An analysis of the contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi District in Zimbabwe

Bindura University of Science Education

Faculty of Agriculture and Environmental Science Department of Agricultural Economics, Education and Extension

A dissertation submitted in partial fulfilment of the requirements for the Master of Science Degree in Food Security and Sustainable Agricultural Policy.

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The undersigned certify that they have supervised and recommended to the Bindura University of Science Education for acceptance of a dissertation entitled '**An analysis of the contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe.'** submitted in partial fulfilment of a Master of Science Degree in Food Security and Sustainable Agriculture.

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DECLARATION

I hereby declare that the research project entitled "**An analysis of the contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe"** submitted to the Bindura University of Science Education, Department of Agricultural Economics, Education and Extension is a record of an original work done by me under the guidance and supervision of **Mr. I Govere** and this work is submitted in partial fulfilment of the requirements for the award of a Master of Science Degree in Food Security and Sustainable Agriculture. The results embodied in this thesis have not been submitted to any University or Institute for the award of any degree of diploma.

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DEDICATION

This research is dedicated to my beloved family Trust, Tinotenda, Tendai and Tatenda Masiya you guys you are wonderful. You are the most wonderful gift I have ever received. Your support and contributions enabled me to be where I am. Thank you for believing in me and for all the love and support. Thank you Lord.

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ABSTRACT

Food security status of households is of concern to everyone in the country. Especially in this era of severe droughts were the production of small grains like sorghum which are tolerant to climate change is being encouraged thus promoted the research which is an analyses of the contribution of small grain production to food security and dietary diversity among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe. The main aim of this research is to determine the adoption status and challenges faced by smallholder sorghum producers,o perform a comparative analysis of the food security status in terms of HDD and HFIA of sorghum producers and non-producers,to investigate the socioeconomic factors contributing to household dietary diversity among smallholder farmers and analyse the socioeconomic determinants of adoption of sorghum production among smallholder farmers in Mudzi..The questionnaire was used as the main tool to gather data from households in selected ward within the districts. Questionnaires were administered through face-to-face interviews. The total sample size was 100. The regression model was used to analyze data. Of the sample under study only twelve percent is not growing sorghum and household size of non-producers tend to be smaller as compared to household size of producers. Low yields was mentioned most as constraint in sorghum production, followed by gritty in the grain. HDDS score appears to be slightly higher for sorghum producers compared to non-sorghum producers. Meaning sorghum producers experience slightly lower chances of being food insecure. At a significant level of 0.05 there was no statistically significant differences between HDDS and HFIAS of sorghum producers and non- producers. This concluded that food security is influenced by various factors other than sorghum production. These factors include household size, land access, access to remittances, education of household head.The findings demonstrate that the age, educational attainment, and prior experience of the head of the household in independent farming all favourable impact household food security. Food insecurity is less common in households headed by older adults and those with more educated adults. Improved food security is also facilitated by remittances and information access. One important aspect that stands out is education. Research shows that household heads with greater levels of education had better dietary diversity and lower levels of food insecurity. Families with a head who has completed secondary or university school have lower levels of food insecurity and higher scores for dietary diversity. The results also indicate that larger households face greater food insecurity and have lower dietary diversity. The older the household head is the less food insecure the household is. Households with large areas under crop are less food insecure as

they have more harvest. Households with more members below 16 tend to be more food insecurity. Credit availability and communication infrastructure has no bearing on the diversity of nutrition. Participating in mobile agriculture and delivery of extension services are positively correlated with dietary diversity. Household size has a positive correlation with production of sorghum. Middle aged households tend to produce sorghum as compared to families with older and younger people. Household with average number of five are the group involved in sorghum production. Another finding is that the household with bigger plots and bigger families are involved in sorghum production. Experienced farmers tend to produce sorghum as compared to farmers with less years in farming.

Key words: food security, HDDS, HFIAS, sorghum.

LIST OF ACRONYMS AND ABBREVIATIONS

FAO	Food Agriculture Organization
HDDS	Household dietary diversity score
HFIAS	Household Food Insecurity Assessment Score
NGO	Non-Governmental Organisation
NR IV	Natural Region 4
NRV	Natural region 5
ZIMSTATS	Zimbabwe Statistical Agency
SPSS	Statistical Package for Social Science
SADC	Southern African Development Committee

Table of Contents

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Food insecurity and shortage of food is one of the challenges that the world and the country are facing. Climate change is one of the contributors to food insecurity. Zimbabwe, where droughts are a constant occurrence along with other economic catastrophes, smallholder farmers of which the majority are in semi-arid regions have seen a greater decrease in grain output particularly maize production. In 2002, Zimbabwe experienced the largest deficit in its food production since 1980 (Nyahunda & Tirivangasi 2019; Muzerengi, 2019).

According to Muzerengi (2019), due to climate change and other socio-political developments taking place in the country, Zimbabwe has experienced an upsurge in food and nutrition insecurity over the past ten years at both the household and national levels .All this is attributed to the country's lack of a comprehensive agricultural policy model. Climate change is contributing to food insecurity and hunger in most parts of the country including Mudzi District.

Although the Mudzi district's farming households frequently endure severe food shortages and droughts, little is known about the precise household-level determinants of food insecurity in this area. Nonetheless, there isn't always a direct relationship between the amount of food available in households and the amount of food available nationwide. For many developing nations, ensuring food security at the national and family levels continues to be a significant concern.

According to Zimbabwe Human Development Report, 2017, Zimbabwe’s farmers grow maize, millet, sorghum and wheat to ensure food security. However, maize takes up approximately 80% – 90% of production and due to the maize crop's sensitivity to temperature change, this makes the Zimbabwe agriculture to be more vulnerable to climate change

Small grains require less nutrients and they survive and mature early. They require fewer inputs as compared to maize varieties, which are too physiological and take between 90 to 200 days to mature hence during drought periods they do not do well as compared to small grains, (Mayhew and Penny, 2008).According to (FAO, 2006) farmers in natural region II

have an comparative advantage in growing maize whereas farmers in natural region IV and V have a comparative advantage in growing small grains.

1.2 Research Problem Statement

Mudzi district is one of district in the country which has been hit by erratic rainfall and low temperatures. Small grains were introduced as a mitigation measure against food security. Food insecurity in the country has remained a problem. According to the extension officers in the area the farmers are getting very low yields of about o.3t/ha for sorghum and 0.35t/ha pearl millet. During the peak hunger period (January to March 2024), 26% of the rural population is projected to be food insecure, ZimVac, (2023). This is a clear indicator which necessitated the study to show if introduction of small grains can change the situation in other districts. The There is a major food scarcity as a result of the commercialization of the maize crop which the majority of Zimbabweans have become acclimated to the taste of maize compelled farmers in marginal areas to produce maize despite the fact that their agro-ecological conditions are unsuited for it. There is a growing perception that this shift is to blame for the very fluctuating crop yield and production of staple food grains in marginal regions.

1.2 Research Objectives

1.2.1 Main Objective

To analyse the contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe.

1.2.2 Specific Objectives:

1. To determine the adoption status and challenges faced by smallholder sorghum producers
2. To perform a comparative analysis of the food security status in terms of HDD and HFIA of sorghum producers and non-producers
3. To investigate the socioeconomic factors contributing to household dietary diversity among smallholder farmers

4. To analyse the socioeconomic determinants of adoption of sorghum production among smallholder farmers in Mudzi.

1.3 Research Questions

- Find out the adoption and challenges faced by smallholder sorghum producers.
- To find out the food security status (HDD and HFIA) between sorghum producers and non-producers.
- What are the socioeconomic factors contributing to household dietary diversity among smallholder?
- What are the socioeconomic determinants of adoption of sorghum production among smallholder farmers in Mudzi?

1.5 Justification of the Study

According to Rukuni et al., (2006) research on traditional crops being grown in marginal rainfall areas is lacking, despite supporting literature that small grains have more advantages than maize in semi-arid and arid areas. Farmers in drought prone areas tend to allocate more land to maize production which is regarded as a high risk crop because of its susceptible to erratic rainfall and is not most suitable to semi-arid regions (Rukuni and Eicher, 1994) Reoccurring of food insecurity at family level has prompted this research so that effective interventions to address this situation are discovered. Literature on the link and interrelated factors of household food insecurity in Zimbabwe and response during crisis is also limited. The research attempts to address this gap through. Evaluating these factors will be helpful in guiding policy makers (Mlambo et al., 2014).

The study will show why production of small grains is still low even if literature supports that they have an advantage as compared to maize. The study will provide information on the issue of food insecurity, which is brought on by climate change, and will help the local communities understand how climate change may affect their crop production methods and way of life. With this research the government will see importance of small grains and promote the growing of these small grains in the marginal areas. More research to be done on improving agronomic practices so as to increase yield of small grain that can be used by these farmers. NGOs will also promote these crop in other districts. The community will

also see how these small grains are contributing to food security as compared to their larger grain crops.

Also for food security to be attained government and NGOs will advocate for input distribution of small grain seed as compared to maize production.

1.6 Assumptions of the Study

This study makes the following assumptions:

- The study assumes that farmers in Mudzi adopted the growing of small grains to mitigate food security.
- The study assumes that households given questionnaires will respond in honesty.

1.7 Outline of the Study

The study is made of seven chapters. The first chapter focuses on the introduction, background to the study research questions, research objectives and significance of the study. The second chapter discusses the literature review regarding food security, food insecurity status, production of small grains which are sorghum, pearl millet and finger millet and the advantage they have over maize production in semi-arid communal areas. The third chapter gives an overview of the study area that is its location and main climatic condition. Also in this chapter methodology of the study, sampling procedure, data collection procedure are covered. In chapter four clarifies on the method of data analysis, and descriptive results of the research. Chapter five presents the conclusions, summary and recommendations that were drawn from the research. All these chapters are linked and cannot be treated as separate units.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Previous chapter was focusing on background information and the aim of the research, whilst in this chapter a review of the evidence that demonstrates how small grains, in particular sorghum and millets, can improve household food security in semi-arid areas of Zimbabwe. It covers on food security and the food security situation in the country, the advantage of small grains over other grains in terms of production.

2.2 Understanding of Key Terms

In this section key terms will be explained for better understanding of the research. Important key terms for the research are food security, household dietary diversity score, household food insecurity score and small grains

2.2.1 Food Security

According to (Maxwell, (1996), there are close to 200 definitions of food security. World Food Summit of 1996, states that “Food security is the state in which all individuals have continuous physical, social, and economic access to an adequate supply of food that is safe, nourishing, and fits their dietary needs and food choices for an active and healthy lifestyle.” This definition was later changed to add the element of food accessibility in response to Sen (1982), who discovered that people were experiencing poverty and famine even when there was an abundance of food accessible.

According to FAO/WFP (2008), household food security in Zimbabwe has decreased as a result of a sharp decline in food and agricultural production as a result of irregular rainfall and the glaring shortage of essential farming inputs. Poor "net consuming" households in Zimbabwe's semi-arid regions had trouble assuring household food security due to the irregular rainfall and a lack of readily available, affordable inputs (Chipika *et al*., 1999).

The most severely impacted provinces were Masvingo and Matebeleland, which are located in agro-ecological areas IV and V and have historically experienced a grain shortfall (FEWSNET, 2008). The four pillars include availability, access, utilisation, and stability. If one of the pillars is not met, the people become food insecure. Members of a household that fails to obtain nutritious and preferred foods for a healthy and productive

life may develop multiple chronic conditions, even obesity (Sanchez, 2002). Carter et al. (2010) note that food insecurity results in poor (self-rated) physical and mental health. As such, a poorly nourished population is a constraint to human and economic development.

Food can come from several different sources. For the rural people food comes from agricultural production some amounts bought and some collected from the natural areas. In times when rainfall is erratic and agricultural production is affected people rely mainly on natural, bought in and food aid. According to (FAO, 2019) good post- harvest handling and processing procedures help reduce losses and ensure households have year round availability to a wide range of nutritious foods. Access to food is linked to access to land, economic and ecological resources, access to knowledge about nutrition and transport to have food. Access to safe, nutritious food by rural communities depends on access to land water, information etc. Accessibility is also influenced by price and demand factors.

According to FAO (2019), utilisation is the socioeconomic aspect of food security. It relates to what is purchased for consumption and how it will be allocated in the household. This is also linked to care given to different households according to their need. Disease prevention is important in utilisation of food. Simelton and Ostwald (2019), highlighted that food utilisation addresses how food is prepared and incorporates various elements for a balanced diet.

Stability relates to the availability of food and access to and utilisation of it in time. Two types of food insecurity which are long term and short term both relate to food stability. Stability is influenced by seasonal factors, environmental factors, and economic factors.

2.2.2 Small Grain Production

Small grain production has become widespread in dry areas with promise of enhancing food security if planted on a larger scale (FAO, 2010). Small grains have got the potential to contribute towards the food security of many of the world's poorest and most food insecure agro-ecological zones. According to Bang 2003, small grains have the potential to improve household security in semi-arid regions because of their adaptability to such environments. Several studies have looked at how small grains can lead to food security especially in semiarid areas (Leuschner and Manthe 1996; FAO 2006; Mukarumbwa and Mushunje 2010).

Small grain crops are early maturity crops. According to (Manzungu, 2000), sorghum matures earlier than maize. He noted that sorghum varieties range from 86 to 101days as compared to 90 to 200 days of maize crops, (Mayhew and Penny, 2008).They highlight the numerous advantages associated with small grain production. Among such advantages are their nutritious value, drought resistance, and the longer periods they can be stored as compared to maize.

(Leuschner and Manthe, 1996) pointed out that sorghum and millet are some of the most important cereal crops for communal farmers in Natural Regions IV. Small grains, particularly sorghum, adapt well to harsh climates and thus can grow in dry conditions due to their ability to tolerate heat, salt, and water stress, which makes them an ideal crop for semi-arid and arid areas (ICRISAT, 2015).

Zimbabwe's agro-ecological regions IV and V have a low total annual rainfall averaging between (400 to 600 mm) (Chard, 2006). People in Zimbabwe have become accustomed to the flavor of maize, thereby persistently engaging in the cultivation of this particular crop even in areas where it may not thrive. In the absence of yield, individuals resort to cultivating small grains as a viable substitute for sustenance. The primary small grains cultivated within the country encompass sorghum, pearl millet and finger millet.

Sorghum is staple food for regions like Africa, South Asia and Central America. Sorghum is regarded a short-grass Savanna crop. It is tolerant to high temperatures of up to 30°C, (Mayhew and Penny, 2008). Rainfall requirements are very low averaging 400 to 800 mm during the growing season, (FAO, 2017).Sorghum is capable of enduring dry periods due to its extensive and profound root system. It is also capable of decreasing the rate of water loss under conditions of moisture deficiency, and its ability to limit growth under stressful conditions, only to resume normal growth once moisture becomes accessible once more. Sorghum has a high yield potential, comparable to that of wheat, rice and maize, for example, 52 000 ha of maize produced 3 600 tons of grain compared to 6 600 tons of grain from 22 000 ha of millet in Matabeleland South province of Zimbabwe during the 2006/07 season (FAO & WFP, 2007). It is also highly nutritious as compared to maize. It can thrive well with little or no fertiliser at all.

Van Slyke, (2003), argues that millet is adapted to hot weather and resist drought spell. According to FAO (2017), pearl millet is a very hardy crop, can be grown under very high

temperatures and low rainfall conditions compared to maize. It requires between 200-600mm of rainfall. It is rich in iron and has higher energy and protein levels. The grain does not contain any tannins and it can be stored for years without insect damage, making it an important food security crop.

Finger millet is rich in fibre, iron and calcium. Its grain can be stored for years without insect damage, making it an important food security crop. It require 500-100mm of rainfall and temperature of 11-27 degrees Celsius.

Strength of millet is shown in the quantity needed. Flour from ground millet is used to make bread and small amount is needed for the bread hence flour is available for a long time. (Dube, 2008) pointed out some advantages of small grains like sorghum and millets over maize as: a smaller amount of flour is needed to cook the main meal compared to maize; a meal cooked from the small grains satisfies hunger for a longer period and gives more energy (which is especially important for persons who do heavy manual labor like farmers).

According to (Ndlovu, 2011), these drought resistant crops have become extremely important to the local community given the fact that they act as both food and cash crops which enables the smallholder farmers to adapt to climate change and variability and attain sustainable livelihoods. Local people brews beer using finger millet and the beer is sold. Income from the sales of beer is used to buy other food commodity hence making food accessible. Excess yield can be sold hence making income available to buy food even in times of food unavailability at local level.

According to (Tiwari et al, 2022) the morphology, physiology, and biochemistry of millet's crop have dynamically developed to enable them to escape and/or adapt to unfavorable environmental conditions. Millets are renowned for their climate-resilient qualities, which include their low susceptibility to environmental stressors, reduced irrigation needs, enhanced growth and productivity under low nutrient input conditions, and capacity to adapt to a wide range of ecological conditions. Shivhare et al., 2020, suggest that millet response to drought in two ways that is short response and long response. Short response include stomatal conductance since a key QTL for drought tolerance on linkage group 2 co-localizes with one of the QTLs for lower transpiration rate under drought stress stomatal conductance in pearl millet has been linked to drought tolerance (Aparna et al., 2015; Tharanya et al., 2018). According to (Shrestha etal ,2023) one of the principal drought-tolerant mechanisms in plants that keeps cell turgor, relative water content, cell expansion, photosynthesis, and stomatal

conductance intact is osmotic adjustment. Another short response is also of antioxidant defense and ROS scavenging ability It is well recognized that both biotic and abiotic stressors can produce reactive oxygen species (ROS), such as singlet oxygen (1O2), superoxide radical (O2-), hydroxyl radical (HO), and hydrogen peroxide (H2O2). (Dudhate et al., 2018).

Long term response properties like the rooting pattern and studies have demonstrated that when the drought treatment was applied to the topsoil, pearl millet's ability to absorb water from wet subsoil layers increased through an increase in lateral root density. Pearl millet displays both elongated and dense root growth systems under drought conditions (Zegada-Lizarazu and Iijima, 2005). The leaves of millet and sorghum decrease leaf canopy area while under drought stress, will allow its leaves to fold, roll, or even wither (Redmann, 1985; Kadioglu and Terzi, 2007) so as to reduce transpiration. When there is drought stress, leaf withering is particularly noticeable during the grain-filling stage (Do et al., 1996)

According to, (Wani, 2011) Early grain cultivars mature in 90–110 days and medium-duration cultivars in 110–140 days at seasonal average daily temperatures greater than 20 °C. Depending on the cultivar, the growing season is extended by roughly 10 to 20 days for every 0.5 °C drop in temperature when the mean daily temperature falls below 20 °C. Researchers observed that the duration of sorghum types varies from 86 to 101 days, while maize crops last from 90 to 200 days (Mayhew and Penny, 2008)

Small grains fit in the pillar of accessible as they are considered a high-energy yielding nourishing food which help in addressing malnutrition. According to (Ambati ,2019), a number of health benefits are associated with the consumption of millets, largely due to the bioactive phytochemicals found in these cereals, such as lignans, flavonoids, phenolic, betaglucan, sterols, inulin, pigments, dietary fiber, and phytate . They aid in the management of health issues such as diabetes mellitus, hyperlipidemia, cancer, and cardiovascular illnesses, as well as decreasing blood pressure, risk of heart disease, cholesterol, and the rate of fat absorption, and delaying stomach emptying , (Nithiyanantham ,2019).

Gleim, 2023 mentioned the following as benefits of sorghum and millet as control of blood sugar especially if you have type 2 diabetes, since they include non-starchy polysaccharides, fiber, and undigestible carbohydrates that help manage blood sugar.

Improves digestive healthy as they are rich in dietary fiber, both soluble and insoluble. They also protect the heart and they have anti-aging effect.

Levy, 2024 states that similar to other whole grains, sorghum boasts an outstanding nutritious profile, offering a substantial amount of plant-based protein, several minerals, B vitamins, and dietary fiber. Remarkably high levels of antioxidants, such as tannins, anthocyanins, and phenolic compounds, which lessen oxidative stress and inflammation, may also be found in sorghum flour.

2.2.3 Constraints in small Grain Production

Small grain cultivation involves a lot of work, from preparing the soil, pulling weeds, deterring birds, harvesting the grain, and processing it. Because manual production methods are employed by the majority of farmers in the area, labor intensiveness is a significant concern. The study also demonstrated how the similarities between finger millet and the weed "*Eleusine Indica*" make weeding more difficult. According to, (UNDP, (2018a) these two are so similar, one may typically choose to pull the crop than the weed. The seeds are too small to handle and must be harvested by hand, harvesting little grains also requires a great deal of labor. Grinding of finger millet requires a lot of skill and work due to the size of the seeds. Processing of small grains requires a lot of labour as there is no machinery to process.

Despite the fact that little grains can withstand most diseases, quela birds pose a serious threat. As with most research (Nciizah 2014; UNDP 2018a), the main obstacles to small-scale grain cultivation are animals and birds. Nciizah (2019) claims that, in contrast to maize, which has leaves covering the grains, the grains of crops are exposed, attracting birds. Also birds are difficult to chase as they attack in numbers.

Small grains have been determined to have a relatively small market for sales since consumers prefer other agricultural products like maize. This is further supported by an FAO, (1996) study that indicates that customers are more likely to buy wheat, rice, and occasionally maize instead of traditional coarse grains when earnings rise. Because of this, farmers now believe that tiny grains yield less than other crops. According to Zvishavane farmers, one significant drawback of tiny grains is the lack of effective marketing channels (Nciizah, 2014).

Mukarumbwa and Mushunje, (2010) demonstrate how insufficient government assistance has a detrimental impact on small-scale grain production. Sorghum and millet are the most drought-tolerant cereal grain crops that can be grown in semi-arid areas, according to research (Taylor

et al. 2006). The nation's economic and political difficulties over the past few decades have severely crippled the Department of Agricultural Extension Services (AGRITEX) and the Department of Meteorological Services, leading to a brain drain of highly qualified personnel (Mutasa 2011).

In Zimbabwe, maize cultivation still predominates over small grain production in the semi-arid regions (Sukume et al. 2000). In semi-arid regions, small holder farmers find small grains to be highly unappealing due to their low yields. Due to the small farm sizes seen in much of small grains production, farmers choose to produce maize. A small number of people who grow small grains also have significant land areas and the manpower to produce these. Additionally, compared to maize, small grains do not yield as much crop residue, which is why the majority of farmers prefer to produce maize. Crop residue, which animals mostly rely on for survival throughout the winter, is provided by maize output, according to Mapfumo et al. (2005).

The majority of farmers have been vehemently rejecting recommendations from agricultural extension officers to grow small grains for years, even in spite of the area's maize crop's obviously appalling performance due to the consequences of climate change (The Chronicle, 2020). Studies have indicated that the general public has little knowledge of small-scale grain farming. Despite knowing that they would likely receive very low returns from the drought, many farmers in disregarded the advice to switch to small-scale grain production and, in many cases, kept growing maize (Nciizah 2014).

2.3 Summary

The chapter covered on the key aspects of small grains to food security. It explained on what food security is and its four pillars. The advantages of growing sorghum and other small grains was also covered in this chapter. Constraints in small grain production were explained hence the research to show if they have any impact on the food security of sorghum producers in semi-arid regions.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter focuses on answering on the methods and tools used to analyse the impact of adapting small grains. It will cover study area, research design, sampling procedure, data collection procedure, data analysis procedure. Description of the study area is essential as it familiarises one with the location of the research.

3.2 Description of the Study Site

The study location is in the semi-arid natural farming region IV, which is located 500–900 meters above sea level, (Mango et al, 2014). The decision to focus on the semi-arid region of Mudzi district was not made by accident; rather, it was prompted by the fact that over the past years, people have primarily relied on rain-fed agriculture and natural resources for their livelihoods, despite these regions and others in Zimbabwe experiencing significant temperature increases, recurrent droughts, and unpredictable rainfall patterns. Due to its high temperatures and lack of rainfall, this region is among Zimbabwe's most vulnerable to climate change. The district has a dry climate making farming very difficult in this predominantly communal area. The mean annual rainfall in the district ranges from 450 to 500 mm and the mean annual temperature is 23^0 c. Natural region IV is characterized by frequent seasonal droughts and severe dry spells during the summer season. According to Mango et al., (2014), the predominant soil type is the ferric luvisols. Rainfall is normally received late in the season and tails off early, resulting in a short season of about two and half months on average.

Mudzi district is located in natural region IV and experiences rainfall of less than 400mm per annum and temperature range of above 25 degrees in summer. Zimbabwe is divided into five agro-ecological regions known as natural regions based on the rainfall regime, soil quality and vegetation among other factors (FAO, 2006). The quality of the land resource declines from Natural Region (NR) 1 through to NR V (Rukuni et al., 2006).

The district is primarily covered in Miombo forest. The native vegetation is primarily found in woodlands, where species like Acacia and Mopani predominate. The popular fruit trees, Musau and Muuyu (Baobab), are being exploited with both local and foreign markets, all the way to Harare. Additionally, there is a valuable timber forest product that is harvested

and traded for cash. Sweet veld is the kind of veld or rangeland. The district as a whole is located in the Greater Mudzi Communal Semi Intensive Farming livelihood zone. For most of the population, agriculture is the main source of income. The primary revenue sources are crop production and sales.

The raising and selling of cattle are additional sources of income. Casual labor is the only source of income for poor households that cannot raise enough food for their family and do not own any livestock. According to Zingore (2006) the households are characterised by lack of wealth with an average having ten cattle and use less of organic fertilisers. According to WFP, 2022 there are no other farming practices in the district; communal farming is the only one used.

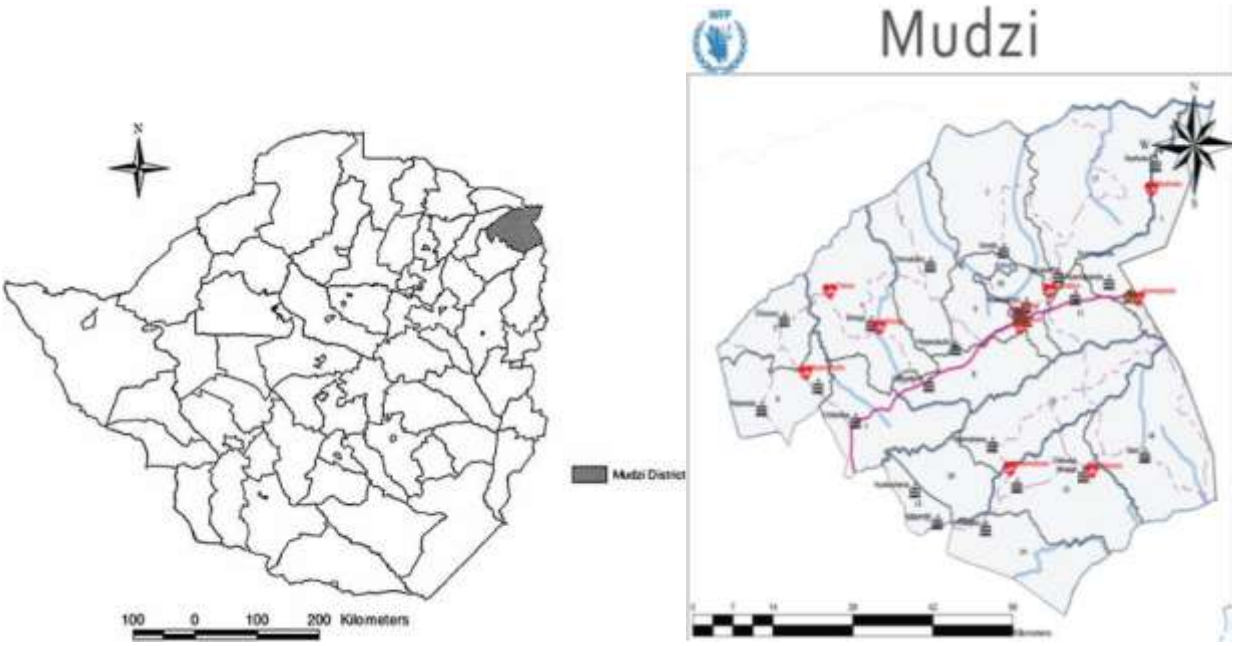

Figure 3.1: Map of Zimbabwe and Mudzi district (WFP, 2020)

3.3 Research Design

Quantitative approach was applied in this research. The primary tool was a questionnaire. The questionnaire (see appendix 1) was administered by CTDO personnel as a baseline report for ecological farming and small scale mechanization project in three districts and nine wards. Of the three districts, Mudzi was picked for the research and the method used for sampling was purposive sampling.Ward 3 was selected due to accessibility of information to the research as a way of cutting cost on data collection. The questionnaire gathered data on the demographic information, sources of income, access to information and markets of the smallholder farmers. Data which was already collected for HDDS and

HFIAS during the same period was collected for analysis. The questionnaire for households which had data already collected on HDDS and HFIAS were used for this analysis. Key informant interviews were carried out with government representatives, community leaders and non-governmental organisation especially Agritex officers. Study was carried out using explanatory research design. This approach was chosen because it allows for in-depth analysis of a problem, data collecting, and logical and analytical justification of the relationship between variables, (Akhatar, 2016).

3.4 Sampling Procedure

There are steps which are to be followed when sampling and these include choosing the target population for the study, selecting the sample frame, determining the sample size and executing the sampling plan, (McCombes, 2023).

3.4.1 Target Population

According to, (McCombes, 2023) a population is the entire group that you want to draw conclusions about. In this research the target population is the people (households, farmers) of Mudzi district.They are defined according to their geographical location which is natural region 1V. The population has also have common farming practices that is growing of maize and small grains.

3.4.2 Sampling Technique

To carry out an experiment or acquire relevant data to answer a specific study issue, a representative or subset of the population is chosen through sampling. Probabilistic research involves random sampling, cluster sampling, stratified sampling and systematic sampling, whereas non probabilistic involves the use of purposive, convenient and snowballing, (Pandey & Pandey, 2021). Purposive was used in selecting the sample. The following section covers sample frame, sample size determination

3.4.2.1 Sampling Frame

The sampling frame ensures that every member of the population is included in sample selection, therefore, minimizing sampling bias, (Kayode-Sanni, 2023). The household list was obtained from Agritex officer responsible for selected ward. Convenience sampling was used to selection process of ward. This technique was chosen on the basis of simplicity

and expenses to the researcher. Within the selected ward the interview households were randomly chosen from household lists provided by resident agricultural extension officers who was involved in the NGO project.

3.4.2.2 Sample Size

A sample was selected using simple random sampling technique. This technique was selected as it gives every participant an equal chance of being selected which reduces bias in the selection of the sample. In order to prevent drawing conclusions that are too broadly based on the opinions of a small number of people, a sample was drawn from the population. The actual number of the respondents who take part in the survey is 100 households.

3.5 Data Collection Procedure

This section will cover the process of designing tools to be used in data collection and the actual process of collecting data.

3.5.1 Questionnaire

A questionnaire was designed as a tool for primary data collection. A pre-test of the questionnaire was conducted in the district on few households prior to the main survey. The purpose of the questionnaire was to gather data on a variety of possible variables. Questionnaires were given to the head of the family or any family member who was directly involved in farming activities. The questions were explained in the local language which is Shona.

Data was collected with the help of well trained and experienced enumerators using Computer Assisted Persona Interview (CAPI) to capture and enter data during interview process. There was a supervisor oversaw collection of data. Before surveying the questionnaire was pre tested .This was done to check on time taken to complete the questionnaire and to check if enumerators understood the questions.

3.5.2 Household Dietary Diversity Score (HDDS)

According to Hoddinott (1999; 2002), food security is difficult to measure as there are roughly 450 indicators of food security. Main focus of studying household food security is to find out how a household produces or obtains food throughout the course of the year, (FAO, 2003).

FANTA (2017), describes household dietary diversity as a proxy measure of household food access. A score of HDD is driven from different groups of food consumed over a given reference period which is 24 hours in this case. A set of twelve food groups is used to calculate the HDDS. This is a commonly used technique to qualitatively analyze food consumption, including the range of foods that a household has access to, and is a readily adaptable instrument to evaluate access to food. The responses to the questions asked is either yes (score = 1) or no (score = 0). The following food groups are used and are as follows: A) Cereals (B) tubers and roots (C) Vegetables (D) Fruits (E) Meat, poultry ,offal (F) Eggs (G) Fish and seafood (H) Legumes ,pulses, nuts, and seeds (I) Milk and milk products (J) Oils and fats (K) Sweets (L) miscellaneous. According to Kassie et al., 2008, the HDDS score is determined by summing the number of food groups consumed. Dietary diversity (DD) is crucial for a high quality diet since it essentially ensures an adequate intake of critical nutrients and significant non-nutritive components which will have been consumed in 24 hours for the past 7 days. It is particularly important within and within food groups and between different types of specific foods.

3.5.3 Household Food Insecurity Assessment Score (HFIAS)

Household food insecurity (HFI) is referred to as a situation of uncertain, insufficient, or unavailable access, or use of food (Obayelu et al, 2021). Deitchler et al. (2011), states that the HFIAS reflects three universal domains of household food insecurity: anxiety about household food insecurity, insufficient quality of food supplies, and insufficient quantity of such supplies. Household food insecurity access scale (HFIAS) is an indicator that measures the severity of household food insecurity. It focuses on the “access” aspect of food insecurity (i.e. not on food utilization). This is predicated on how respondents view the food insecurity of their households and how they act in response to food insecurity (FANTA, 2017) also suggest that there is a link between insufficient intake of important nutrients and inadequate resources to afford sufficient food both for individual and household needs, which leads to poor nutrition. HFIAS score is calculated after households have been asked occurrence questions. The occurrence questions can be summarised as follows: (Q1a) anxiety about food adequacy; (Q2a) eating less preferred foods; (Q3a) eating foods of a limited variety; (Q4a) inability to eat even less preferred foods; (Q5a) eating smaller meals than needed; (Q6a) eating fewer meals in a day; (Q7a) failing to obtain food of any kind; (Q8a) going to bed hungry; and (Q9a) going the whole day or night without eating anything. The respondents are asked whether a particular condition (Q1a to

Q9a) associated with the experience of food insecurity occurred at all during the past 30 days, with a 'yes' answer being given a value of one and a 'no' answer given a value of zero. Each severity question is followed by a frequency-of-occurrence question, which asks how often the reported condition occurred during the previous 30 days (1 = rarely, 2 = sometimes, and 3 = often). The minimum HFIAS is zero and is obtained when a household responds 'no' to all of these questions. The maximum score is 27, which is obtained when a household responds 'yes' to an occurrence question and 'often' to the nine frequency-of occurrence questions. According to (Coates et al. 2007), the HFIAS is computed as the sum of the frequency of occurrence during the past 30 days for the nine food insecurity-related conditions as follows:

3.6 Data Analysis Techniques and Presentation

This is an important stage in the research process because it allows information collected to be made to facts that can be used to conclude findings. The Statistical Package for Social Sciences (SPSS) and Microsoft Excel were used to analyse the data collected from the participants.

Table 3.1: Data analysis procedure

Objectives	Variables	Data Analysis
1. To determine the adoption status and challenges faced by smallholder sorghum producers in Mudzi district.	Adoption status: Binary (1=adopters, 0=non-adopters) Challenges faced: Qualitative assessment	Descriptive statistics for adoption status (means and frequencies), thematic analysis for challenges
2. To perform a comparative analysis of the food security status (in terms of HDD and	HDDS: Count of food groups consumed in 24 hours HFIAS: Scale	Mann-Whitney U or ANOVA for comparison of HDDS

Objectives	Variables	Data Analysis
HFIA) of sorghum producers and non-producers.	assessing food insecurity experiences	and HFIAS scores between groups
3. To investigate the socioeconomic factors contributing to household food and nutrition security (HDDS) among smallholder farmers.	Socioeconomic factors: Income (local currency/USD), Education level (years of schooling), Household size (count), Access to resources (binary).	Regression analysis to identify significant socioeconomic predictors of HDD
4. To analyze the socioeconomic determinants of adoption of sorghum production among smallholder farmers in Mudzi.	Socioeconomic determinants: Income (local currency/USD), Education level (years of schooling), Access to credit (binary), Landholding size (hectares).	Regression to identify significant socioeconomic predictors of adoption status

3.7 Ethical Consideration

According to Bhandari (2021), scientific integrity, respect for human rights, dignity, cooperation between science and society all depend on research ethics. These guidelines ensure that study volunteers are safe, informed, and willing to participate in investigations. The most important aspects of research ethics to take into account are potential for damage, anonymity, informed consent, and voluntary involvement.

3.7.1 Potential for damage

This is an important factors as participants need to be protected from all forms of damage. According to Jowett (2020), it is imperative for researchers to implement safety measures to mitigate potential risks associated with participation and guarantee that participants are not exposed to unnecessary risks. As a result, the researcher investigated every potential risk to the participants and provided them with information. The damage which need to be avoided include psychological harm, social harm, physical harm and legal harm. Interviews were done one on one, No personnel information on participants was collected.

3.7.2 Anonymity

Any information collected is not linked to any person. According to Bhandiri (2021), this is made sure by not gathering any identifiable personal data, such as names, phone numbers, email addresses, IP addresses, physical attributes, images, or videos. The participants' real names or other identifying information can be replaced with codes or pseudonyms to achieve this (Jowett, 2020).

3.7.3 Informed Consent

According to Bhandiri (2021), all possible participants are given and comprehend all the information necessary to make an informed decision about whether or not to participate, this is referred to as informed consent. This contains details regarding the advantages, dangers, funding, and institutional clearance of the study. As a result, the participants were given the opportunity to choose whether or not to engage in the data collection procedure after the researcher had outlined the goals of the study.

3.7.4 Voluntary Involvement

This implies that there is no compulsion or pressure on any research participant to choose to participate. There is no commitment for any participant to stay in the study; they are free to leave at any time. Participants in your study are not required to give a reason for quitting. It's critical to make it abundantly evident to participants that declining to participate will have no adverse effects.

3.8 Confidentiality

According to Bhanditi, (2021), as long as you store or utilize their personal information, you should secure it since every participant has a right to privacy. Whenever possible, you should protect confidentiality even in situations where anonymous data collection is not possible. As a result, the researcher took care to make sure that data collected ad passed to the researcher will be kept in confidentiality.

3.9 Summary

The research approach that was employed to accomplish the research goals was examined in this chapter. The chapter demonstrated the application of qualitative and quantitative research. On quantitative there was use of questionnaires to gather data. The discussion on

research ethics that were observed throughout the study wraps up the chapter. The following chapter is going to mainly focus on the results of the study

CHAPTER 4

RESULTS PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents results on the study of contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe. The results presented on this chapter are based on objectives 1 to 4.Tables, graphs were used to present the results.

4.2 Material and Methods

4.2.1 Description of the study area

The study was carried out in Mudzi district as detailed in chapter 3.2

4.2.2 Research Design

A questionnaire was used to gather information on HDDS, HFIAS and demographic information. Challenges encountered by small holder farmers was collected from face to face interviews with farmers and Agritex officers in the area as detailed in chapter 3.3.

4.2.3 Sampling Procedure

Procedure used is detailed chapter 3.4.

4.2.4 Data collection Procedure

Data was collected from ward 3 Mudzi using questionnaire as detailed in chapter 3.5

4.2.5 Data analysis Procedure

Descriptive analysis using frequencies was used to describe the socio-demographic characteristics of respondents. The data were analysed using Statistical Package for Social Sciences (SPSS v.27). The dataset was coded in preparation for analysis. The coding included representing age, sex and other characteristics as numbers.

4.3 Results

This section presents the results of the study based on the demographic and socio-economic characteristics of small holder producers in Mudzi. The dataset includes the demographic and

household characteristics of one hundred households, offering a thorough overview of their socioeconomic makeup, sex and other characteristics as numbers.

4.3 Results

This section presents the results of the study based on the demographic and socio-economic characteristics of small holder producers in Mudzi. The dataset includes the demographic and household characteristics of one hundred households, offering a thorough overview of their socioeconomic makeup, sex and other characteristics as numbers.

4.3.1 Adoption status and challenges faced by smallholder sorghum producers

Table 4.1 Sorghum Producers (SP) and Non Sorghum Producers (NSP) Descriptive Statistics

	Age of household head		**male16_58**		**females16_58**		**membersLess16**		**members59+**		**Household members who are away and send remittance**		**Household size**		**Land Under Crop**		**Land owned**		**HDDS_Score**		**HFIAS score**	
	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP	SP	NSP
count	88	12	88	12	88	12	88	12	88	12	88	12	88	12	88	12	88	12	88	12	88	12
mean	47.966	42.833	1.625	1.833	1.977	1.667	0.784	1.000	0.443	0.083	0.659	0.417	4.830	4.583	3.349	2.962	2.826	3.092	5.227	6.083	10.38	9.00
std	12.248	12.547	0.875	0.718	0.994	0.651	0.988	1.128	0.709	0.289	1.277	0.996	1.649	1.443	0.848	0.662	1.092	0.839	1.868	1.240		6.701
min	17	27	0	1	0	1	0	0	0	0	0	0	1	2	2.1	2.06	1.25	1.6	1	4		2
max	79	69	3	3	5	3	4	3	2	1	6	3	11	7	6.25	4.12	7.5	4.2	9	8		19

The data suggests sorghum producers tend to be middle-aged with an average household size of 5 members. The average producer cultivates 3.3 hectares of land and owns 2.8 hectares, with landholdings and cultivation area ranging from 2 to 7.5 hectares. Due to the limited data (only 12 entries), drawing conclusions about non-sorghum producers compared to sorghum producers is challenging. However, the data suggests non-sorghum producer households size tend to be slightly smaller than sorghum producers with an average of 4.6 members. The average non-sorghum producer is around 43 years old, with ages ranging from 27 to 69. While the average land ownership (3.1 hectares) is comparable to sorghum producers, the cultivated land area (2.9 hectares) is slightly lower. It's important to note that these values might not be representative due to the small sample size.

Table 4.2 Challenges Faced by Farmers in Sorghum Production

Constraints	Percentage %
Low yields	85
Gritty	78
Birds	62
Availability of inputs	61
Labour	55
Poor soils	45
Drought	32
Other	17

Source survey results 2020.

From the survey eighty eight of households are sorghum producers and twelve are non-producers. Smallholder sorghum producers were asked to rank challenges they face during the production cycle of sorghum on a scale of 1 to 5.One was regarded as least important and 5 as most important. Challenges which were most frequently mentioned are ranked according to number of times they were mentioned and are shown above.

4.3.2 Comparative Analysis of the Food Security Status in Terms of HDD and HFIA of Sorghum Producers and Non-Producers

This analysis examines the food security status of households based on their sorghum production practices. Dietary diversity (HDDS) and food insecurity (HFIAS) scores to understand potential differences between sorghum and non-sorghum producers

As shown in table 4.3, the Mann-Whitney U test results suggest there might not be statistically significant differences in food security between sorghum and non-sorghum producers.

For the HDDS scores (dietary diversity), the test statistic (376.5) indicates a potential difference in medians, but the p-value (0.103) is slightly higher than the typical significance level (0.05). This means we cannot reject the possibility that the observed difference might be due to chance.

Similarly, the HFIAS scores (food insecurity) show a test statistic (596.5) suggesting a possible difference in medians. However, the p-value (0.469) is well above the significance level. Again, we cannot confidently claim a statistically significant difference in food insecurity between the two groups based on this test.

These results might be influenced by the sample size, particularly for non-sorghum producers. A larger sample size could provide more conclusive evidence. Overall, based on these tests, we cannot claim with confidence that sorghum production has a significant impact on household dietary diversity or food insecurity.

Table 4.3 Statistic and p values for sorghum producers and non-producers

	HDDS	HFIAS
Sorghum producers	statistic=0.9587	statistic=0.9057,
	p-value=0.0065	p-value=9.1151
Non-sorghum producers	statistic=0.9339,	statistic=0.8656
	p-value=0.4207	p-value=0.0576
Mann-Whitney U Test	statistics 376.5	statistics 596.5
	p-value: 0.1030	p-value: 0.4696

Figure 4.1 visualized the distribution of HDDS and HFIAS scores for both groups. While the plots might show some potential variations in medians or spreads, the statistical tests suggest these differences are not statistically significant at the chosen level hence cannot definitively conclude that sorghum production has a significant impact on household dietary diversity or food insecurity.

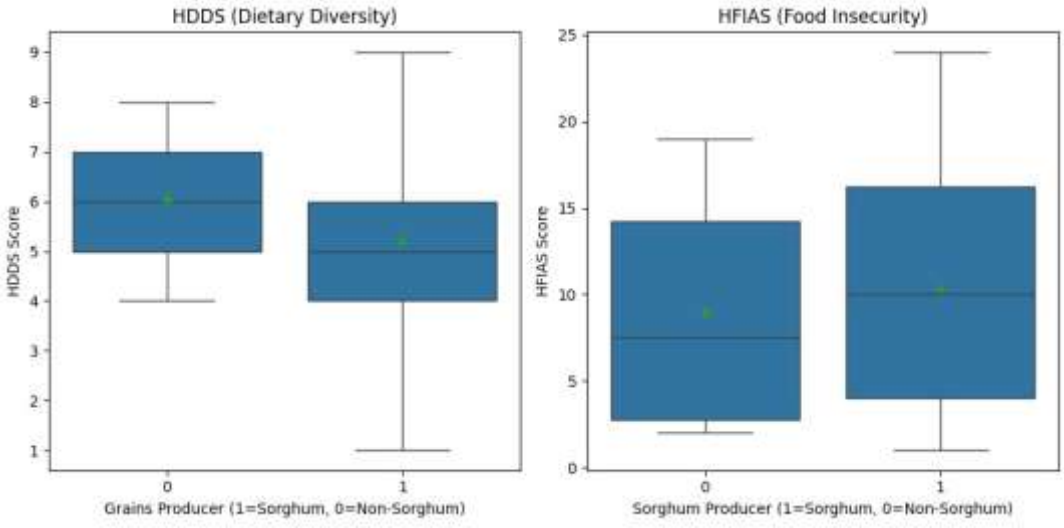

Figure 4.1 Boxplot of Sorghum Producers and Non-sorghum producers.

The median HDDS score appears to be slightly higher for sorghum producers compared to non-sorghum producers. The box for sorghum producers is slightly wider, indicating a larger spread of scores in dietary diversity compared to non-sorghum producers. The median HFIAS score seems to be lower for sorghum producers compared to non-sorghum producers. This suggests that sorghum producers might experience slightly lower food insecurity. The boxes for both groups have a similar spread, indicating comparable ranges in HFIAS scores.

While the boxplots suggest some potential differences in the distribution of HDDS and HFIAS scores, the statistical tests performed previously (Mann-Whitney U test) didn't reveal statistically significant differences at a significance level of 0.05.

4.3.3 Socioeconomic Factors Contributing to Household Dietary Diversity (HDD) Among Smallholder.

Table 4.4 displays the findings of the multiple linear regression analysis. It includes the coefficients, standard errors, t-values, and p-values for each predictor variable that affects the dietary diversity of households in the Mudzi area. Several important conclusions are drawn from the study of the factors influencing household dietary diversity in the Mudzi district. Interestingly, there is a negative correlation between household size and nutritional diversity, indicating that larger households might have trouble keeping a variety of cuisines. An increase in household size at reduces HDDS .Furthermore, it seems that the availability of credit and communication infrastructure has no bearing on the diversity of nutrition. On the other hand, there are indications that participation in mobile agriculture and the delivery of extension services are positively correlated with dietary diversity. This suggests that technological

interventions and agricultural assistance programmes could be crucial in improving dietary diversity within families. In the meanwhile, there are no significant correlations found between dietary diversity and factors including head age, gender, education level, hectare under cultivation at 5%.

Table 4.4: Determinants of household dietary diversity in the Mudzi district

Explanatory variable	Description	Coef	std err	T	p-value
Const		6.4697	1.801	3.591	0.001
Household head gender	Gender of household 1 male 0 female	0.5604	0.604	0.929	0.356
Household head age	Age of responded in years	-0.0331	0.029	-1.13	0.261
Household head education level	Level of education for household head 1-9	0.0739	0.083	0.896	0.373
Household members who are away and send remittance	Number of households members who are away and send remittance	0.2823	0.198	1.426	0.157
Household size	Total number of household members directly dependent on household head	-0.2028	0.121	-1.673	0.098
Period in farming	Years involved in farming	0.0079	0.023	0.34	0.735
House type	Type of household	-0.034	0.022	-1.559	0.123
Land Under Crop	Total size of farm being used	0.113	0.24	0.47	0.64
Extension Service	if household receives extension service, otherwise	0.4086	0.398	1.028	0.307
Credit	if household have access to credit service,	0.3428	0.758	0.452	0.652
Communication	f household has access to communication (radio)	-0.9107	0.492	-1.851	0.068
Mobile Agriculture	if household have access to mobile agriculture service,	0.6312	0.577	1.095	0.277

Table 4.5 presents the results of the examination of the Mudzi district's Household Dietary Diversity (HDD) of sorghum and non-sorghum producer, which range from 1 to 9. The mean score was 5.33, with a standard deviation of 1.82. According to the distribution, 27% of homes have an HDDS of 4 or lower, and 61% of households fall between 5 and 7, which corresponds to the median score. Moreover, 75% of homes have an HDDS score of six or lower. A more detailed analysis of the tercile distribution shows that 68% of households are in the middle tercile and27% of households are in the lower tercile, which indicates comparatively less dietary diversity. On the other hand, a smaller percentage (5%) of households, are in the higher tercile, indicating a higher level of dietary diversity.

Table 4.5: Household dietary diversity scores and dietary terciles for sorghum and non - sorghum producers in the Mudzi district.

	HDDS Statistics	Proportion of households sorghum producers	Proportion of households non sorghum producers
	Household dietary diversity score		
	Proportion of households with HDDS of 2 to 4	21.00	6.00
	Proportion of household with HDDS of 5 to 7	57.00	4.00
	Proportion of households with HDDS of 8 to 9	10.00	2.00
	Household dietary diversity score terciles		
	Low(groups 1 to 4)	27.00	
	Medium (5 to 8)	68.00	
	High (9 to 12)	5.00	
Max	9		
Mean	5.33		
Min	1		
Std	1.82050609		

4.3.4 Socioeconomic Determinants of Adoption of Sorghum Production Among Smallholder Farmers

From the analysis household size has a positive relation with the decision of growing sorghum. Greater household sizes would be advantageous in labor-intensive agricultural production systems since they would indicate more labor being available, which would increase the likelihood of adoption. This is significant at 5%.At the 1% level, the age of the farmer had the anticipated negative and significant impact on the likelihood of producing sorghum. This is consistent with Manda et al. (2016), who pointed out that as farmers age, they tend to abandon riskier crop enterprises in favor of less hazardous cropping systems with favorable support and reduced transaction costs. Households who usually get regular visits from extension officers tend to adopt more to the production of sorghum. These normally get an average of five visits per season. Household with more years in farming tend to produce sorghum as compared to farmers with less years in farming. Farmers with access to mobile agriculture tend to shun the production of sorghum. This may be attribute the farmer access to information and different groups. This may be to the fact that household gets more info on markets hence shunning the crop as prices offered on the market are low. Tefera et al. (2012) also note that farmers' choices of sorghum were sensitive to the relative inefficiencies in the market brought about by

government policies that erected obstacles to entry for private enterprises. However, variables such as gender, access to remittances, land under cultivation, credit availability and communication infrastructure show non-significant relationships adoption of sorghum production.

Table 4.6 Socioeconomic Determinants of Adoption of Sorghum Production Among Smallholder Farmers

	Coef	std err	T	p-value
Const	20.7082	6.156	3.364	0.001
HeadGender	-1.6528	2.062	-0.801	0.425
HeadAge	-0.2041	0.1	-2.039	0.044
HeadEducationLevel	-0.7212	0.282	-2.557	0.012
awayRemitters	-1.0998	0.677	-1.625	0.108
hseSize	1.7217	0.414	4.157	0
periodFarmingIndependant	0.1654	0.079	2.081	0.04
hseType	0.1078	0.075	1.445	0.152
landUnderCrop	-1.5701	0.822	-1.911	0.059
extService	1.2598	1.359	3,012	0,210
Credit	1.1947	2.59	0.461	0.646
Communication	-1.0419	1.681	-0.62	0.537
mobileAgriculture	0.0709	1.97	0.036	0.971

4.4 Discussion of Results

As shown on Table 4.2 the most faced challenge is low yields from sorghum and other small grains. Eighty five percent specified that yields they get cannot sustain them for the whole year. This is the major reason why they end up not growing the crop. This was also noted by Sukume et al, (2000) that small grains producers attain low yields as compared to maize .This has acted as a major obstacle for farmers not to uptake production of these crops on a large scale. Low yields are a result of lack of inputs farmers tend to use less of fertilisers and also use retained seeds for sorghum production. This is also supported by FAO (1996), Mukarumbwa et al. (2010) and Silas et al. (2021).

About 62% mentioned the problem of birds and this in in line with what was also mentioned in other studies (Ariningsih et al., 2023; Silas et al., 2021; Belete, 2022). Farmers suggested different innovative solutions for bird scaring. They mentioned that it requires more labour to scare the birds and this also reduces the yields of the sorghum. The birds normally attack the crop during the sprouting stage hence reduction in yields. During processing there is a challenge of gritty and this has made the crop less favourable for most households. Mahajan et al. (2024) also mentions the problem of gritty in the processing of small grains. Although sorghum is a drought tolerant, the continued reduction of rainfall due to climate change has also resulted in low yields. One of the *Agritex* participants had this to say "The rainfall pattern is changing and becoming extreme and complex"

Some of the minor challenges mentioned include pest attack, itchiness from dust during processing of the crop.

From Fig 4.3 media HDD score appears to be slightly higher for sorghum producers compared to non-sorghum producers. The box of sorghum producers is slightly wide, indicating a larger spread of scores in dietary diversity compared to non- sorghum producers.

Median score seems to be lower for sorghum producers compared to non-sorghum producers. This goes with the findings by Sani et al (2017), Mapfumo (2017). It suggest that sorghum producers experience slightly lower chances of being food insecure. The boxes have similar spread, indicating comparable ranges in HFIA score. Whilst the boxplots suggest some potential difference in the distribution of

HDD and HFIA score the statistical test performed (Mann-Whitney U test) didn't reveal statistically significant differences at a significant level of 0.05. This might be explained by sample size, limited sample size, particularly for non- sorghum producers, could hinder the detection of true difference. Food security is influenced by various factors other than sorghum production. These factors include household size, land access, access to remittances, education of household head these play a more significant role.

Table 4.4, shows that numerous important factors influencing dietary diversity among families are revealed by the examination of determinants Household Dietary Score (HDDS) in the Mudzi district. The findings demonstrate that the age, educational attainment, and prior experience of the head of the household in independent farming all favourable impact household food security. Food insecurity is less common in households headed by older adults and those with more educated adults. Improved food security is also facilitated by remittances and information access. This is consistent with finding by Mango et al. (2014), Bashir et al. (2012) and Kumar et al. (2022).

One important aspect that stands out is education. Research shows that household heads with greater levels of education had better dietary diversity and lower levels of food insecurity. Families with a head who has completed secondary or university school have lower levels of food insecurity and higher scores for dietary diversity. This demonstrates the value of educational programs in raising the standards of food security.

The results also indicate that larger households face greater food insecurity and have lower dietary diversity. Household size is negatively correlated with dietary diversity and positively correlated with food insecurity, emphasizing the challenges larger households face in maintaining adequate food access and variety larger households are associated with higher food insecurity and lower dietary diversity. These go hand in hand with results by Otekunrin et al (2021). This may be due to large number of people to feed hence diversity lacks.

Moreover, there are noteworthy correlations between food security indices and agricultural practices including crop land under cultivation. Pesticide-using

households are more likely to have a diversified diet and experience less food poverty, which raises questions about the possible advantages of contemporary agricultural inputs in boosting food security, this is consistent with Tefera (2009). On the other hand, using animal manure is linked to somewhat decreased dietary diversity and increased food insecurity. This finding may be a reflection of the difficulties and constraints involved in sticking to conventional farming practices.

The older the household head the less food insecure the household is. This may be due to years of experience with life the head is. Findings by Bekele (2015) shows that and as age of the household head increase, the likelihood of being food insecure decreases. Households with large areas under crop are less food insecure as they have more harvest. There is a positive correlation, suggesting that households with more members below 16 tend to have higher food insecurity, this may be lack of labour to work in the fields as this age is still school going age.

Credit availability and communication infrastructure has no bearing on the diversity of nutrition. Participating in mobile agriculture and delivery of extension services are positively correlated with dietary diversity. This suggest that technological interventions and agricultural assistance programs are crucial in improving dietary diversity within families. Interesting insights are revealed by analysing gender patterns in connection to food insecurity. Households headed by female heads have a mean HFIAS score of 11.08, which is somewhat higher than that of households headed by male heads, which have a mean HFIAS score of 10.09. Even while there isn't much of a difference in the mean scores between the two groups, it raises the possibility that there are gender differences in the community's experiences with food insecurity.

Age has an impact on adoption of sorghum production as those who grow sorghum tend to be middle aged this may be due to high labour required in growing the crop. Household size of five is the average of producers. The larger the household size the more likely the family will adopt the production of sorghum. This is in line with findings of Musara et al,(2013) Land size has an impact on adoption of sorghum production as those with the larger land size have adopted the production of sorghum. Household size of non- producers is

smaller as compared to sorghum producers. Households with access to extension services tend to adopt more to sorghum production, this may be due to the fact that they get more tips on production from extension officers.

4.5 Conclusion

This chapter presented and discussed the results that were obtained from the study. The first part presented on demographic and socioeconomic factors which were analysed. The household size of non-producers tend to be smaller as compared to household size of producers .Average household was 1,6 males and 2 for females which are between 16-58 years old. Main challenge faced by sorghum producers is low yield which lead to shunning of the crop. Households also mentioned quelea bird and gritty as some of the challenges. Research showed that larger households face greater food insecurity and have lower dietary diversity. Household size is negatively correlated with dietary diversity and positively correlated with food insecurity.

Other findings from the research are that age, educational attainment, and prior experience of the head of the household in independent farming all favourable impact household food security. Food insecurity is less common in households headed by older adults and those with more educated adults. These variables which affect HDDS and HFIAS need to be addressed so as to improve the livelihoods of smallholder farmers in Mudzi. The next chapter covers conclusion and policy recommendations for the study.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter is built from previous chapter which covers presentation of results and discussion of the findings. This chapter will dwell on the summary of the findings and conclusion from research findings. Recommendations and are to be drawn from results of the study while policy implications are also discussed. Chapter will conclude with suggestions on areas of further study.

5.2 Research Summary

This section covers the summary of the finding of the research according to objectives. The aim of this study was to examine the contribution of small grain production to food security among smallholder farmers in the semi-arid areas of Mudzi district in Zimbabwe.

The objectives of the study were:

i. To determine the adoption status and challenges faced by smallholder sorghum producers.

ii. To perform a comparative analysis of the food security status in terms of HDD and HFIA of sorghum producers and non-producers

iii. To investigate the socioeconomic factors contributing to household dietary diversity among smallholder farmers

iv. To analyse the socioeconomic determinants of adoption of sorghum production among smallholder farmers in Mudzi.

The study was a quantitative research approach where data was collected through the use of questionnaires .The data was analysed using SPSS. The study was divided into five substantive chapters.

Chapter I of the study concentrated on introducing the study. In this chapter the introduction, background to the study were given while the problem statement was also highlighted. The topic went further to discuss the objectives of the study, research questions, justification, scope, limitations of the study, and outline of the thesis.

Chapter II of the study covered on the literature review. The chapter provided an in-depth literature inquiry highlighting perceptions of others on small grains production, food security, HDDS and HFIAS. Several literature studies were discussed while empirical evidence was also provided. In essence, this chapter centered on providing similar research studies that have been carried out before.

Chapter III of the study was on research methodology. It explains how the research was carried out. The study site is described in this chapter, design adopted to carry the research .The sampling procedure and the data collection procedure are also explained in this chapter. It goes on further to explain the data analysis procedure and ethical considerations. Reasons for adopting research design were justified and explained in this chapter.

Chapter IV of the dissertation focused on the results of the study. The results are presented as per objective. First, the chapter provided materials and methods used to collect the data. The socio-demographics of the respondents were given based on data collected from the questionnaires. The results indicated that twelve are non-sorghum producers and eighty-eighty produce sorghum. Factors like preferences religion and other production challenges hinders them from producing sorghum. The factors include low yields, quelea birds and gritty. The findings also indicate d that HDDS for sorghum producers is high as compared to non-sorghum production. In another test that is the Manny-White test revealed no statistically difference.
This may be due to fact that HDDS and HFIAS is influenced by other factors.

Age, education, remittances, experience of head in farming have an impact on food security. Food insecurity is less common in household headed by older and more educated head. Larger household face greater food insecurity and have lower dietary diversity. Credit and communication have no bearing on diversity of nutrition. Age has an impact on adoption of sorghum production as those who grow sorghum tend to be middle aged this may be due to high labour required in growing the crop. Household size of five is the average of producers. Land size has an impact on adoption of sorghum production as those with the

larger land size have adopted the production of sorghum. Household size of non-producers is smaller as compared to sorghum producers.

5.3 Conclusion

The result of this study show that sorghum producers tend to be middle aged with an average household size of five. Only twelve household from the sample were found to be non-adopters of sorghum production. Limited sample size may suggest that this is not a true representative due to small size. Low yield was the most mentioned challenge followed by availability of gritty. The lower yields were caused by the fact that farmers resorted to the use of retained seed and less use of fertilisers in the production. Drought was the least of the reasons of not producing sorghum. Security status of a household vary with household characteristics and socioeconomic. The major factors that affect household food security include age and education level of head of household, remittances, experience in farming of household head. Also quelea birds are a problem during production cycle.

The household dietary diversity score for non-sorghum producers is high as compare to sorghum producers. Sorghum producers experience slightly low chance of being food insecure. Statistically there is no difference between producers and non-producers. This may be due to the fact that food security is influenced by many factors other than sorghum production.

Factors which contribute to a household being food secure include age of household head, education level of household head, remittances, experience of household in farming. Education is important as shown from study that the more educated the household head is the less insecure a household is.

As people grow they understand the importance of producing small grains. Production of sorghum requires labour to guard against quelea bird and also processing. Innovations to make bird scaring easy task for household will improve the production of sorghum. Households with larger families tend to produce sorghum and age of household has a negative effect on the production

of sorghum. Households with access to mobile agriculture tend to shun the production of sorghum. Visitation by extension agents has a positive impact on the production of sorghum.

5.4 Policy Implication and Recommendations

However, the study highlighted that the major challenge in sorghum production is low yields Suggest that policies be crafted to have high yielding varieties and varieties which are resistant to attack by birds. Varieties has to be more drought tolerant as climate change is affecting production more. According to Taylor (2003), these crops are known to have better adaptability to such agro-ecological environments over the main staple maize. Improving food security among the smallholder farmers should be a comprehensive effort by different stakeholders which are government, non-governmental organisation and grain millers. According to Mango et al (2003) joint efforts should focus on promoting technologies which reduce labour requirements and ease processing.

Policies that strengthen input and product markets for sorghum in Zimbabwe are recommended. In semi- arid areas there should be set up area to be put under sorghum. Extension services need to encourage growing of sorghum and training as education improve food security.

According to Bekele (2015) there is need to reduce family size and dependency ratio cause food insecurity, he suggest that attention has to be given to limit the increasing population in the study area. This can be achieved by awareness campaigns to effect family planning, although every individual has a natural right to multiply

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APPENDICES

Questionnaire

A. IDENTIFYING INFORMATION

(a) Household ID

(b) Name of Supervisor	(c)Date Checked

1. Name of Enumerator	
2. Date of interview	
3. District	
4. Ward	
5. Village	
6. Name of head of household	
7. Name of Respondent	
8. Is respondent household head? 1 = Yes; 0=No	
9 If not, relationship to household head 1 = Wife 2=Husband 3=Son 4=Daughter 5=relative 99 = Other (specify) ***NB: (As far as possible, interview should only be carried out with the two adult members of the household with full information of household data i.e. husband or wife or adult children relative or others living at home)***	
10. GPS coordinates of residence (waypoint)	(1) NORTHINGS: (2) EASTINGS: (3) Elevation (m.a.s.1)

B. GENERAL HOUSEHOLD INFORMATION

NB: The "household" refers to all members of a common decision making unit (usually within one residence) that are sharing income and other resources.

Variable	**Response**	**Codes**
Demographic data		
1. Gender of Household head		1=Male 0=Female
2. Marriage status		1=Single, 2=Monogamously married, 3=Polygamous married, 4=Widowed, 5=Separated/Divorced 6=Other (Specify)
3. Age of Household head		

4. Education level of household head		1=no formal education, 2=Adult education 3=some Primary education, 4=completed primary education, 5=some vocational training, 6=completed vocational training, 7=some secondary education, 8=completed secondary education, 9=College education 10=University education
5. Number of males aged 16 to 58 years		
6. Number of female s aged 16 to 58 years		
7. Number of members aged below 16 years		
8. Number of members aged 59 and above		
9. How many members of this family are living away who regularly send remittances?		
10. Household size		
11. How long has the house hold head been farming as an independent household?		Number of years
12. Type of household		1=male headed (monogamous), 2= male headed (polygamous), 3= female headed (husband absent), 4=female headed (widowed), 5=female headed (divorced) 6=female headed (single), 7=male headed (single), 8=male headed (divorced), 9=male headed (widowed) 99=Other (Specify)

C. LAND OWNERSHIP

NB: 1 ha=2.47acres, 1 acre =0.405 hectares 1ha = 10000m², 1 m²=0.0001 NB: Please indicate here whether you use acres (=1), hectares (=2) or m² (=3) *How much land this household own now?*

Holdings	(a) Homestead land	(b) Upland away from home	(c) Wetland (if applicable	(d) Other	(e) Total	(f) Unit of measure[1]
1. Owned						
2. Sharecropped in						
3. Borrowed						
4. Rented out (for more)						
5. Sharecropped out						
6. Lent out (for free)						
7. Under crop cultivation (2020/21)						
8. Under woodlot (2020/21)						
9. Total land under other uses (fallow, pasture, etc. (2020/21)						

D PRODUCTION ENHANCERS

Assess enhancer to the project success

D (1) General access to inputs

NB: Average cost (e) is to be given in one currency, please indicate here which currency used How would you rate your access to the following inputs?

Type of inputs	(a) Do you use the following inputs 1=Yes, 0=N0 (-> f)	(b)Common source [1]	(c) Distance from house to regular source (km)	(d) Time taken in hours to get to regular source	(e)Perception of cost[2]	(f)Other constraints to access [3]
1. Fertilizer (NPK, Urea, DAP, SSP, Others)						
2. Herbicide						
3. Fungicide						
4. Pesticides						
5. Animal Manure						
6. Certified seed						
7. Seed dressing chemical						
8. Post-harvest insect control						
9. Organic Manure						
10. Conservation Agriculture						
11. Other methods (specify)						

[1] **common source of inputs:** *1 = purchased from market; 2=purchased from stockists;3=purchased from other farmers; =received from government; 5=received from NGOs; 99=Other (specify)*

[2] ***Perception of cost:*** *1= very affordable, 2=Affordable 3=Not affordable*

[3] ***Other constraints to access:*** *1 = Too for household, 2=Unsuitable packaging (large) 3=Not knowledge of how to use 4=No transport 5=Not enough money 99=Others (specify)*

D(2) . ACCESS TO SERVICES, INFORMATION, EXTENSION, AND TRAINING

Do you have access to the following services?

Services	(a) Is the service available? 1=Yes 0=No	(b) Have you used this service in the last 12 months? 1 = Yes; 0 = No	(c)How do you rate its effectiveness	d) How do you rate the efficiency of the service	e)Distance to service
1. Credit					
2. Extension services					
3. Access to communication (radios)					

4.Mobile applications eg. Agric share, Eco farmer, kurima mari					
5. Farming as a					
business information					
6. Weather			+		
7. Banking					
8. Loan					
9.Savings club					

Rate its effectiveness: RANK FROM 1(most effective) TO 7 (least effective

D (3) Use of Post-Harvest Technologies

Technology	(a) Do you know it? Yes=1 No=0	(b) Have you ever used it? Yes=1 No=0	(c) Most important source of information of technology?[1]	(d) When did you first use it? (Year)	(e) Did you ask for information on it? 1=Yes, 0=No	(f) Did you use this technology during the 2020/21/ season? 1=Yes 0=No	(g) On what crop did you use the technology?
1. Drying							
2. Threshing/shelling equipment							
3. Improved storage facilities(special granaries							
4. Post control							
5. Grading							
6. Hermatic bags							
7.							
8.							

[1] **Code for source of information on technologies:** *1=Government Extension workers, 3=Farmer Group members, 4=NGO 5=other farmers, 6=Radio, 7=Demonstration/research sites, 99=other (specify)*

D4. MARKETING OF AGRICULTURAL PRODUCE

NB1: Ask question (a) for all crops before going on to questions b-p

NB2: If one product is sold in more than one form, enter each form on a separate row

NB3: price (e & m) is to be given in one currency, please indicate here which currency you used

NB4: please convert units used (for example bag, ox cart, pile, bunch, bucket etc.) to kg, and insert this in question (b) and H (1) Marketing strategies and linkage with agricultural traders

	Market 1 (main market)						
Crop	(a) Did you sell? 1=Yes 0=No	(b) If yes, quantity sold (kg)	(c) Type of market	(d) How far is the market?	(e) Price per unit in market	(f) In what form did you sell?[2]	(g) How did you sell?3
1. Priority cereal crops							
2. Priority legume crops							

E. AGRICULTURAL ENTERPISE PRODUCTION AND MANAGEMENT

Questions in this section will be used to provide baseline information for the following indicators

The time spent by targeted households to plant and process traditional grains and legumes has reduced by 45 % and 50 % respectively

At least 25% of the targeted households' youths actively engage in the planting and processing of traditional grains

On average, the area under cultivation for traditional grains and legumes has doubled among the targeted HH.

E1 Crop Production in specific fields

Introduction. Details of land parcels and plots for crops. Ask the farmer to draw a map of their land (including any away from homestead Land) on the ground and transfer this to blank side of questionnaire. A parcel is a contiguous piece of land owned or operated by the farmer. Number all parcels and plots and use the same numbering throughout this section. For example, if you assigned a parcel as #1, please assign the same number when completing the other sections. Please ask the following questions for each plot. Refer to the last two seasons of crop activity. In areas with unimodal rainfall, there is only one cropping. In such cases, report data for only one season.

NB1: 1 ha=2.479acres, 1 acre =0.405 hectares 1ha = 10000m^2, 1 m^2=0.0001hectares, 1 acre=405m^2

NB2: Please indicate here whether you use acres (=1), hectares (=2) or m^2 (=3) used

NB3: 1 Km = 0.625 Miles and 1 Mile = 1.6 km's

[1] **Soil type** 1=Sandy 2=Clay 3=Sandy Loam 4=Clay Loam

[2] **Soil fertility status** 1=very poor 2=poor 3=not poor nor rich 4=rich 5=very rich

[3]Tenure: 1=customary; 2=leasehold/rent; 3=freehold, 99=other, specify:

E(2) Crop production for the last season

NB1: Value (9 & 13) is to be given in one main currency, please indicate here which currency used NB2: Please convert quantity used (for example bag, ox cart, pile, bunch, bucket etc) to international units, and insert this under the unit questions

Row	Parcel name	Parcel ID #	Plot #	(i). Plot area	(ii). Distance from home (Kms)	(iii). Soil type [1]	(iv fert
1							
2							
3							
4							
5							
6							
7							

		Seed / Planting material	**Production/output**

Row	Parcel ID#	Plot ID #	(i) Crop-ping system [1]	(ii)Do you used Conservation Farming (b)	(iii) Main crops grown on plot (in writing)	(iv)Who makes the decision on the crops to be grown	(v) Used improved variety Yes=1 No=0	(vi) Source of seed/ planting material [2]	(vii) Quantity (in kgs)	(viii) Quantity in kgs
1										
2										
3										
4										
5										
6										
7										

[1] **Cropping system**: 1 = Pure stand (mono cropping); 2 = Intercropping (two crops); 3 = Mixed cropping (more than two crops); 99 = other (specify)

[2] **Source of seed/planting material:** 1=Bought; 2 = saved from own harvest; 3 = Given by NGO/FBO; 4 = Given by Government; 5 = Given by farmer organization/CBO 6 = Given by trader 7 = Given by a friend/relative; 8= community seed banks99 = Other

*** Crop codes** should be written down in words, and will be post-coded during the data entry

1= Pear millet (Mhunga; 2 = Finger Millet (Zviyo/Rukweza); 3 = Sorghum (Mapfunde); 4 = ground nuts; 5 = cow peas B; 6 =other main legume (specify) 7= sesame 8=Sunflower

E3 Land preparation

NB1: Total costs is to be given in one main currency, please indicate here which currency used

			Land preparation			**Weeding**			**Labour input for activities other than land preparation & weeding**	
Row	Parcel ID#	Plot ID #	(i). Land preparation method [1]	(ii). Total family labour for land	(iii). Total hired labour for land	(iv). Number of weedings	(v). Total family labour for	(vi). Total hired labour for weeding(days)	(vii). Total family labour	(viii) . Total hired labour for

				preparation	preparation (days)		weeding		for other activities	other activities
				(days)			(days)		(days)	(days)
				M F	M F		M F	M F Y	M F	M F
1										
2										
3										
4										
5										
6										
7										
8										

[1] **Land preparation method:** 1=hand hoe; 2=oxen; 3=tractor/mechanized; 4=chemical; 5 = Tractor and Oxen; 6 = Slash and burn;

99=other (Specify) **E4 Crop management**

E5 Harvesting and processing

	Harvesting				**Threshing**			**Processing**		Post harvest	
Row	Plot	Method of harvesting used	(i). Total family labour for harvesting (days)	(ii) Total hired labour for harvesting (days)	(iii). Total family labour for threshing (days)	(iv). Total hired labour for threshing (days)	(v) Methods of processing used	(vi). Total family labour for processing (days)	(vii). Total hired labour for processing (days)	(viii) Total family labour for post harvest~(days)	(ix) Total hired labour for post harvesting (days)

			M F	M F	M F	M F		M F	M F	M F	M F
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											

Methods of harvest 1=kudzura nzungu 2=ox plough

	Application of fertiliser			**Application of pesticides**	
Row	Plot	(i). Total family labour for applying fertilisers (days)	(ii). Total hired labour for applying fertilisers (days)	(iii). Total family labour for applying pesticides (days)	(iv). Total hired labour for applying pesticides (days)
		M F Y	M F Y	M F Y	M F Y
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

3=cutting

F HOUSEHOLD INCOME

Out of the targeted youth and women farmers, at least 25% confirm that they earn income from selling surplus traditional grain cereals and legumes.

NB: amount (d) is to given in one currency, please indicate here which currency you used

1. What are your priority sources of income and what is the income estimate from these sources for the last 12 months? Which household members are engaged in these business or wage labour activities? *(Ask for each source one at a time and if the household does not get income from that source, move to the next)*

Income source	(a) Do you get income from this source 1=Yes 0=No	(b) From whom within the household?	(c) How regularly do you get income from this source [1]	(d) What is the estimated amount that you have got from this source in the last 12 months (currency)	(e) What importance would you give this source of income in terms of contributing to total household income[2]
1. Sale of Pearl millet		Head			
		Spouse			
		Youth			
2. Sale of finger millet		Head			
		Spouse			
		Youth			
3. Sale of sorghum		Head			
		Spouse			
		Youth			
4. Sale of legumes ground nuts		Head			
		Spouse			
		Youth			
5. Sale of legumes cow peas		Head			
		Spouse			
		Youth			
6. Sale of legumes C		Head			
		Spouse			
		Youth			
7. Sale of livestock		Head			
		Spouse			
		Youth			
8. Sale of other products e.g firewood, trees		Head			
		Spouse			
		Youth			
9. Regular employment		Head			
		Spouse			
		Youth			
10. Casual employment		Head			
		Spouse			

(agricultural related)		Youth			
11. Casual employment (non-agricultural related)		Head			
		Spouse			
		Youth			
12. Running own business		Head			
		Spouse			
		Youth			
13. Remittances from family members		Head			
		Spouse			
		Youth			
14. Remittances from non-family members		Head			
		Spouse			
		Youth			

[1] **Regularity of income source** *1= Do not get, 2=occasionally, 3= Regularly 4 = All the time*
[2] **Importance of source:** *1= Not important, 2= Moderate importance 3 = High Importance 4 = Very High Importance*

F (2). Household Food Security

1. The level of gritty of the processed traditional grains is reduced by half when using smallmechanised equipment as compared to traditional practices

2. The number of targeted households consuming traditional grains and legumes has increased by 20% by the end of the project period.

1 Number of Months that harvest lasted
In the 2020/21 season, how long did your harvest of the most important cereal and legume crops last?

(a) Crop	(b) How long did the harvest last? (no. of months out of 12)	(c) How long do you think your harvest will last this time? (no. of months)	(d) How often does this household consume?	(e) Level of gritty in the food	(f)Perception on colour	(g)Perception of taste of the food	(h)Knowledge of preparing the food from
1. Pearl Millet							
2. Finger millet							
3. Sorghum							
4. Legume A							
5. Legume B							

6. Legume C							

Codes for (c) 1 = daily; 2; 3 times a week; 3= Once a week; 4 = Once a month; 5 = never

Codes for d: 1 = no gritty; 2 = acceptable; 3 = occasionally; 4= unacceptable 5 = very unacceptable

Codes for e 1= very acceptable 2 = acceptable; 3= unacceptable 4 = very unacceptable

Codes for f: 1= very acceptable 2 = acceptable; 3= unacceptable 4 = very unacceptable Codes for g:1 = very good 2 = good 3 neither good or bad 4 = bad 5 = very bad

G MEMBERSHIP IN PRODUCERS ASSOCIATION

At least half of the 10 Traditional Grain Farmer Associations are actively engaging with the government and local authorities on policy making processes

Smallholder farmers have contributed to the development of at least 2 specific cases of new legislation or policy regarding traditional grains and appropriate mechanization

Are you or any member of the household a member of Traditional Grain Farmer Associations?

If yes! What is the core business of the Association; Do not prompt

Helps to negotiate with local authorities	
Helps to negotiate with government departments	
Pricing pre-planting pricing, post harvesting	
Farmers rights of production, rights to save, use and exchange seed	
Intergrated seed system- recognising the improvement of farmer seed systems	
Policy to adoption eg of mechanisation	