their basic needs for a healthy life. Malnutrition has been a pressing issue, hence the need to manipulate through the use of edible insects as an alternative source of nutrients. It is possible to create edible insects with a lower environmental impact. Insects are eaten by about 2000 different species worldwide, primarily in tropical regions (Manditsera, 2018; Selaledi, 2021). Edible insects provide sufficient protein to supplement the body's nutritional requirements, including micro-nutrients, hence the need to find mechanisms to conserve and sustainably harvest them.

Insects are eaten as part of various traditional cuisines in over 113 nations, including Asia, Africa, and South America (Manditsera, 2018; Tao, 2018). Around 2000 edible insects are consumed by over 2 billion people (Kim, 2019). Many of these insects have protein, fat, vitamins, and minerals at levels comparable to routinely consumed animals. One of the most pressing global concerns is achieving an environmentally sustainable food security system, including food and nutrition security for different households (Selaledi, 2021).

In western countries, the use of insects as food has recently acquired popularity. Several businesses have begun to breed insects for human consumption (House, 2018). For example, in the United States, crickets are frequently seen in processed foods such as protein bars. They are already available in supermarkets in several countries (Mancini, 2022).

Children are particularly vulnerable to insufficiently nutritious meals, as malnutrition can have long-term negative implications. A nourishing dinner is beyond the reach of many underprivileged people, especially during COVID-19, because healthy food is often more expensive (Kim, 2019).

Although cultures have consumed edible insects worldwide for hundreds of years, many people are averse to including them in their meals. However, as more people become aware of the numerous advantages of eating edible insects, more people are becoming open to insects as a food source. Insects may hold the key to resolving concerns such as poverty, food insecurity, and environmental damage. By 2027, the edible insect market is predicted to reach $4.63 billion, making it a profitable business opportunity (Selaledi, 2021).

Sustainable insect farming has the potential to significantly improve food security, particularly in places prone to environmental variability. Most communities, especially women and children, are responsible for harvesting edible insects to supplement their nutrition and food security. With the demand for insects in Zimbabwe and neighboring countries, there has been overexploitation and harvesting of the mopane worms, among other insects, contributing to a positive and negative impact on the rural communities.

3. Research Methods

3.1 Conceptual Framework

In this chapter, the researcher outlines the theoretical concepts that will guide the study. Distinctively, the study has employed mixed-method research approaches and described both the qualitative and quantitative approaches of the research. The chapter further included the food security framework as it will guide the discussion and presentation of the results.

3.2 Food Security Framework

The household food security conceptual framework adopted by EFSAs considers food availability, food access, and food utilization as core determinants of food security. It links these to households' asset endowments, livelihood strategies, and political, social, institutional, and economic environments. Food security is when all people constantly have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for active and healthy life (FAO, 2006). The framework highlights two fundamental principles: causes and effects of food security and the relationship of factors that affect food and nutrition security, which were fundamental during data collection and analysis, including a description of the findings. Ecker and Breisinger (2012) noted that the food security status of any household or individual is typically determined by the interaction of a broad range of agro-environmental, socioeconomic, and biological factors. In terms of health and social welfare, these were key in contributing to food security.

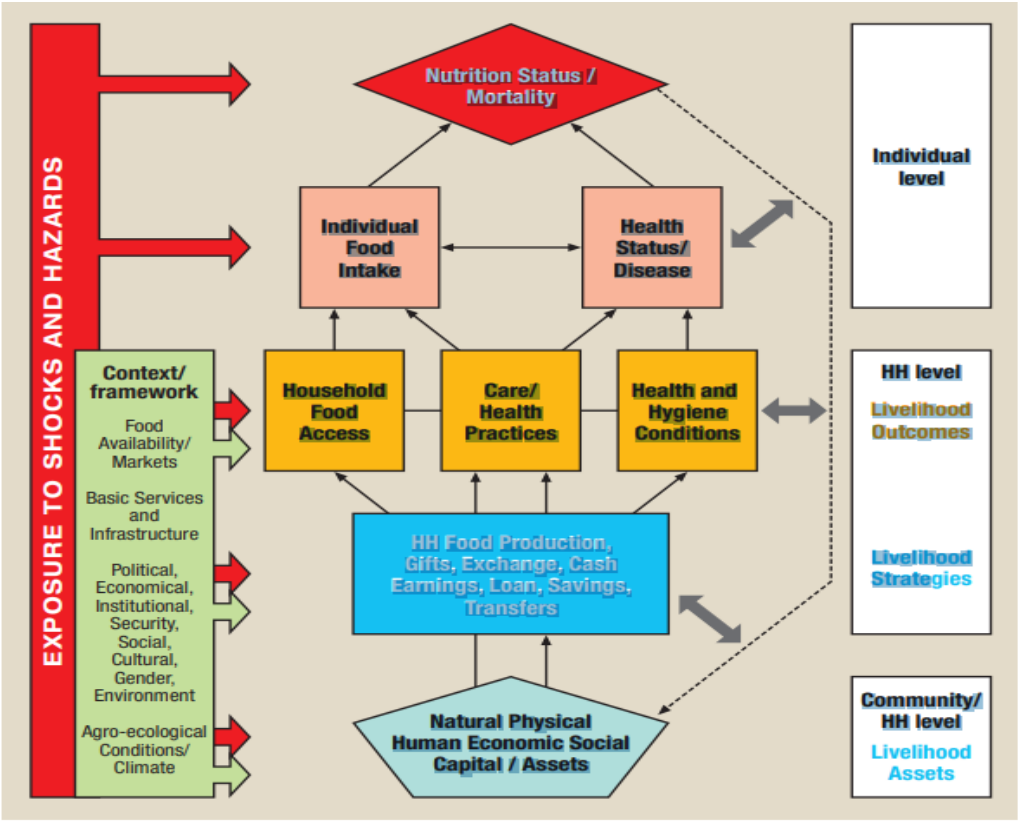

Figure 1: Food Security Framework (adapted from Ecker and Breisinger, 2012)

Food availability, house food access, availability, and individual/ household utilization are critical dimensions in the food security framework that define household food security in a given household or community. FAO (2015) further added that vulnerability is a forward-looking concept for assessing community and household exposure and sensitivity to future shocks. Finally, a household's or community's vulnerability is determined by its ability to cope with hazards connected with shocks such as drought, flood, crop blight or infestation, economic volatility, and violence. The concept demonstrates that the frequency and intensity of natural and human-induced hazards and their socio-economic and geographic breadth affect risk exposure. The levels of a household's natural, physical, economic, human, social, and political assets and its ability to diversify its income sources and consumption to reduce the consequences of the dangers it may encounter at any given time are all drivers of coping capacity. The food security framework was the one adopted in the current research. The exposure of a household to the shock and hazards affects the household status in terms of its food security status, which is demarcated by the red color. The key aspects that were elaborated in the research include household food access, the capital, and the results of the impact in terms of individual, household, and community outcomes.

4. Methodology Approach

4.1 Introduction

This chapter describes the methods employed in the current research, including the research design used by the researcher to gather data to understand better the effect of the Land Reform Program on the existence of edible insects. This chapter also includes the choice of the philosophical assumption that guides the study, the data collection instrument, and the data analysis procedures. It further reveals how the three follow-up questions from the overarching research question were dealt with to develop the data. Finally, research ethics, confidentiality, and scope were discussed.

4.2 Study Area

This study was carried out in Zvimba and Mhondoro districts in ward 34 and ward 5, respectively. Ward 34 of Zvimba has a total population of 6876 and 1892 households and an average household size of 4.0 (ZIMSTAT, 2012). The area has A1 farmers (Land Reform Program in 2000) who are individual households with at least 5 hectares of arable land, a designated homestead in a village, and a common grazing land for livestock (ZIMSTAT, 2011). Ward 5 of Mhondoro has a total population of 5786 with 1368 households with arable land averaging at least 1.5-2 hectares. Inward 34 of Zvimba, the land was formerly under large-scale commercial farms and later distributed to indigenous small-scale farmers from the year 2000. The communities rely on agriculture for their livelihoods, including cattle production, cash crop production, and field crop production.

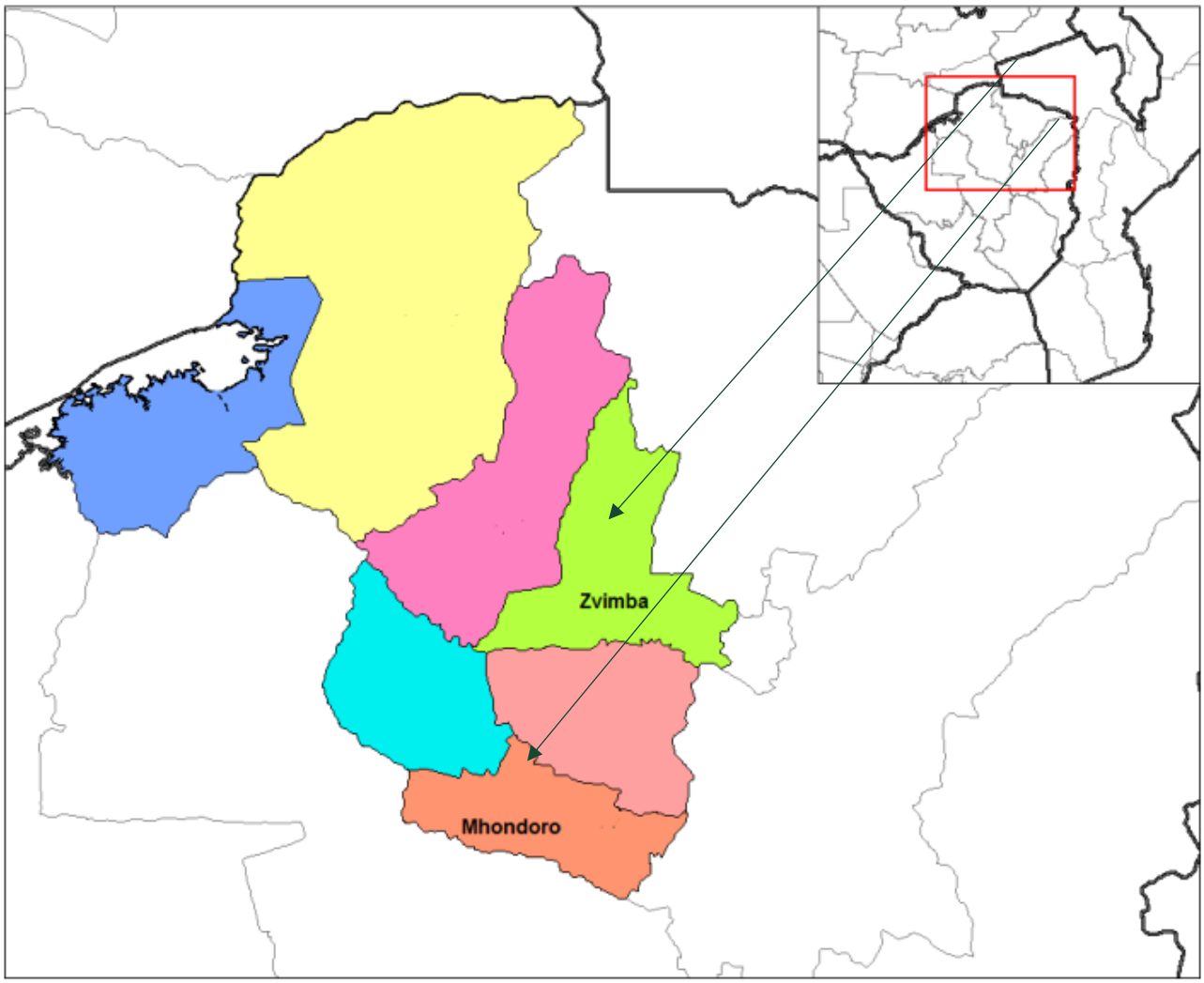

Figure 2: Mashonaland West Province showing Mhondoro and Zvimba districts, adapted from Relief Web, 2011)

4.3 Diet and Food Consumption in the Zvimba and Mhondoro area

Vegetation in the two districts comprises Miombo woodlands, a vast African dryland forest ecosystem covering close to 2.7 million km2 across southern Africa (Angola, the Democratic Republic of the Congo, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe) (FAO, 2018). The woodlands are characterized by the dominance of *Brachystegia species*, either alone or in association with *Julbernardia* and *Isoberlinia species*. It is estimated that the woodlands – through their numerous goods and services which include various non-wood forest products (NWFPs) (e.g., insects, mushrooms, fruits, tubers, medicine, fodder, honey, seeds, and wood fuels), sustain the livelihoods of more than 100 million rural people and 50 million urban people. The staple food is predominantly Sadza from maize meal, sorghum, and Finger millet. Most edible insects that are harvested to supplement nutrition and dietary diversity include

Mopane worms, which are predominant because of the vegetation characteristics in the area. However, other insects found and used in the area include termites, locusts, and caterpillars.

Though outlawed by the country's Environmental Management Agency, the charcoal sector employs vast rural people and offers additional income to many poor rural families (FAO, 2018). While the caterpillars are on the tree, mopane worms are harvested for a brief time (approximately three to four weeks). A modest second harvest happens in April or May following heavy rains, but there usually is just one primary harvest per year. Seasonal outbreaks of mopane worms are common. The preliminary harvest occurs during the early months of the rainy season (November to January), although a minor second harvest occurs after excellent rains in April-May. The availability of rainfall and host tree leaves affects population levels yearly. The degutted, boiled, and dried/smoked mopane worms can be rehydrated and fried or cooked in a spicy or peanut butter sauce and served with Sadza as a crunchy snack or dinner (Ndlovu, 2021). Canning is a method of industrial processing. Mopane worms are being increasingly widely traded throughout southern Africa, Zambia, and the DRC, and nationally within the main producing countries (Botswana, Namibia, South Africa, and Zimbabwe) (Kozanayi, 2002).

Communities moreover rely directly on the woodlands for food and nutrition. NWFPs add vital micro-and macronutrients to local diets and contribute to diversified food systems. At the same time, wood fuel is essential for cooking and sterilizing, thus ensuring proper nutrient absorption and providing clean water for drinking (FAO, 2018).

However, a growing population is in high need of agricultural land, and unsustainable use and over-harvesting of natural resources in parts of the Miombo woodlands, combined with climate change impacts (e.g., drought, fires). This leaves insufficient time for many trees and associated species to regenerate naturally, posing a serious threat to the products and services of the woodlands and to the livelihoods that sustain them. Compounding the problem and hindering the development of the Miombo ecosystem are i) lack of an enabling policy environment; ii) unsustainable management; iii) limited willingness and ability to pay for and access to energy-efficiency technologies; iv) inadequate awareness and information, including technical capacity; v) high poverty levels, and vi) limited access to microcredit facilities.

4.4 Methodology

4.4.1 Qualitative Approach

A qualitative approach is one of the methods used in this research to understand how land reform affected the abundance and availability of edible insects. I used several tools that included focus group discussion, key informants, and observation of the participants. The researcher also used images, video clips, and audio to collect the qualitative data in the current research. The interview scripts were then analyzed to develop interview transcripts; field notes were then interpreted using thematic and content analysis.

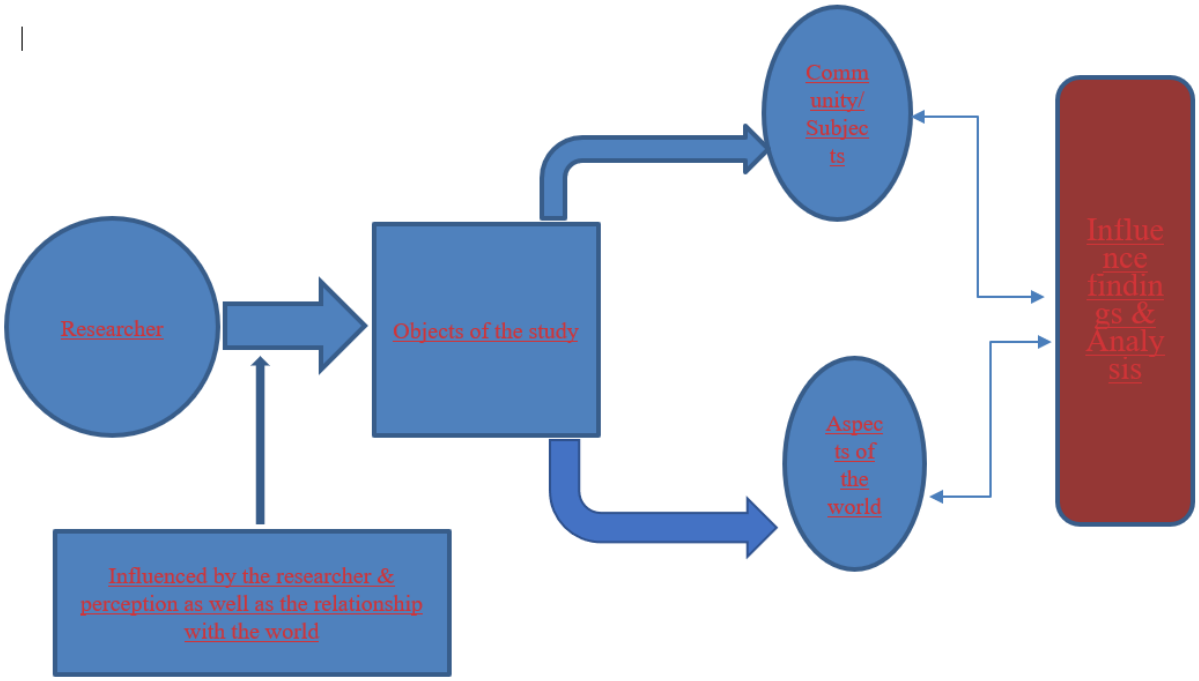

Figure 3: Relationship between objects with subjects and researcher (Own)

Other important concepts which support the research framework

4.4.2 Quantitative Approach

A quantitative scientific approach is one of the two methods that were used in this study to collect quantitative data. Quantitative research underscores quantification in the collection and analysis of data (Bryman & Bell, 2007). It strives to count events, create statistical links amongst variables and simplify findings to the population from which the sample was drawn (Onwuegbuzie & Collins, 2007). The approach principally uses post-positivist claims for developing knowledge (cause-and-effect thinking, reduction to specific variables, hypotheses and questions, use of measurement and observation, and the testing of theories), employs strategies of inquiry such as experiments and surveys and collects data on set instruments that produce statistical data (Creswell, 2013).

4.5 Research Design

The study adopted the case study approach. According to Baxter and Jack (2008), a case study describes, compares, evaluates, and helps get an in-depth understanding of the research problem. A case study focuses more on a small area to get a deep understanding of the community in terms of the dynamics related to land reform and how it has affected the availability and abundance of edible insects in the research area. The thrust of this study was guided by qualitative methodology but integrated through the mixed-method approach. Due to

the nature of the research, much attention was given to the philosophy of constructive worldview. According to Creswell (2014), the two research approaches reveal worldview as meaning to understanding an individual's world around them, interpreting the meaning and their experiences. The constructivist perspective with the belief that human beings construct meanings as they engage with the world they are interpreting (Creswell 2014) was adopted in this study.

4.6 Methods

4.6.1 Questionnaire

Questionnaires are used to collect both subjective and objective data in a large sample of the study population to obtain statistically significant results (Maxwell, 2012), especially when resources are limited. A questionnaire is a specific set of written questions that extract specific information from the chosen respondents. The questions and answers are designed to gather information about respondents' attitudes, preferences, and information. Questionnaires focus on sampling a smaller population statistically representative of the broader population in question Smith and Dans (2012). This sample, in turn, proves more manageable to study, reducing the investigator's overall workload and costs while also making it easier to ensure homogeneity and quality within a smaller dataset. Once investigators have drawn their sample population, questions are administered to respondents. After the questionnaire design, it should be piloted before it is finally deployed for final data collection to improve the quality of the data collected.

4.6.2 Key informant interviews

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews was to collect information from many people, including community leaders, professionals, or residents who have first-hand knowledge about the community. With their knowledge and understanding, community experts can provide insight into the nature of problems and give recommendations for solutions. The following are two common techniques that were used to conduct key informant interviews: Telephone Interviews and face-to-face Interviews. All two methods were used. Those who were reachable were dialed on the phone, and face-to-face interviews were held. The key informant included the district and local stakeholders at the community level, including councilors, village heads, and local government departments.

4.6.3 Snowball Sampling Technique

The study was explorative and descriptive; therefore, the snowball sampling method was applied since it had the advantage of gaining entry where convectional approaches were facing difficulties (Atkinson and Flint, 2001). The snowball technique allowed the researcher to recruit participants through referral. This technique was ideal because it helped the researcher

understand the source of influence on the acceptance of edible insects as part of the study society's diet (Atkinson and Flint, 2001). Therefore, cross-referencing with the Agritex Officer who knew and understood if the name stated was that of a farmer in that area was conducted.

4.6.4 Focus Group Discussions (FGD)

A focus group discussion (or FGD) is a qualitative research method in the social sciences, with a particular emphasis and application in the developmental program evaluation sphere. FGDs guide had predetermined semi-structured interview questions which were led by a skilled moderator. The moderator asked broad questions to elicit responses and generate discussion among the participants. My goal as a moderator was to generate the optimal discussion and opinions within a given period. Focus group discussions were adopted in the research to harvest a more profound and greater understanding of the research problem and the developed questions. The moderator was able to manage the different participants and ensure equal participation of the participants.

4.6.5 Observations

Besides interviews, additional information was collected through observation through interactions with government officials, village heads, and individuals in A1 land reform communities and communal farmers. Observations were important in understanding gender dynamics and relations between societal members. It was also important to understand body language on certain issues as well as inspect the crop fields, the types of crops grown, and the farming methods practiced. Five days were spent in each ward to understand things that people could not explain in words. Field notes were also recorded on all the observations and discussion points in organized group discussions (OGD) or while visiting the fields. The observation was crucial in triangulating data between what the respondents had said and what was obtained or what could not be explained in words.

4.7 Data Processing and Analysis

Data entry, cleaning, and analysis of household survey questionnaires were conducted using the Statistical Package for the Social Sciences (SPSS) Version 17. The collected evaluation data were synthesized, analyzed, and presented in user-friendly tables and illustrational charts/graphs. The responses were subjected to descriptive analysis, frequency analysis, cross-tabulations, and significance tests. Data collected using various qualitative techniques were analyzed using thematic analysis, which involved theme coding. Data analysis is important to consolidate the research findings, in high quality and data integrity.

4.8 Reliability

The research and evaluation methodology in the evaluation effectively responded to the purpose and objective of the evaluation. In addition to that, to ensure reliability, the data (recordings, notes, and transcripts) was done intensively to ensure a clear link between the collected data and the interpretations. As further supported by Riege (2003) and Thomas et al. (2011) for quantitative methodology, the process was logical, traceable, and documented reflexively. In addition to that, the pilot questionnaire test was important in testing the type of data yielded, elimination of bias, errors, and validation of the data. Lastly, the pre-findings and draft evaluation report were presented back to the community and stakeholders to rubber-stamp their views and the findings in the research document. It adopted a mixed-method approach where both qualitative and quantitative methodology was employed to ensure reliability and enrich the research.

4.9 Validity

Throughout the data collection process, the researcher validated the findings and interpretations during key stakeholder team debriefing meetings and meeting with the small-holder farmer associations and the project supervisor. In addition to that, the research paid much attention to detail and accuracy to ensure the authenticity and trustworthiness of the research process.

4.10 Ethical Consideration

The following ethical considerations were observed during the process of this research. This included informed consent, privacy, and confidentiality of the interviewed participants in terms of their names and identity. Thus, participants' dignity, safety, and justice were observed in this research process. At the inception of the research, it was critical to clearly explain to the respondents the purpose of the research and again seek their consent in terms of their participation in the research. The study paid attention to the cause no harm principle both psychologically and physically to the respondents. In the same vein, as supported by Piper and Simons (2005), the respondents' culture was respected with dignity and the researcher avoided approaching the respondents judgmentally. Ethical consideration was fundamental in guiding the research in terms of protecting the study participants in terms of violating their dignity.

5. Study Finding and Analysis

5.1 Introduction

Chapter 5 focuses on the descriptive analysis, interpretation, and discussion of the research findings in line with the reviewed literature. Subheadings were inserted in the discussion of the findings to aid the organization of the research findings. The conceptual framework was used in the final presentation of the research findings and the chapter was concluded with a summary of the research findings. The findings of this research were based on the mixed-method approach that was used and adopted in the research.

5.2 Level of Education Attained

All respondents from this study had participated in some form of formal education. There was however a marked variation in the levels of education attained between farmers from communal areas and those from the A1 resettlement schemes. This study indicated that 38% of the respondents only went as far as primary level (grade 1 – grade 7) in their education (Figure 8A). The data, as shown in the graph below, shows the fact that a greater percentage of the communal (45%) have primary level education while 30% of the A1 respondents have primary education. The greater proportion (70%) of the A1 respondents have a secondary education level while 55% of the communal farm type have a secondary level. Theoretically, the level of education would be expected to be a determinant of agricultural management practices by individuals as well as environmental management practices.

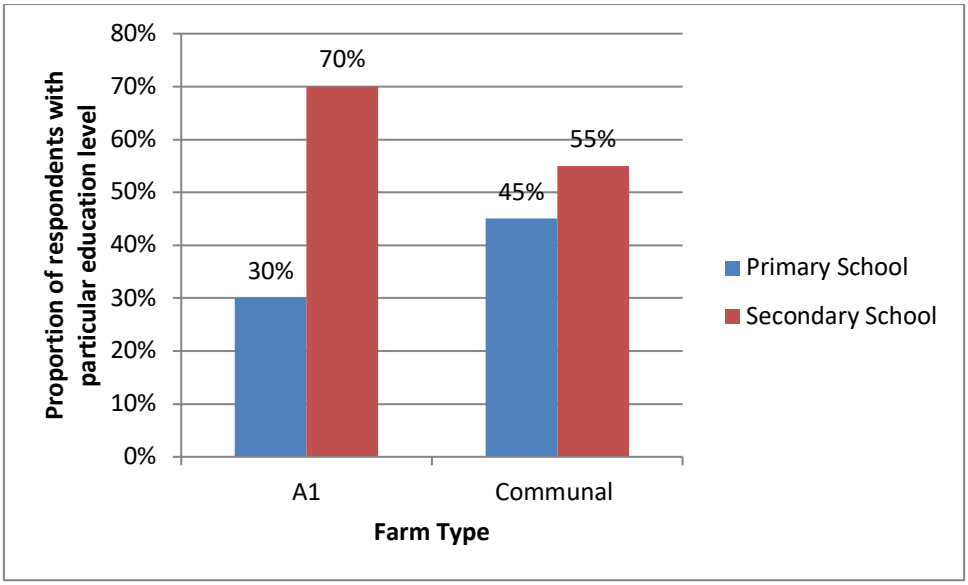

Figure 4: Proportion of the level of education attained based on the farming system

Objective 1: To assess the contribution of edible insects to the livelihoods, food, and nutrition security of the different households in the Zvimba and Mhondoro districts of Zimbabwe.

5.3 General findings for objective 1:

In the presentation of the findings for objective one, the findings were linked to the food security framework. What was key to note during the analysis was that availability, access, utilization, and stability are fundamental factors that affect food security and nutrition. Overall, more households had access to significant income from A1 farmers, meaning there had a greater ability to meet their food and nutrition security from the edible insects and other sources of income. Sustainable food and nutrition requirements of the communal farmers were compromised because of their exposure to contextual factors including the negative effects of the land reform program. Furthermore, it was worth noting that, both the two farming communities had Agriculture and cash crop production as their main source of livelihood and income.

Agriculture and cash crop production were established as fundamental in ensuring household food production leading to food and nutrition security and enhancing the health and well-being of the different households. Though the different farming households were affected differently, the A1 was better positioned again because of their access to a bigger piece of land and availability of edible insects as compared to communal farming households. Overall, the findings of the research established the significant contribution of edible insects to the livelihoods, food, and nutrition security of the different farming communities including other external support like agriculture and other unestablished sources of income. The greater

significance was more on the A1 farmers as compared to communal farmers who were struggling with sustaining their livelihoods, food, and nutrition security.

5.3.1 Household monthly incomes

All the households had subsistence agricultural production as their primary source of livelihood. Notably, all the households on the communal farms produce maize as a primary food crop. Tobacco farming also augments other sources of income for the households in the A1 farm type as it is grown as a cash crop by 34% of the respondents. The monthly income thresholds, again, as with education levels, are higher for the A1 farm type than for the communal. The highest two income levels, of $100-199 and $200-350 per month, are dominated by households in the A1 farm type, with the class being more than 30 percentage points above the communal households for the two-income subgroups. Among the respondents, there were 20 communal farmers and 20 A1 farmers from the sampled population.

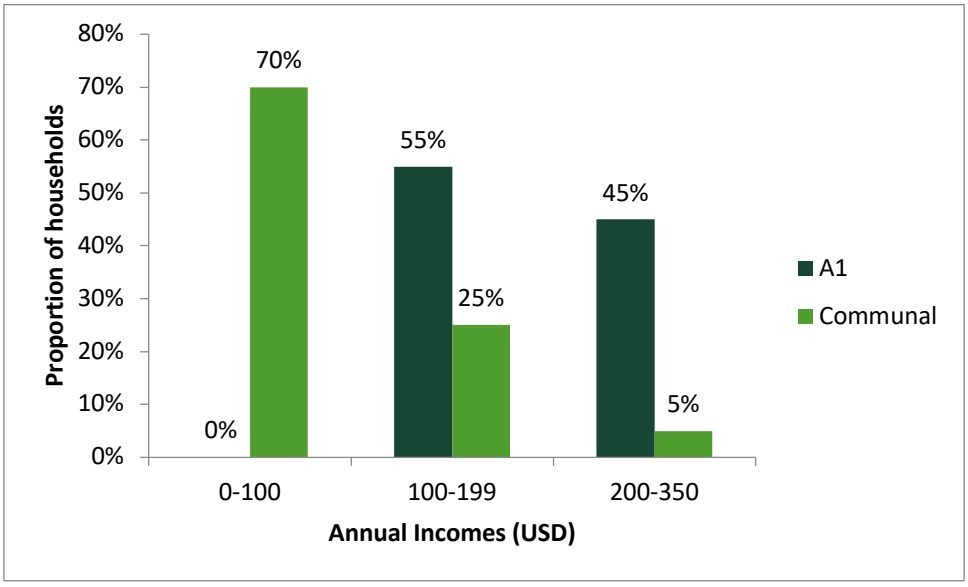

Figure 5 Monthly income for the respondents in farming the category

Although the study did not dig deeper into the causal factors leading to the income discrepancies between the two farm types, it was evident from the other indicators such as landholding and utilization (below) In the A1 farming households had a significant edge over those in the communal sector. Tobacco production, especially curing, was the chief culprit of environmental degradation, according to one district key informant from the department of agriculture.

5.3.2 Main Livelihood analysis for respondents

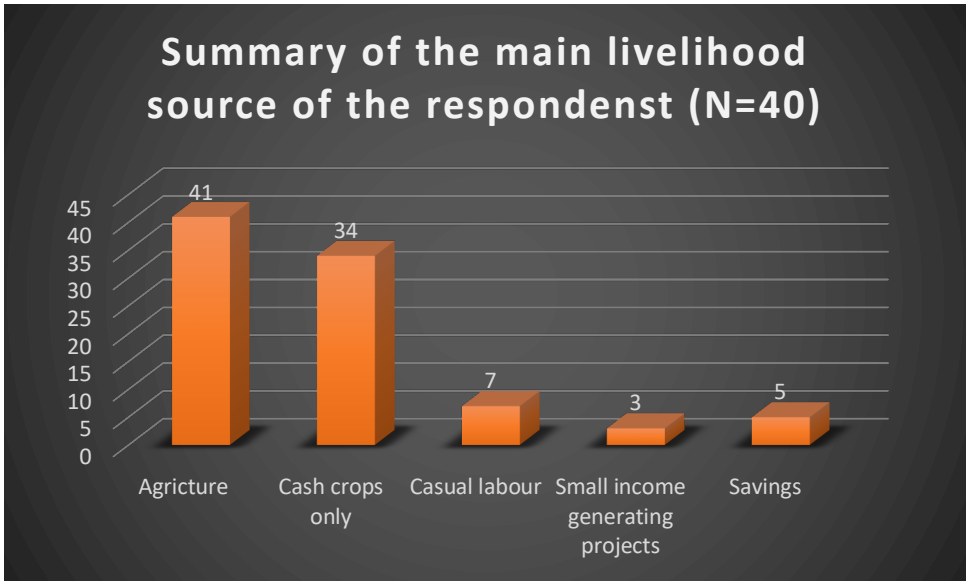

Figure 6: Main livelihood analysis for the respondents

The study established that the main sources of livelihood for the Mhondoro and Zvimba communities are predominantly agriculture. There was a total percentage of 75% of the households who reported that they rely on agriculture, especially cash crop production, for their livelihoods. The FGD groups confirmed that farmers in the two communities heavily rely on rain-fed agriculture, except for a few who were using submersible pumps for tobacco irrigation. It was interesting to establish that casual labor, small income projects, and savings had small but significant contributions to the livelihood sources of most households that responded to the research. According to one of the key informant interviews, this was the main source of agricultural intensification, mainly by the A1 farmers. According to the FGD and key informant interviews in Mhondoro and Zvimba, the government just allocated land but there was no deliberate effort to monitor the agricultural systems and the cutting down of trees for agricultural land.

Summary of the number of meals per day among the respondents

Table 2: Summary of the respondents on meals per day among the respondents

Number of meals	Frequency Communal (%)	Frequency A1 (%)
3 Meals per day	31	86.2
2 Meals per day	40.7	12.6
1 Meal per day	28.3	1.2

The table shows that, among the respondents, 86.2% had consumed at least three meals per day (breakfast, lunch, and dinner), which is the normal number of meals that are supposed to

be consumed for a given household and was associated with the A1 respondents. In the same vein, 31% of the communal farmers indicated that they were consuming 3 meals per day among the sampled households. Furthermore, there were 40.7% of the respondents consumed 2 meals per day as compared to the A 1 farming category. The research further established the acute food and nutrition issues in the communal farming category, where 28.3% of the respondents had eaten 1 meal per day. The high food insecurity established among the communal farmers was attributed to poor farming methods and lack of inputs by the communal farmers, apart from the depleted soil fertility. They employ poor methods of farming and burn vegetation for land preparation, which again has a detrimental effect on the environment as it is the main source of edible insects. One key informant confirmed that, in the past, when they had just been resettled, they used to rely more on natural insects to supplement their nutrition. However, heavy deforestation and agriculture intensification, which involved cutting down trees as the main source of edible insects, are perceived to have led to a critical reduction in the edible insects which were used by the communities to boost and supplement their diets, thus compromising food security and nutrition in general.

Table 3: Summary of the Food Consumption Score

Food Consumption Score	Communal farmers %	A1 farmers %
Below 35	57	34%
Above 35	43	66%

The Food consumption score (FCS) is a score calculated using the frequency of consumption of different food groups consumed by a household during the 7 days before the survey. There are standard weights for each of the food groups that comprise the food consumption score (WFP, 2007). It is one measure of dietary diversity and food intake by households. Table 4 indicates that 57% of the respondents were below the average food consumption score of 35, which is regarded as poor, and 34% of the respondents were still below the FCS of 35 for the A1 farming category. This means that among the respondents, there are still a significant number of farmers who are struggling with food and nutrition security. Furthermore, 66% of the respondents from the A1 farmers had a food consumption score above the minimum threshold of 35, which is a good indication in terms of respondents consuming a balanced diet. In the same vein, 43% of the respondents among the communal farmers were able to score a food consumption score above 35. Edible insects were highlighted as one of the main sources of nutrition. The FGD revealed that most edible insects are harvested by the communal farmers, but they are sold to A1 farmers who have more income, and the communal farmers sell more than they consume. Research has shown that they sell insects to make extra money for their families. This makes sense since their farming methods aren't very good.

5.3.3 Edible insects' consumption habits

All the respondents reported that they consumed edible insects. Regardless of being Christian, none of them reported a ban on the consumption of edible insects by their different denominations. Most insects are consumed due to their good taste (43 % of the respondents), while 33 % indicated that they consume insects due to their good nutritional attributes, while 24 % indicated that they solely consume insects as a relish. Furthermore, in both study areas, the majority (57.5%) of respondents preferred consuming insects as a relish, snack, or in combination with another relish, while 20% preferred consuming insects as a relish and in combination with other relish dishes, and 22.2% consumed them as relish only. Edible insects were highlighted as a key contributor to food and nutrition security.

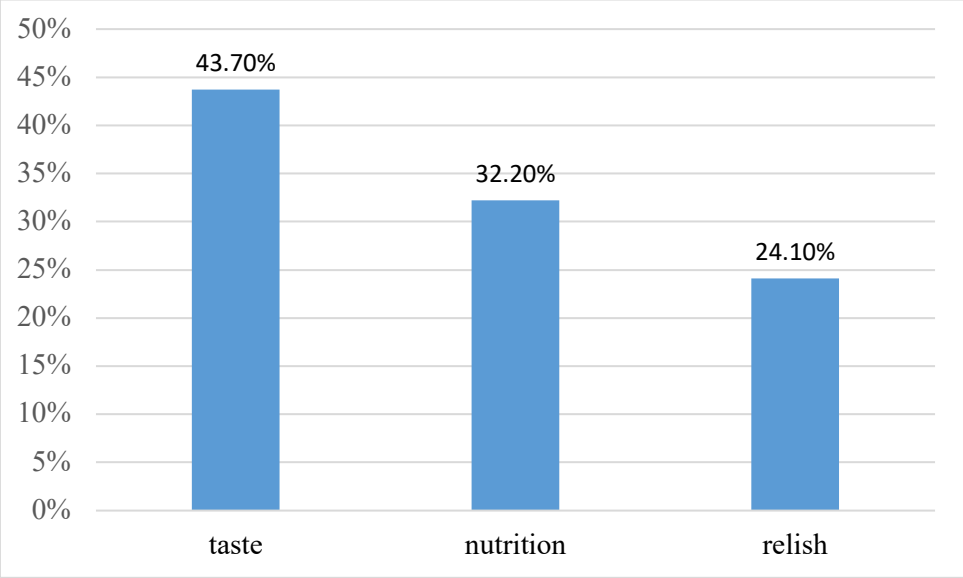

Figure 7: reasons for the consumption of the edible insects

Major insects consumed by communal farmers include termites (ishwa), mopane worms (madora), crickets (makurwe), grasshoppers (tsunyarunya), locusts (mhashu), and black ants (tsambarafuta). In both the communal and A1 farming sectors, there was a significant change in the population and a reduction in the edible insects in the two farming communities.

5.3.4 Type of landholding and utilization and how it has affected the edible insects

Landholding and utilization were vital variables for the investigation, as the hypothesis postulates that agricultural activities interfere with the availability and abundance of edible insects. Figure 8 shows the types of land holdings and percentages of land use for both types of farming, as well as how this has changed the availability of insects that can be eaten.

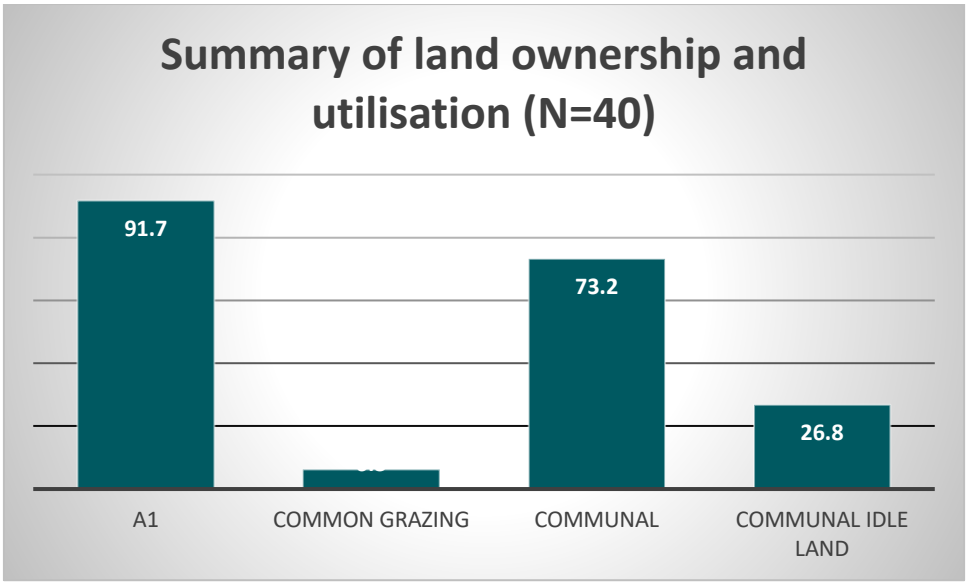

Figure 8: Summary of land ownership and utilization according to farming category

The research established that 91.7% of the land is owned and utilized by the A1 farmers and only 6.3% has been left for grazing. The increased and intensified use of land for agriculture has a significant impact on the habitat destruction of edible insects, particularly Mopane worms and other edible insects. One of the focus groups among the A1 farmers confirmed that they have improved in terms of agriculture. However, the methods that have been adopted in terms of land preparation include burning and cutting down trees. The study further confirmed that this has not only affected the environment but the general ecosystem and the availability of the edible species that have been dominant in the Mhondoro and Zvimba communities. The A1 farmers, through the focus group discussion, highlighted that they were worried about the depleted nutritional reserves they had been getting from the edible insects. They further confirmed that the communal farmers would come into the A1 re-settled area to harvest different edible insects to supplement their nutrition, especially mopane worms, which have been heavily affected by the rate of deforestation and poor environmental management.

In the same vein, 73.2% of the land among the communal farmers is under heavy utilization. However, one of the key informant interviews confirmed that the methods that are being employed by the communal farmers are bad and hence have a detrimental impact on the environment in general. The key informant further highlighted that the communal grazing area that was left idle was one key area where farmers would then harvest the edible insects, especially Mopane worms, among other edible insects found in the area. The reserved area was meant for common grazing, and in the same vein, the farmers would harvest the insects. One of the 79-year-old communal farmers could not hide his tears, as he highlighted and narrated how they used to harvest the edible insects and sell them to other communities every year. He further elaborated that it was indeed a source of livelihood and food security, especially the nutritional component. The research through the FGD and key informants established that the poor methods of agriculture that are being employed by both the communal and A1 farmers had detrimental effects on both the environment and the ecosystem and have caused the

extinction of the edible insects in both the A1 and A2 farming areas. Though A1 farmers were said to be still accessing the edible insects, especially in their protected areas, communal farmers had no access to these self-protected areas.

A further probe into the FGD further proved that there is increased competition in the reserved area and that women and children, especially the boded, can win the competition of edible insect harvesting. Women and children were highlighted as dominating in the harvesting and preparation of edible insects for both the A1 and communal farming areas. The key informant interviews further confirmed that edible insects are a key source of food and nutrition in the area, especially for nutrition supplementation and as a key source of relish. Hence, there is a need to employ strategies that can preserve edible insects as an important supplement and source of nutrition. The strategies to restore natural trees and other environmental species should involve the affected community and its stakeholders.

5.3.5 Crop production among the different farming categories

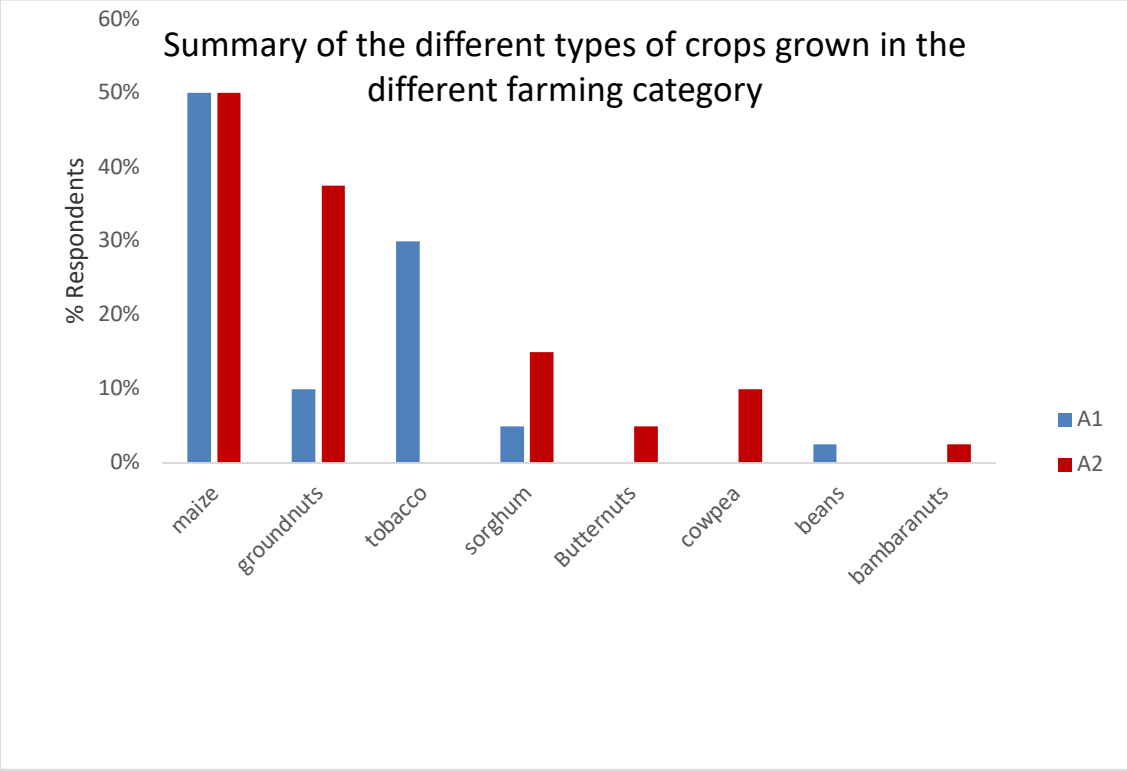

Figure 9: Crop production among the different farming categories

The research used other proxy indicators to trace the impact of the fast land reform in Zimbabwe. The research established that maize is the predominant crop under production, followed by tobacco with 60 % and 18%, respectively. In both farming systems, there was evidence of crop diversification, with evidence of crops being grown for food and commercial purposes. By farming category, 44% of the communal households and 55% of A1 households

have tobacco as a crop that takes up the greater part of the households' total production land. The establishment of the different types of crops grown had a strong bearing on the food security of the different households among the respondents. Beneficial and edible insects were highlighted by one of the FGD in the regulation of the ecosystem, including pollination and natural plant regulation. Apart from the provision of excellent food from edible insects in terms of protein, vitamins, and fiber, edible insects emit far fewer greenhouse gases than their non-edible counterparts. The key informant interview further revealed that edible insects are an efficient protein source, and the insects are critical in bio-waste production. Hence, insects are an important player in the ecosystem in general.

5.3.6 Perception of the respondents regarding the causing factor of edible insects' extinction

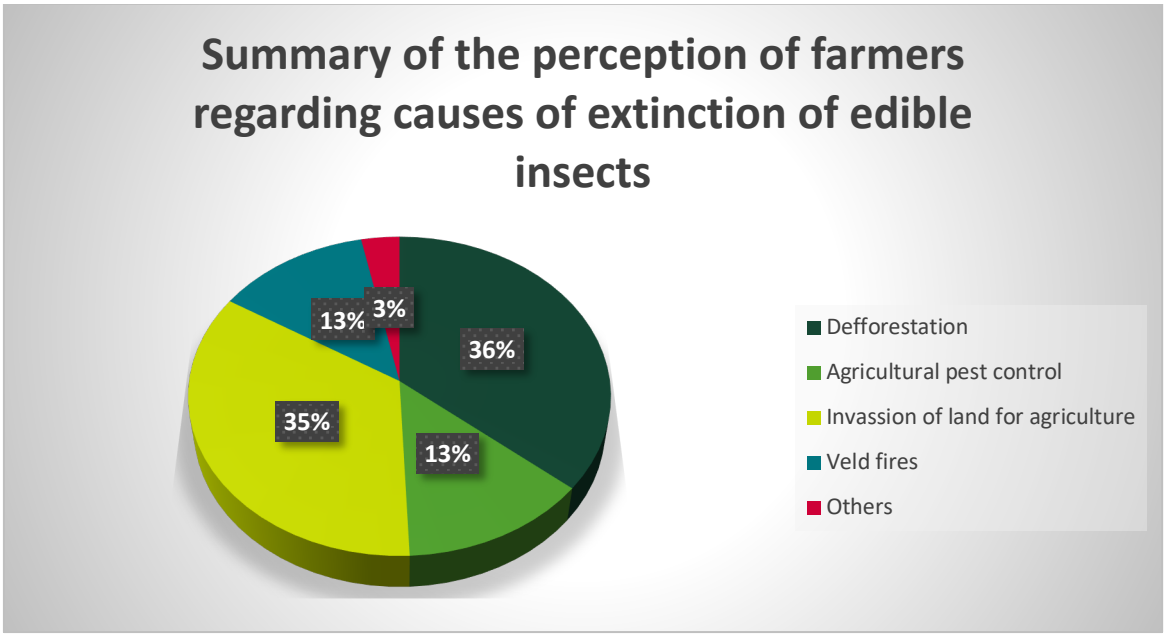

Figure 10: Summary of the perception of the farmers regarding causes of edible insects extinction

The research highlights some potential causes of the low availability of edible insects in the two farming communities. The respondents perceived deforestation and invasion of land for agriculture as the chief culprits, especially agriculture intensification. The FGD further added that there had been high rates of deforestation in the area and heavy cutting down of trees for agriculture. One key informant interviewed added that the relaxation of the local laws by the local leadership and Ministry of Land necessitated the heavy environmental destruction in the area, leading to heavy disturbance of the ecosystem. The key informant interview further added that this has critically affected the availability and accessibility of edible insects, which had been a good protein and nutrient supplementation source in both the Mhondoro and Zvimba communities. The FGD further highlighted that the local communities had a special way of processing and preserving the local edible insects and supplementing nutrition in the lean season, especially during the agriculture season when most farmers will be focusing on crop

production. The insects would act as a source of readily available protein. Agricultural pest control and veld fires had a 13% contribution to the reduced number of edible insects in the area of both the communal and A1 farmers. Poor agricultural practices have necessitated the decline in the number of edible insects. There is a need for local stakeholders to develop and devise a plan that would help preserve the edible insects to make sure that the edible insects are preserved for future generations while meeting the nutritional needs of the current generation in the two districts. More work needs to be focused on the agricultural practices of the two communities, to ensure continuous harvesting of edible insects for food and nutrition security.

Objective 2: Identify strategies and mechanisms that can be implemented to promote the preservation and better management of the environment and edible insects

The research further probed the communities in terms of what can be done to reverse the negative impact on the environment and ensure that the edible insects continue to be a source of livelihood, food, and nutrition security.

5.4 Findings for Objective 2

5.4.1 Perception of the community in terms of local strategies to sustain the availability of edible insects

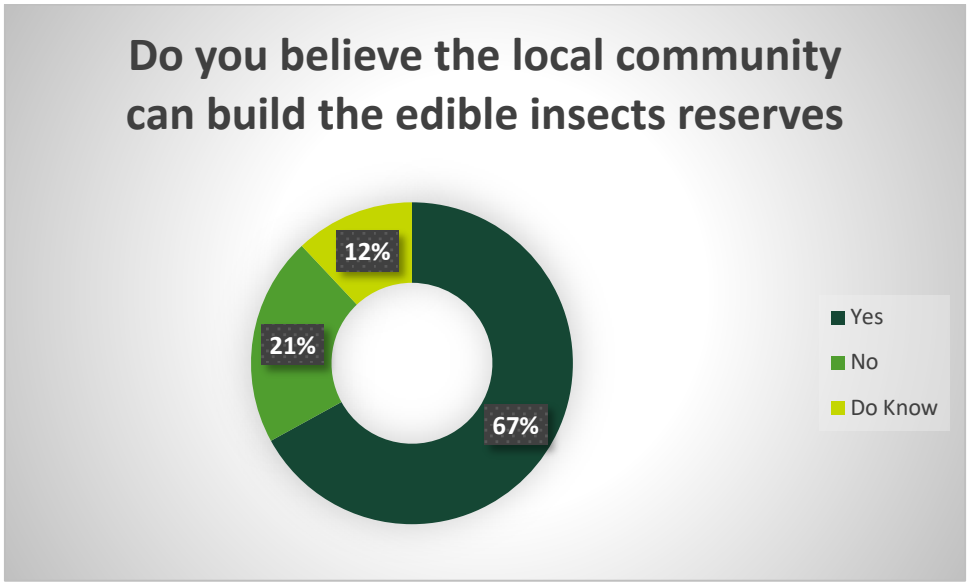

Figure 11: Summary of the respondents on their belief in building the edible insects reserves

Regardless of the farming community, the respondents felt that there is a need to develop local strategies that can be implemented to restore the availability of the different edible insects. It

was established that 67% of the respondents were confident, through their local leadership engagement in both Mhondoro and Zvimba, that they could positively change the landscape in terms of the availability of edible insects. One FGD further highlighted that they would use local strategies like planting trees, both indigenous and exotic, to build back the ecosystem. They further added that they can develop fireguards by embarking on a local campaign through EMA (which is the Environmental Management Agency arm of the government) in terms of community awareness for both communal farmers and A1 farmers. There was a total of 21% of the respondents were not confident in terms of building back the edible insects' reserves. However, a further probe in terms of why such efforts cannot yield fruits was conducted. They failed to explain why; they believe the reserves cannot be replenished. Again, 12% of the respondents said they do not know what should be done to restore the availability and accessibility of such edible insects. According to one key informant from the EMA department, a combined effort between the different stakeholders would play a pivotal role in terms of ensuring the positive availability and accessibility of such an important source of food and nutrition security. The number one pillar that will be effective in rebuilding better is community collaboration in terms of the full restoration of the localized ecosystem.

Another key informant in Mhondoro added that there is a need to develop localized models that can be used by the local communities to ensure they all understand the balance and the importance of ecosystem restoration in general. Community engagement, networking, and mapping were integral strategies that were key in the process of restoring the integrity of the ecosystem in the two districts and among the different farming communities.

5.4.2 Role of stakeholders

The key informant suggested that government ministries play an important role in the promotion of edible insects as food. They added that this can be done through the development of environmentally friendly natural resource regeneration, including backyard forestry production. They further added that there is a need for a collaborative effort by the relevant government ministries in terms of community campaigns and the strengthening of local existing policies and regulations. The involvement of the different level stakeholders was highlighted as key, and these stakeholders included local chiefs, village heads, local extension government staff, and district and national stakeholders. One key informant interview highlighted that no one was left behind; it was the responsibility of all, including the local community. Penalties and fines were regarded as key in the process to ensure a safe environment for the insects, the community, and a good ecosystem in general.

5.4.3 Shows and competitions

The FGD added that there is a need to conduct shows, look and learn for the community leaders or to conduct a look and learn in other communities that have managed to successfully manage their natural resources and edible fruits and insects. As a strategy to understand the best governance system that can be integrated by the community in the general management of the environment in which the insect's habitat, the shows, and cooking competitions were again

highlighted as key in formulating the best strategies for environmental and edible insect preservation. Overall, the community felt that there is more that can be done to ensure the sustainable harvesting of edible insects in the environment in general. The healthier the environment, the more the different farming communities can benefit from the environment and a healthy ecosystem. For long-term food security, shows and competitions can be used to encourage new ideas and teach the public about sustainable harvesting.

6. Discussion of Findings

The discussions of the research were based on the different types of tools that were adopted and deployed by the research. The tools provided excellent results regarding the key objectives of the research. The research used the FGD, key informant interviews, questionnaires, and observation. Agriculture production was regarded as the key livelihood source for the Mhondoro and Zvimba communities. The research established that the respondents cited agriculture as their main source of livelihood among all the respondents. The finding of the main source of livelihood was in agreement with the ZimVac results (2020). Furthermore, it was established by the research that different edible insects are providing different food and nutrition security in the two districts. It was established that edible insect harvesting and marketing was one of the main sources of income, especially among communal farmers. Edible insects are being sold for income. The findings of the research were in tandem with the findings of the FAO (2012) article on edible insects: the future of food and feed security. Their contribution to income and nutrition has been highlighted as outstanding. However, their source of livelihood has been threatened by agricultural intensification and poor farming systems, including heavy cutting down of trees, including mopane trees, which are a key component of edible insects' habitation and a source of feed.

The research was concluded by highlighting some strategies and mechanisms that can be implemented to promote preservation, and better management of the environment, and edible insects. The role of stakeholders was identified as key in the general management of the environment and the habitat for edible insects in Zimbabwe. This was identified through the FGD and key informant interviews, and the findings were in tandem with the findings of Dobermann (2017) in his research on opportunities and hurdles of edible insects for food and feed. It was important to figure out what role each stakeholder played in preserving and managing edible insects so that they could be used by the current generation and future generations.

The research concluded that the Fast Track land reform program had an insignificant impact on the abundance of edible insects in the A1 areas compared to those of the communal farming areas. The two study sites registered perceptions of a net drop in edible insects. This is true, especially given the abundance and availability of the insects around the A1 farmers and how the environment has been degraded. The findings were again about the findings of Rusenga (2021) in his article on the fast-track land reform program in Zimbabwe. So, more research needs to be done. For example, a physical inspection of the bio-environment could be done to see if land reform has changed the real physical environment in a big way.

The focus group discussions also buttressed the idea of how the socio-economic plight of individuals can make them engage in environmentally damaging practices. The respondents

highlighted that most of the individuals in both A1 and communal areas are aware of the laws which prohibit the cutting down of trees, farming in prohibited areas, and other malpractices. The results of the focus group discussions indicated that the effect of community structural poverty as an underlying factor cannot be ignored when assessing the perceptions of the abundance of edible insects over time.

7. Conclusion and Recommendations

7.1 Conclusion

The research concluded that the two different farming systems contributed much in terms of affecting the availability and accessibility of edible insects because of the impact of the Land Reform Program. It was established by the research that heavy deforestation and veld fires were the chief culprits in the depletion of the edible insects among the two farming sectors, the A1 and the communal farmers in Zimbabwe. Edible insects have a high contribution in terms of food and nutrition security for most households in both the Zvimba and Mhondoro districts in Zimbabwe. There was a significant contribution from edible insects in supplementing the most needed protein source for most households. The selling of edible insects was one key income and livelihood source apart from the results established by the research that most households rely mainly on agriculture as the main source of income and livelihood. Overall, it was established by the research that there is a need for a combined effort by different stakeholders to ensure sustainable management of the edible insects in Zimbabwe. It is key that the government and other key stakeholders be involved in agriculture and environmental management for the sustainable harvesting of edible insects for food and nutrition security.

7.2 Recommendations

- There is a need for community capacity building on sustainable harvesting of natural edible insects.
- Continuous involvement and engagement of all the stakeholders, including the community, in the sustainable management of the environment are fundamental.
- There is a need for intercropping to reduce household vulnerability to food insecurity.
- There is a need for the A1 farmers in Mhondoro and Zvimba to start practicing conservation farming as an appropriate strategy to reduce household food insecurity and achieve sustainable agricultural production and environmental management.
- The government and agricultural policymakers in Zimbabwe should start promoting appropriate climate-smart technologies and farming systems such as greater crop diversity and improved processing, storage, and preservation of farming produce.

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Popular science summary

The research focused on evaluating the effect of the land reform program on small-holder farmers' livelihoods and the availability of edible insects for food and nutrition security in the Zvimba and Mhondoro districts of Zimbabwe. The Zimbabwean land reform program was projected to enhance the food security and livelihoods of the majority. However, due to poor agricultural systems and practices, the environment was under pressure and heavily degraded. The situation necessitated and accelerated food and nutrition security problems, including the unavailability of edible insects. Much of agriculture was focused on land intensification rather than inputs to increase output per given area, but this led to an increase in land use, which affected many species. The study adopted case study analysis and integrated a mixed-method approach where both qualitative and quantitative methods were employed. The food security framework was also employed and guided data collection development and results in discussion. The research discussed the participants' livelihoods, socio-economic status, and food consumption. The study also established that agriculture is the primary source of livelihood and food security in the Mhondoro and Zvimba districts and maize constitutes 60% whilst tobacco constitutes 18% of the total crop under production across the Zimbabwean farming sector (86).

After thorough investigations and interviews, the respondents highlighted that they can afford to eat three meals and above a day hence the assurance that they are food secure. 43% of the respondents said they consume edible insects due to their good taste, whilst 33% indicated that they consume insects due to their good nutritional attributes. 24% indicated that they solely consume insects as a relish. Furthermore, 67% of respondents were confident that by engaging in local leadership in both Mhondoro and Zvimba, they could positively change agricultural practices and create sustainable environments for the natural ecosystem to promote the availability of edible insects and a sustainable livelihood. The key recommendations that were established during the research period include the need for community capacity building on sustainable harvesting of natural edible insects. Furthermore, continuous involvement and engagement of all the stakeholders, including the community, is imperative in the sustainable management of the environment.

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Appendix 1: Research Questionnaire

Edible insect in Zimbabwe - The role of Agricultural Intensification.

Introduction statement

My name is James Chikonyani, a student at the Swedish University of Agricultural Science which is in partnership with the Chinhoyi University of Technology. I am doing my thesis on Edible insects in Zimbabwe-The role of agricultural intensification. I have a few questions I would like to ask to generate information that will be used for this study only I will continue to ask you if you are willing to participate in this survey and if you are free either on continuing answering the questions or reject to continue with this survey. The survey will approximately take 45-60 minutes to fully complete them depending on how we conduct this questionnaire.

Section 1: Administration

1.1Respondent number:..... 1.2Date of interview: .....

]

.3 Time interview started:..... 1.4 Time interview ended: .....

]

.5 Location: ..... 1.6 Village/Town: .....

]

.7 Ward: ..... 1.8 District:.....

]

.9 Province..... 1.10 Agro-ecological region: .....

Section 2: Socio-demographic information

2.1 Gender: Male ☐

Female ☐

2.2 Ethnic group

☐ Shona

☐ Ndebele

Other (specify)

☐ .....

2.4 Age in years ☐ ≤ 18 years

19-29 years ☐

30-39 years ☐

40-49 years ☐

≥50 years ☐

2.4 Level of education: (what is the highest level of education attained)

No education ☐

Primary level ☐

Secondary level ☐

Vocational training ☐

Tertiary level (college diploma/university degree) ☐

2.5 Main source of livelihood:

Formal employment ☐

Informal employment ☐

Subsistence farming ☐

Commercial farming ☐

Casual labor ☐

Remittances ☐

Petty trade ☐

Pension ☐

☐

Other (specify).....

2.6 What is the estimate of your household monthly income:

Less than $100 ☐

$100-$199 ☐

$200-$350 ☐

$351-$450 ☐

$451-$600 ☐

$601-$800 ☐

$801-$1000 ☐

Over $1000 ☐

The number of people in your household?.....

Composition of people living in your household by age group and sex.

Age group	Males	Females
< 18 years		
19-29 years		
30-39 years		
40-49 years		
Above 50 years		

Section 3: Agricultural Activities Section

3.1 How many years have you been involved in farming activities? (*Tick appropriate*) 5-10yeas…… 10-15years…….15-20 years…….....

3.2 Are you an A1 or A2 farmer or none settled? *(Tick appropriate*) A1……. A2…….. None settled……

3.3 How many pieces of land do you own or have access to (*ha*)? (*Tick appropriate*)

5-10 *ha* .....

10-15*ha* ……..

15+ *ha* ……

3.4. How many (*ha*) are being utilized? (*Tick appropriate*)

5-10*ha* ……

10-15*ha* ……

15+ *ha* ……

3.5a. Which crops do you grow in summer? (*Tick appropriate*)

Maize……. Sorghum…… Millet…….. Sunflower……. Cotton…… G/nuts…….. B/nuts……..
Field beans…….

Others (Specify)……

Winter?

Wheat……. Peas…… Others (specify)…….

3.5 b. Which crop occupies much of the land? *(Ask above crops and list)*

.....and why?.....

3.6a. Do you have any livestock? (*Tick appropriate*)

Cattle…….Goats……..Sheep……donkeys…….Poultry…….

b. How often do you slaughter them for consumption?

Twice per week.....Once per week.....After two weeks.....Once per month.....and why ……

3.7 Which pest or insects mainly affect your crops?……..

3.8. How do you eradicate or control the insects or pests?.....

Section 4: Edible insects' consumption habits

4.1 Do you eat any edible insects?

Yes ☐

No ☐

4.2 If the respondent replied NO to the question. Have you ever consumed edible insects before?

Yes ☐

No ☐

If responded yes, what were the reasons that made you stop eating?

.....

.....

.....

4. 3 Which insects do you or have you consumed? List them

Insect name	Still eating them	Eaten them before
Ishwa		
Madora		
Majuru		
Tsunyatsunya		
Makurwe		
Hwiza/Ndongwe/Mhashu		

Tsambarafuta		
Any other: specify		

4.4 How often do/ did you consume these edible insects (when in season)?

- ☐ ≥ 3 times per week
- ☐ 1-2 times per week
- ☐ 1- 4 times a month
- ☐ Once per month

4.5 What are your reasons (motives) for consuming edible insects?

- ☐ Taste
- ☐ Nutrition
- ☐ Medicinal properties
- ☐ The only food option
- Other:
- ☐ Specify……

4.6 How do you take edible insects? (Tick all the possible)

As the only relish ☐

As relish but in combination with another relish ☐

As a snack ☐

4.7 On average, how many edible insects do you take per day for the following situation? (Tick the appropriate)

Situation	Less than 1 cup	Equivalent to 1 cup	More than 1 cup
If only relish			
If in combination with another relish			
As a snack			

4.8 How do you obtain these insects before consumption (Tick all the possible options)

- ☐ Harvest me or a member of the household
- ☐ Buy from formal markets (shops and markets)
- ☐ Buy from vendors
- ☐ Other (specify)

.....

.....

4.9 Who normally prepares the edible insects for you before consumption?

Self ☐

Any member of my family ☐

Other people not members of my family ☐

Section 5: Factors related to characteristics of the environment

5.1a. What does your religion say about eating edible insects?

My religion does not forbid me from eating any edible insects ☐

My religion makes me selective of insect species I consume ☐

My religion strictly forbids me from eating any insect species ☐

5.1.b What is your religion?

☐ Christianity

☐ African Traditional

☐ Muslim

☐ Other: Specify

For Christianity specify denomination……..

5.2 a. Do you think your upbringing has influenced your eating/not eating edible insects?

Where I grew up made me eat edible insects ☐

Where I grew up made me not eat edible insects ☐

Where I grew up made me selective of the insects I eat b. What is the setting of your upbringing?

Urban setting ☐

Rural setting ☐

Combination of urban and rural ☐

5.3 Has the availability/non-availability of edible insects in your geographic location influenced your insect consumption behavior?

I consume insects because they are widely available in my location ☐

I do not consume insects because there are not available in my location ☐

The availability/non-availability of insects has not affected my consumption of insects ☐

6.1 Who is mainly involved in

Harvesting,…….

Preparation,……

Marketing of these insects?……

6.2What benefits do you derive from harvesting and consumption of edible insects in your household?.....
.....
.....

6.3 Have you been involved in selling them at the market and how?.....

6.4 The money you get from sales, how do you use it?.....

6.5 Do you face any challenges when harvesting or selling them?.....

Section 6: Climatic or Agricultural factors on edible insects

7.1According to your knowledge, how do you tell about the numbers of these insects from these years *(Tick appropriate*) 1995-2000 (low.....Medium.....High.....),

2001-2005 (low.....Medium.....High.....),

2005-2010 (low.....Medium.....High.....),

2011-2015 (low.....Medium.....High.....),

2015 to date (low.....Medium.....High.....).

7.2 Do you have any knowledge on which insects are now available from 2000 to date and which ones were not available in the area?.....

7.3 a. What do you think are the factors contributing to their decline in numbers.....and since when……
……

b. What do you think are the factors contributing to their increase in numbers.....and since when……
……

(Hint; Agricultural activities-forestry clearance, Agrochemicals; climatic conditions-temperatures, rainfall, changes in weather patterns, etc.)

7.4 What government departments or institutions do you work with when involved in harvesting……
……

Consumption……
……

Marketing of edible insects……
……

7.5 What do you feel should be done by the local authority in minimizing the challenges you are facing in accessing edible insects?.....

7.6 What other suggestions do you have in mind about edible insects in terms of harvesting,……
……
……

Consumption……
……
……. and
Marketing of edible insects? …….
7.7 Do you have any questions for me?……

End Of Questionnaire: Thank you very much

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