

DEPARTMENT OF ENVIRONMENTAL AND GEOGRAPHICAL SCIENCE
UNIVERSITY OF CAPE TOWN

**ANALYSING THE RELATIONSHIP BETWEEN
SEED SECURITY AND FOOD SECURITY: THE
CASE OF CHIMANIMANI DISTRICT,
ZIMBABWE**

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DECLARATION

I, Bulisani Lloyd Ncube, declare that:

**Analysing the relationship between seed security and food security: The case of
Chimanimani District, Zimbabwe**

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Abstract

Many smallholder farmers in southern Africa rely on crop production as their main livelihood source. However, they often suffer from a lack of appropriate seed as well as high levels of food insecurity. Interventions such as community seed production, seed aid, and input subsidies are used to address these concerns. However, the relationship between seed security and food security has been understudied. This study thus aimed to explore the factors that have an impact on the relationship between seed security and food security. This was done to enhance understanding about the conceptual linkages between the dimensions of seed security, which include availability, access, and utilisation, and those of household-level food security, which include dietary diversity and food consumption. The case study was conducted across two sites in Chimanimani district of Zimbabwe. Methods included both quantitative and qualitative research methodologies. Quantitative data were subjected to statistical analyses while qualitative data were analysed for themes and trends. Results showed the dominant role of informal seed systems in ensuring improved access to affordable and timely seed to smallholder farmers. Informal seed sources were more reliable than formal sources in ensuring that seed was available on time and in closer proximity to households. Seeds sourced informally also showed comparable quality to that from formal sources. The relationship between seed security and food security was shown to be complex and contextual rather than direct or one-directional. Seed security does not necessarily equate to food security, nor does seed insecurity necessarily lead to food insecurity. Although timeliness and proximity of seed affect its availability, these did not directly relate to access to food. Similarly, household assets and income correlated with better food security status, but did not always ensure access to seed. This is because farmers' seed sources were predicated on non-financial factors such as social relations. The quality of farmers' seed was essential in ensuring that adequate food was produced. The thesis argues that the combined factors of seed availability, access and utilisation are essential in ensuring better crop productivity and improved food access. Findings underscore the manner in which household determinants such as assets, farming practices and geographical characteristics, as well as broader contextual factors, affect and influence the relationship between seed and food security. These results imply that interventions such as community seed production, seed aid, and input subsidies do not automatically result in improved seed security and therefore food security. Efforts to enhance seed and food security should be informed by specific household characteristics that take account of wider contextual factors such as climate, as well as socio-economic and political processes that have a historical influence as well as a continuously evolving effect on farmers' seed and food security.

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List of Acronyms

AGRITEX	Department of Agricultural Technical and Extension Services
CELUCT	Chikukwa Ecological Land Use Community Trust
FAO	Food and Agriculture Organization of the United Nations
FCS	Food Consumption Score
FFA	Food For Assets
FIES	Food Insecurity Experience Scale
FSSCS	Food Security Self Classification Scale
HDDS	Household Dietary Diversity Score
NGO	Non-Governmental Organisation
PORET	Participatory Organic Research Extension and Training
SDC	Swiss Agency for Development Cooperation
SKI	Seed and Knowledge Initiative
SSA	Seed Security Assessment
TSURO	Towards Sustainable Use of Resources Organisation
UCT	University of Cape Town
USD	United States Dollars
ZANU PF	Zimbabwe African National Union Patriotic Front
ZAR	South African Rands

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CHAPTER ONE: INTRODUCTION

1.1. INTRODUCTION AND RATIONALE FOR THE STUDY

More than 820 million people in the world continue to face hunger, while two billion people, concentrated mostly in the Global South, experience moderate or severe food insecurity (FAO et al., 2019). This lack of regular access to nutritious and sufficient food puts them at great risk of malnutrition and poor health. Smallholder farmers in Southern Africa rely on agriculture as both their main source of food and livelihood (Gollin, 2014). Studies have noted that, although agricultural production has increased globally over the years, the number of hungry people that cannot access adequate, high quality food continues to increase (Greenpeace International, 2009; Ingram, 2011; Grobler, 2014). In Sub-Saharan Africa, although production on smallholder farms is critical to the food security of the rural poor, national policies and local interventions are not designed to take advantage of opportunities and address constraints that affect smallholders (Frelat et al., 2016).

Food security is defined as the physical, social and economic ability to access sufficient, safe and nutritious food that meets dietary needs and food preferences for an active and healthy life (CFS, 2012; Jones et al., 2013). The four pillars of food security derived from this definition are: availability of food, stability of the food supply, access to adequate food and utilisation of food (FAO 2008; Capone et al., 2014).

Some critics argue that one of the causes of household food insecurity is seed insecurity, resulting from the limited availability, and accessibility to farmers, of adequate-quality seed for their cropping needs (FAO, 1999; Sperling and McGuire, 2012). Household seed security is defined as having sufficient access to adequate quantities of good-quality seed and planting materials of preferred crop varieties at all times, regardless of the cropping seasons (FAO, 2015a). The pillars of household seed security according to the Food and Agriculture Organization (FAO) include availability, access, varietal suitability, seed quality, and resilience of the seed system (Remington et al., 2002; FAO, 2015a).

Research has shown that seed can be an important entry point for promoting productivity, nutrition and resilience among smallholder farmers (Briema et al., 2013; Abebe and Alemu, 2017). Many agricultural projects address seed insecurity through increased supply of certified seed of improved crop varieties (Sperling and McGuire, 2010a; AGRA, 2014). Seed interventions, such as community seed production, emergency seed aid, and crop input subsidies are the major agricultural responses used in the Global South to address seed insecurity and the high prevalence of food insecurity (Remington et al., 2002; Bengtsson, 2007).

Although proponents of improved varieties suggest that they contribute to attaining higher and more stable yields and higher crop incomes (Evans, 1980; Traore et al., 2017; Takam-Fongang et al., 2019), more critical researchers suggest that these varieties make a limited contribution to crop diversity, are not well distributed and the inputs needed to produce them can be expensive for poorer farmers located in remote areas (Sperling and McGuire, 2010a; Scoones and Thompson, 2011; ACB, 2014;). There is a diversity of smallholder farmers in Southern Africa and they use a broad set of seed systems that includes formal seed systems, informal seed systems, or a combination of both. A formal seed system is one that is regulated by national governments and provides new and improved varieties of certified seed from commercial sources (Sperling et al., 2013a). An informal seed system, on the other hand, is not formally regulated by state laws, and operates at individual and community level, providing the bulk of seed for smallholder farmers (Almekinders and Louwaars, 2002; Louwaars and de Boef, 2012). Participation in various seed systems is also not static, but is influenced by national policies, smallholders' personal circumstances, preferences, and their interaction with different development actors.

It is noted that there are other broader causes of food insecurity, such as plant pests and diseases, climate change, natural disasters, social factors, and economic and political instability (Israel and Briones, 2012; Wheeler and von Braun, 2013; Deaton and Lipka, 2015; FAO et al., 2019; Popp et al., 2019). Many scholars have thus advocated the use of a “socio-ecological niche framework” for understanding the various dimensions of interaction that link the natural ecosystem and the social systems of smallholder farmers (Ojiem et al., 2006; Lescourret et al., 2015; Nkurunziza et al., 2020). The socio-ecological niche is created by the convergence of agro-ecological, socio-cultural, economic and ecological factors, to describe a multi-dimensional environment in which

aspects of seed systems and access to food can be analysed (Ojiem et al., 2006). This can be used to understand the context of smallholder farmers and how this affects their farming systems, seed systems and access to food. What has not received comprehensive empirical enquiry, however, is the relationship between seed security and food security (McGuire and Sperling, 2011; Mucioki et al., 2018), a contribution that this study seeks to make.

The importance of understanding smallholders' seed systems and how they affect the seed and food security of farming households cannot be over-emphasised. Almekinders et al. (2019) argue that most seed studies are superficial as they do not pay attention to contextual factors and the enabling environment. Sperling (2008) contends that, despite key differences between seed security and food security, determinations of seed security have almost always been based on food security assessments. This results in evaluators assessing food needs, and then extrapolating seed requirements as part of the aid package. It is assumed that food insecure households are also seed insecure, resulting in provision of seed as a way of addressing food insecurity for agriculture-based households. This assumed linkage underpins a great deal of emergency assistance provision. It is critical to understand the differences and the link between seed security and food security as this has implications for policy interventions prescribed to address both. It is necessary for national policies to provide and support a conducive environment to enable improved availability, access to quality seed and planting materials that meet farmers' requirements and contribute to their improved access to food. The relationship between seed security and food security has received less investigation by researchers. Seed studies have typically assessed the seed-security status of farming households without explicit links to food security (CIAT et al., 2009; McGuire and Sperling, 2016; Mazvimavi et al., 2017).

Thus, the purpose of this study is to enhance understanding about the conceptual relationships between the dimensions of seed security, which include availability, access and utilisation (Sperling 2008; FAO 2015a, b) and those of household-level food security, which include dietary diversity and food consumption (Weingärtner, 2004; Sibhatu et al., 2015). Some level of seed insecurity and food insecurity has been noted amongst smallholders in parts of Africa (McGuire 2007; Mucioki et al., 2018) and particularly in rural Zimbabwe (CIAT et al., 2009; Mazvimavi et al., 2017; ZIMVAC, 2018; ZIMVAC, 2019). Farmers' agricultural practices, a limited asset base

(especially limited land and lack of access to income) and climate variability aggravate this situation further. It is critical to explore the implications of how the seed systems adopted by smallholder farmers have an effect on their seed and food security outcomes. These dimensions have been explored in this study through an assessment of farmers' production levels, seed systems, and the food security status of smallholder farmers in the Chaseyama and Chikukwa Wards of Chimanimani District in Zimbabwe. Attention has been given also to historical influences on farmers' seed systems, and the contextual factors that have had an impact on both seed and food security.

Figure 1.1 shows a comparison of the proportion of food insecure populations in the Southern African Region, Zimbabwe, Manicaland Province, and Chimanimani District (both of the latter two are located in Zimbabwe) during the years 2011-2012 to 2018-2019. This illustrates that the proportion of food insecure population in Zimbabwe was higher than the proportions in the region, except during the 2014-2015 and 2016-2017 seasons. The trend shows that Zimbabwe has been more food insecure generally compared with other countries in the region. Such high rates of food insecurity have been explained by low food production, and challenges of socio-economic and political instability. Manicaland province and Chimanimani District also had large numbers of food insecure people, similar to the rest of Zimbabwe, though proportionately less except during the 2016-2017 season. The overall trend shows an increasing proportion of food insecurity in the region, while the proportions of food insecure households in Zimbabwe were even higher and very variable over the years.

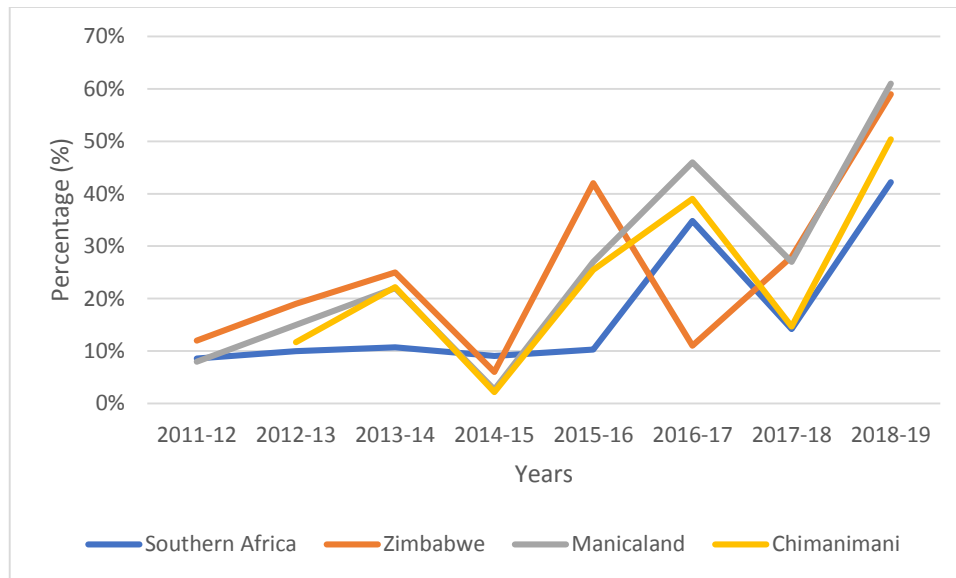


Figure 1.1: Proportions of populations that are food insecure

Source: Developed using data from SADC (2019); ZIMVAC (2012-2019) reports; Southern Africa, excluding Madagascar, Mauritius and Seychelles; Chimanimani (data for 2011-2012 missing).

Although there could be many causes of regional and national food insecurity, limited access to high-quality seed at household level have been thought to be a central reason (FAO 1999; Sperling and McGuire 2012;). Thus, many agricultural projects have been implemented to address seed and food insecurity through seed interventions, such as input subsidies and relief, seed production, seed fairs and exchanges (Remington et al., 2002; Sperling and McGuire 2010a; AGRA 2014). For example, the target of the AGRA Project was to achieve a 45 % increase in the use of improved seed, fertilisers, and other production technologies that would lead to increasing grain production by 4.5 million tons and contribute to boosting food security for 7.6 million people (AGRA, 2014: 7). Interventions in the seed sector have been regarded as vehicles for promoting increased agricultural productivity, access to income, food, nutrition, and climate resilience (McGuire and Sperling 2016). Thus, actually, seed initiatives are not an end in themselves, but supposedly a means to multiple ends (food security, income and social ties). It is necessary to clarify how seed initiatives contribute to the seed security and, ultimately, the food security of farming households.

Literature reveals that the relationship between diversity of farm production (linked to farmers' seed systems) and diversity in consumption (a measure of food security) has been under-researched

(Keding et al., 2012; Gomez et al., 2013; Pinstруп-Andersen, 2013; Sibhatu et al., 2015). Sibhatu et al. (2015) contended that, although the diversity of agricultural production systems is increasingly recognised as a potential means to provide diversified food sustainably for rural communities, empirical evidence connecting diversity of farm production (a proxy measure of seed access) and diversity of farm-households' diets (a proxy measure of food access) has been scarce. Sibhatu et al. (2015) concluded that a universal link between diversity of farm production and dietary diversity does not exist. Snapp and Fisher (2015) argued further that there were few studies that have tested the impact of crop varieties on smallholder farm production and household diets. The aim of this research was to address the gap in knowledge about the relationship between access to seed and attaining access to food. Seed security affects food security in complex ways, which remain poorly understood (McGuire and Sperling 2011: 495).

The study of Chimanimani provides a relevant framework specifically for the analysis of smallholder seed systems in the context of a low-income country, characterised by economic melt-down, high food insecurity, persistent drought and political uncertainty. The majority government in 1980 inherited a highly skewed pattern of land distribution characterised by a dual agricultural system of a few white commercial farmers owning the majority of the productive land (78%) and the majority of black smallholder farmers owning 22% of the land (Adams et al., 1999; Walker 2002). After 2000, the fast-track land reform programme changed the distribution of land by forceful transfer of legal title of large tracts of land to commercial and smallholder black farmers (Moyo, 2011). This process, together with frequent droughts, and political and economic instability resulted in recurrent food insecurity at national and household level. What is not clear is how this food insecurity was related to, or caused by, household seed insecurity.

1.2. AIM AND OBJECTIVES

The aim of this study was to investigate how the dimensions of seed security (availability, access and quality) affect household food security (dietary diversity and food consumption) among smallholder households in the Chimanimani District of Zimbabwe. In addition, the aim was to explore the factors that have an impact on the relationship between seed security and food security, an aspect that has received little investigation. Understanding these factors and their relationship

with seed and food security is vital in determining policy interventions, as well as the implications of smallholders' seed security strategies for improved food security. The hypothesis was that seed systems, the contexts in which they are located, and the household characteristics of seed-secure farmers have an effect on their food security. The specific objectives were to:

- Examine the seed-security situation of smallholder farmers in Chaseyama and Chikukwa;
- Characterise the household food-security status of Chaseyama and Chikukwa households;
- Explore the relationship between household-level seed security and household-level food security;
- Contribute towards a conceptual framework that relates seed security to food security; and
- Determine policy implications of smallholders' seed strategies for improved food security in the Zimbabwean context and beyond.

1.3. THEORETICAL DEBATES

The concepts of seed security (Alemu 2011a; McGuire and Sperling 2013; Munyaka et al., 2015) and food security (Capone et al., 2014; Okello et al., 2017; Kissoly et al., 2018) which underpin this study, have received much scholarly attention. What has received less attention is the relationship between seed security and food security.

Several different approaches have been used in seed assessments, such as the seed value chains framework (Jordaan et al., 2014; Mango et al., 2018) and seed security assessments (FAO, 2016a; McGuire and Sperling, 2016) to understand the constraints faced by smallholder farmers in meeting their seed requirements. The seed value chains framework consists of a system of interdependent activities whereby seed is developed and moved through the value chain to multiplication and production to the time it is used by farming communities (Jordaan et al., 2014; Mango et al., 2018). This approach was designed to analyse the commercial seed system, and thus fails to address the diverse networks in the informal seed system. Also, the approach does not always guarantee increased access and adoption of improved seed by smallholder farmers (Spielman and Smale 2017; Almekinders et al., 2019; Lunduka et al., 2019). Seed security assessments have been used to define and understand the seed systems that smallholder farmers

use and also to determine their seed-security situation (FAO, 2016a; McGuire and Sperling, 2016). However, the assessments were not designed to understand the relationship between seed security and food security.

The approach that came closest to linking seed security and food security was that of McGuire and Sperling (2011), who developed this framework in the context of acute (transitory) and short-term shocks that have affected seed and food security. The present study will contribute new knowledge based on an investigation of the relationship between seed security and food security in the context of chronic stress, such as economic and political crises, repeated drought and non-functional institutions. It will thus capture what Almekinders et al (2019) refer to as the “missing elements” of farmer research studies that include the contextual nature of farmers’ situations, considering entire farming systems, and reflecting livelihood situations. The inclusion of historical profiles of farming communities will also ensure that the understanding of seed and food security of households is broader than a snapshot, aiming to capture better the variable, real-life context of smallholder farmers (Almekinders et al., 2019).

The theoretical contribution of this thesis was built on the food and seed security concept of McGuire and Sperling (2011), while interrogating how the dimensions of seed security impact on household food security. This relationship has been linked further to the enabling and constraining factors and determinants, which include assets, farming practices and geographical characteristics, and the broader context such as weather, climate and social, economic and political factors.

1.4. RESEARCH METHODS

This study is based on empirical research carried out in the Chimanimani District in Zimbabwe, supplemented by secondary data. To understand fully the complex relationship between seed security and food security, a combination of qualitative (using intensive approaches) and quantitative methods (using extensive approaches) was used. An intensive research approach focuses on a relatively small number of instances of the phenomena studied to understand it in-depth (Swanborn, 2010). Each instance is studied in detail in its own specific context and on its own merit. In order to understand farmers’ seed systems, it was essential to understand how the

seed systems of smallholder farmers have evolved through time, including the institutions, relationships and knowledge, spanning processes across informal and formal systems. This required intensive research approaches, including in-depth life histories of selected farmers; focus-group discussions with farmer groups; use of participatory research approaches such as historical trend analyses, seed diversity wheels; and pairwise ranking and key participant interviews.

On the other hand, an extensive research approach involves collecting information about the relevant properties of a large number of instances of a phenomenon. Each survey respondent provides information based on a standardised set of questions aggregated over all the respondents to create information about relationships between the variables examined, to enable understanding and explanation of the phenomenon (Swanborn, 2010). For this study, a modified, household, seed-security assessment survey of a representative number of households in Chimanimani was used (Sperling, 2008; FAO, 2015b). This tool was modified to capture additional food-security indicators, including a household dietary diversity score, food consumption score and the household food-insecurity experience scale (Swindale and Bilinsky 2005; FAO, 2011; FAO, 2016b).

1.5. STUDY SITE

The study site was selected purposively, based on key characteristics that were useful in achieving the research objectives. Zimbabwe has had continuing episodes of food insecurity both at national and household levels, especially in the drier regions. The country has a long history of diverse seed interventions, such as government subsidies, formal seed markets, farmer-led seed systems and NGO-supported interventions. Altogether, accounts of these interventions provided a rich history of farmer interactions with diverse seed systems. The two areas of Chaseyama and Chikukwa, located in Chimanimani District, were selected because of their different bio-physical characteristics and agricultural potential. Useful secondary data (both published and unpublished) were provided also from government records and organisations based in the research sites.

1.5.1. Chimanimani District

This study was conducted in Chimanimani District, which was the smallest of the 10 districts of Manicaland Province, located in the eastern highlands of Zimbabwe (see Figure 1.2). The district is bordered by Mozambique in the east, Mutare District in the north, Buhera District in the west and Chipinge District in the south. Chimanimani has a population of 134 490, of which 94.9% was rural (Zimstats, 2012a). The entire district consists of 23 wards, covering an area of 354 805 ha (3548 square kilometers) and comprises all five, agro-ecological zones (see Table 4.1) of Zimbabwe (Mate, 2001; Oxfam-UNDP/GEF, 2015; Chimanimani, RDC 2017a). The expectation was that research conducted in this district could be applied to other districts in the country. One reason for selecting Chimanimani as a study area was that the district provides a good case study of two contrasting agro-ecological regions of Zimbabwe. Moreover, the researcher was knowledgeable of the key stakeholders in the area, which made it easy to build rapport for the research process.

1.5.2. Chaseyama Community

Chaseyama, a rural communal area, named after a distinctive hill (Campbell et al., 1995), is located on the western side of Chimanimani, and is accessible easily from the Mutare-Masvingo highway. The Chaseyama community live in Ward 3, comprising seven villages: Namire, Mubururu, Zvokuitirwa, Jinga, Nechitima, Musweweshiri, and Mutidzawanda. This western side of Chimanimani had the lowest and most erratic rainfall in the district. The area is hot and dry with periodic, seasonal droughts and has predominantly shallow, sandy soils, derived from granite, that are inherently infertile. The area is deemed to be relatively unsuitable for dry-land crop production (Campbell et al., 1995; Oxfam-UNDP/GEF, 2015). The vegetation of the area is mainly *Colophospermum* mopane woodland, classified as arid-eutrophic savanna, characteristic of semi-arid locations in Zimbabwe (Campbell et al., 1995).

This area of Chimanimani is classified as semi-arid, Agro-ecological Natural Region IV, characterised by low rainfall of 300 - 450 mm per annum; mean minimum temperature range of 11- 20 °C; mean maximum temperature range of 19-26°C; and a mean annual temperature of 18 - 24°C. Chaseyama is an extensive livestock producing area with some drought-tolerant crops

such as sorghum, pearl millet and finger millet. Farmers also grow some short-season maize varieties (Mugandani et al., 2012; Mashapa et al., 2013).

The IPCC (2020) report and Frischen et al., (2020) note that global warming has resulted in a higher frequency and severity of droughts in several parts of the world, including much of Africa. The history of Chaseyama has been characterised by several episodes of drought that affected cropping negatively. Droughts have been a frequent occurrence in the area, both historically and at present. From the 1980s onwards, there had been more drought years than wet. The highest frequency of drought was in the 1990s, when most of the years were drought (Oxfam-UNDP/GEF, 2015). Historically, Chaseyama has been affected not only by droughts, but also by wars and migration that have compromised the community's seed provision and access to food.

1.5.3. Chikukwa Community

Chikukwa is a rural communal area located in a mountainous, cool and remote area on the eastern side of Chimanimani District, and situated 170 km from the nearest city, Mutare (CELUCT, 2013). Chikukwa is a beautiful, lush and mountainous area that is home to approximately 1052 households encompassing eight villages: Chitekete, Rujeko, Munaka, Kubatana, Mabasa, Kwaedza, Juntia and Hanganani in Wards 10 and 11.

Chikukwa is in Agro-ecological Natural Region I, characterised by high rainfall of 1,000 mm per annum with mean minimum temperatures of 10 - 12 °C; mean maximum temperature of 19 - 23°C; and mean annual temperatures of 15 - 18 °C. The area has stable, deeply weathered, red-clay soils that are highly suitable for diversified cropping and high-value crops such as coffee, tea and potatoes (Mugandani, et al., 2012; Oxfam-UNDP/GEF, 2015).

Drought is not as frequent a phenomenon in Chikukwa compared with Chaseyama and is a more recent and isolated event with occurrences in 1992 and 2008. More recently, Chikukwa was affected by Cyclone IDAI that resulted in high rainfall and flooding that caused damage to crops, livestock and infrastructure particularly, including roads, bridges, water installations, power and communication and many homes, schools and community structures (OCHA, 2019).

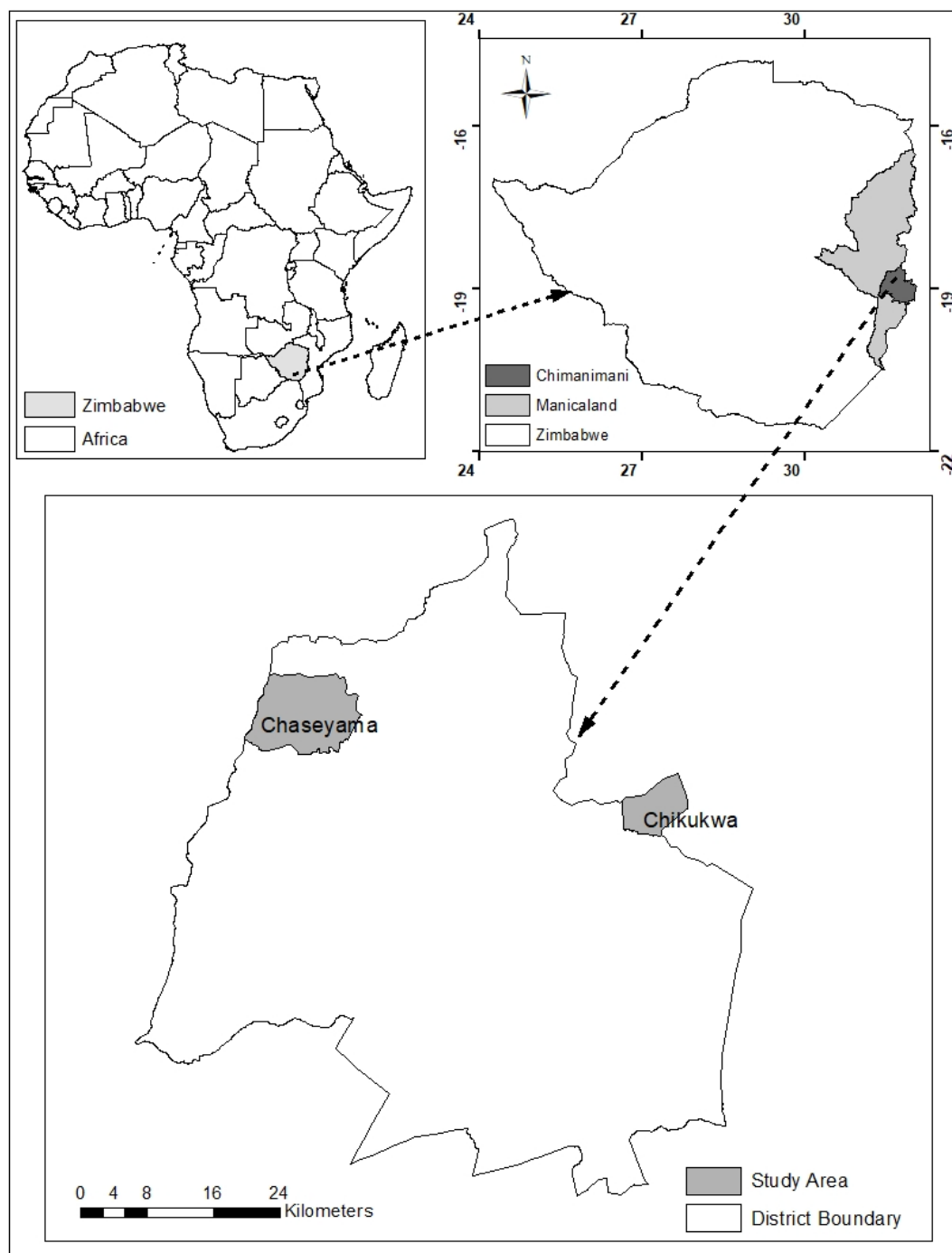


Figure 1.2: Location of Chimanimani District in Zimbabwe where Chaseyama and Chikukwa are situated

1.6 STRUCTURE OF THE DISSERTATION

This chapter described the study context, as well as the rationale for the relevance of the study. The broader aim and specific objectives of this study were explained, and the case-study sites were introduced. The theoretical contribution of the study was also explained.

The next chapter consists of the literature review and an explanation of the conceptual framework for linking seed security to food security. The key concepts and theoretical ideas relevant to seed security and food security are discussed. Other key elements of the chapter include literature on the Zimbabwean seed system as well as the factors and determinants of food security.

Chapter three provides a description of the research approach and methodology adopted for this study. A description of the mixed methods is provided, and the data analysis and triangulation conducted for this study are explained. The philosophical considerations supporting the choice of research methods used are presented. The chapter ends with a presentation of ethical and protocol issues followed during the research process.

Chapter four presents the socio-economic and demographic profile of Chimanimani District with a focus on the two areas selected for the research, Chaseyama and Chikukwa. The emphasis of this chapter is on a descriptive analysis of household demographic characteristics, the means of livelihood and the community-based organisations supporting farmers in the area. The presentation provides an understanding of the wider socio-economic and livelihood contexts within which smallholder farming in Chimanimani is practiced and how it contributes to seed security and food security.

Chapter five includes a description of the seed systems used by Chimanimani smallholder farmers over three seasons. The historical trajectory of seed systems is elaborated.

Chapter six analyses households in Chimanimani quantified and classified according to their seed security situation. Household seed security is examined using the framework of seed availability,

seed access and seed utilisation. In addition, the determinants of household-level seed security of Chimanimani households are examined.

Chapter seven contains an analysis of the food-consumption and food-security status of Chaseyama and Chikukwa farming households. The analysis begins with the national context of the food-security situation in Zimbabwe and then delves deeper into how food security is manifested throughout the study sites. Food consumption and food insecurity experience-based indicators are used to reflect the multi-dimensional nature of food security. The chapter concludes with an elaboration of the determinants of the food security of Chimanimani households.

Based on the findings of Chapters six and seven, Chapter eight is an examination the relationship between seed security and food security and the influence of underlying characteristics of Chimanimani households. The seed- and food-security indicators are cross-tabulated and subjected to statistical tests to determine significant relationships. Evidence of the key enablers and constrainers of seed security and food security are drawn from the household life histories.

Chapter nine is a discussion of the research findings in the context of the literature and theory discussed in Chapter two, drawing inferences and insights about factors that shape the current relationship between seed security and food security. This is done by outlining some of the key themes that emerged from this study and relating them to debates in the literature. The links between seed-security and food-security debates are explored in-depth.

Chapter ten concludes the dissertation with a summary of the findings, in relation to the study aims and objectives, and a proposal of policy recommendations.

CHAPTER TWO: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1. INTRODUCTION

This chapter reviews the literature on seed security and food security. An appraisal of the concepts of seed and food security follows in the section below. In the last part of the chapter, the conceptual framework is presented that informed this study, which comprises the contribution of seed security to food security and the relationship between them. The findings of the literature review were used to guide the research approach, methodology and conceptualisation of seed security and food security.

2.2. ELEMENTS OF SEED SECURITY

Seed is a key input for all crop production because its quality can increase crop yields and contribute to improved access to food at household level (Wekundah 2012; Sperling et al., 2013b). Seed includes grains that are sown, cuttings, tubers and other agricultural planting materials (Sperling, 2008:5). A strong base of diverse varieties reduces the threat of disease and climate change to food production. Promoting the use of diverse crops enhances the quality of household food consumption and promotes the preservation of traditional, cultural practices and values (CIS, 2012; Jones et al., 2014; Snapp and Fisher 2015).

Household seed security exists when the household has sufficient access to adequate quantities of high-quality seed and planting materials of preferred crop varieties at all times, following both good and bad cropping seasons (FAO, 2015a: 2). The pillars of household seed security according to the Food and Agriculture Organization include availability, access, varietal suitability, seed quality, and resilience of the seed system (FAO, 2015a). According to Remington et al., (2002: 319), seed availability means having sufficient seed of desired crops within reasonable proximity (spatial availability) and in time for sowing (temporal availability). Availability refers to the farmer's supply of seed from all sources. This can include own saved seed, social networks, local markets, the formal seed sector and from aid sources (FAO, 2015a; McGuire and Sperling, 2016).

The seed should be available in close proximity at the time of planting.

Access to seed is defined as having the ability to acquire seed through exchange, loan, barter or use of influence in social networks (Sperling et al., 2013b; FAO, 2015a). Sperling et al. (2013b: 6) also highlighted the importance of access to relevant information about seed properties and management as an important but under-appreciated part of seed access. It is critical to differentiate access from availability because the seed might be available within the community or market, but some farmers might not have the resources or the social influence to acquire it. These farmers thus would be seed insecure in a world of plenty. Access comprises of social access and economic access (FAO, 2015a). Social access refers to seed that can be acquired through a household's social network, while economic access refers to having the financial resources to acquire seed when needed.

Varietal suitability refers to the ability of farmers to access seed of crop varieties that they prefer (Sperling et al., 2013b; FAO, 2015a). These attributes are subjective and depend on the farmer's needs and characteristics. Some of the features that farmers prefer include taste, appearance, size, storability and disease and pest resistance. It is essential to ensure that seed programmes are based on the farmers' preferred characteristics rather than the traits chosen by breeders, otherwise the crop varieties are not adopted and used by farmers (Muthoni and Andrade, 2015). It is vital to consider also the needs of other stakeholders in the value chain, such as consumers and livestock owners.

The technical aspects of the seed, particularly germination, physical purity, seed health and varietal purity determine seed quality (Walsh et al., 2014; FAO, 2015a). Seed germination requires tests to ascertain the percentage of seedlings that germinate from a given sample. The physical purity refers to seed that is clean and free from foreign material with no broken or immature grains. Seed health means the seed should be free from pests and diseases. Varietal purity means that the seed is of a single variety, absence of foreign seed (especially weed seed) and not a mixture of varieties or seed of various crops (FAO, 2015a: 9). It is essential that the seed quality characteristics should be congruent with the needs of farmers who, ultimately, are the end users, which might mean that the smallholder farmers do not consider some characteristics as important as others. FAO (2015a)

contends that varietal purity, for example, might be less important for some crops such as beans and groundnuts. The end-use is the key determinant of the crop. In farmers' seed systems, varietal diversity might be preferred to varietal purity, as some types of varieties would ensure various characteristics such as adaptation to different agro-ecological environments and other preferred culinary and storability characteristics.

The resilience of a seed system is the extent to which seed security is affected adversely by stresses and shocks (Lin, 2011; McGuire and Sperling 2013; FAO, 2015a). McGuire and Sperling (2013: 645) emphasised the idea of maintaining the functions of the elements of a system, giving attention to the institutions, relationships and knowledge that extend over the processes of informal and formal systems. The degree to which a seed system can resist, adapt and recover from shocks and stresses will determine the extent of its resilience. Households in the same community are affected by stress and shocks differently, depending on their capabilities, activities and asset base (Chambers and Conway 1991). The FAO (2015a) argued that the resilience of a seed system can be measured by changes in the indicators of seed availability, access, quality and varietal suitability (i.e. all the components of seed security). These elements of seed security were used as the basis for determining the seed security of Chimanimani households.

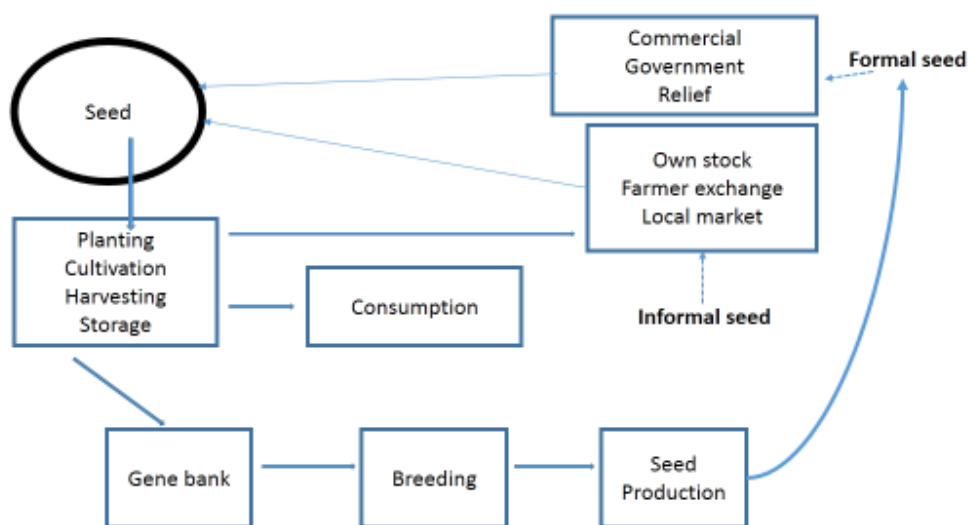
The dimensions of seed insecurity include acute and chronic seed insecurity. Acute seed insecurity (short term, transitory) occurs because of distinct, short-duration events such as a flood or short civil disturbance (CIAT et al., 2006; Sperling et al., 2008). CIAT et al. (2006) contended further that acute seed insecurity could be the result of failure to plant in a single season, the loss of a harvest, or by high levels of infestation of stored seed stocks. Chronic seed insecurity, on the other hand, is long-term seed insecurity caused by structural factors such as economic (poverty, limited resources), ecological (continuous droughts, degraded land) and political constraints (Sperling et al., 2008:591). CIAT et al. (2006) argued that populations that are chronically seed insecure are characterised by continual shortage of adequate seed, difficulties to acquire seed off-farm owing to lack of resources, and routine use of low-quality seed or less preferred varieties.

Although acute and chronic seed insecurity are presented as distinct conditions, in practice they tend to exist together, especially in instances of protracted crises. In Zimbabwe, for example,

drought has become a frequent phenomenon in recent years, affecting the poorest households disproportionately (Kinsey et al., 1998; Kokera and Ndoma 2016). CIAT et al. (2006) noted two trends in the relationship between acute and chronic seed insecurity. The first was increasing evidence of a general transition from acute to chronic seed insecurity, rather than the presumed goal of recovery. The second trend was that many of the aid cases originally considered acute were exhibiting more aspects of chronic stress.

2.2.1. Seed Systems

Seed systems are defined as being the sum of physical, organisational, and institutional components and their actions and interactions that determine seed supply and use, in quantitative and qualitative terms, and include formal, informal, semi-formal and seed aid elements (Almekinders and Louwaars, 2002; Scoones and Thompson, 2011; Louwaars and de Boef, 2012). FAO (2015a:25) summarised the seed system as “the value chain of demand and supply of seeds inside a given agricultural system”. The seed systems should be designed to meet specific goals such as food production, nutrition, and income generation (Sperling and McGuire 2012; Sperling et al., 2013b). This is necessary as it will determine the crops grown, stakeholders engaged, and which smallholders are involved. Figure 2.1 below illustrates the elements of a seed system adapted from Sperling (2008).



Source: Adapted from Sperling (2008)

Figure 2.1: Elements of a seed system

Seed systems can be sub-divided into formal, informal and semi-formal or intermediate seed systems. Formal seed systems provide new and improved varieties of certified seed of consistent quality and purity that are regulated by national governments. The public and private sectors are the key role-players in this system. The guiding principle for the formal seed system is that it is depend on officially-sanctioned quality assurance systems such as the maintenance of distinctiveness, uniformity, and stability (DUS); value for cultivation and use (VCU); production of seed of optimal physical, physiological and sanitary quality; official marketing through limited formal channels. (Sperling et al., 2013a; TASAI, 2015).

The informal seed system, also referred to as a farmer-led, traditional, or local seed system, is not regulated formally, operates at individual and community level and provides the bulk (60%-100%) of seed for smallholder farmers (Almekinders and Louwaars, 2002; Louwaars and de Boef, 2012). Almekinders and Louwaars (2002) contend further that the significance of informal seed systems is broader than supplying local seed supply and maintenance of varieties, but also constitutes a dynamic, on-farm conservation system that gives it an important role in the management of plant

and genetic resources for food and agriculture. Informal seed systems are characterised by diversity, multiplication, selection, dissemination, and storage as integral parts of crop production and marketing systems (Sperling et al., 2013a: 2). Ravinder et al. (2007: 20) maintain that seed in the informal system includes seed saved on farms and seed obtained from the trading and exchange sub-systems within the community.

The semi-formal/intermediate seed system is a blend of the formal and informal systems and can include the quality-declared seed system and the relief seed system (FAO, 2006). The quality-declared seed system is characterised by farmers and community-based organisations multiplying and selling small quantities of seed of improved varieties to other farmers within a restricted zone, with minimal, formal, quality assurance (FAO, 2006; CTA, 2014). This applies to locations where a quality-declared seed system is recognised. This system provides flexibility in terms of quality standards and access to new germplasm and a means for farmers to earn an income at the same time.

While the seed systems are defined as though they could be identified distinctly and separately, in reality, they co-exist (as shown in Figure 2.1) and farmers interact with all the systems in their endeavor to access and use different crop varieties for their various needs. The interaction between the informal seed system and the formal seed system is more pronounced than depicted in Figure 2.1. Some seed obtained from the formal system can find its way into the informal system as farmers exchange the seed through social relations, while some of the seed obtained from the informal system initially can be developed further and introduced into the formal system (Bellon et al., 2006; Westengen et al., 2019).

2.2.2. Zimbabwe Seed Systems and Seed Legislation

The formal seed system in Zimbabwe consists of a well-developed, national seed industry supported by the government and the private sector. The government is active in enforcing the Seed Act (Chapter 19:13) and Regulations on one hand, and in seed provisioning, especially seed aid, through the Presidential Input Support Scheme and Command Agriculture on the other (Mutonodzo-Davies, 2010; Government of Zimbabwe, 2013a; Chinyoka, 2017). The private sector

consists of a vibrant seed-trade association of between 24 to 38 seed companies that are undergoing mergers and consolidation to remain viable in the existing economic climate (ACB, 2016; Mwashaireni, 2019). Certified seed is available commercially to farmers through various channels such as wholesalers, retailers and agro-dealers scattered throughout the country.

Key seed companies included Seedco, Pioneer/Pannar, Agriseeds, and National Tested Seeds. These companies produce and sell mainly maize (mostly hybrids and a few open-pollinated varieties) and groundnuts, soya beans, wheat, sunflower and cotton (CIAT et al., 2009; ACB, 2016). CIAT et al. (2009) note that the development of the formal seed system can be analysed by comparing the system during the pre-liberalisation and the liberalisation periods. During the pre-liberalisation period (from 2006 to 2009), there was an unfavourable policy and regulatory framework that resulted in price controls and inflationary currency constraints. This led to limited seed production in the country and the closure of most seed retailers. During this period, the land reform programme led to seed companies establishing new networks of seed out-growers because large-scale commercial farmers were dispossessed of land in favour of black smallholder farmers.

The liberalisation phase involved the liberalisation of policies and the introduction of the United States Dollar and South African Rand as official trading currencies. During this period, the seed houses increased seed production in the country significantly, and many agro-dealers opened throughout the country. In parallel, government seed distribution and seed distributed through non-governmental organisations (NGOs) channels and voucher programmes also became prominent (CIAT et al., 2009). The relief seed system became prominent in Zimbabwe through the NGO network, particularly during the period prior to 2009 (ACB, 2016). The commercial sector provided most of this seed.

The informal seed sector supplies the seed that farmers obtain from own production, social networks of seed exchanges, and open, informal markets for seed and grain sales throughout urban and rural areas. In 2009, this sector supplied about 95% of the seed that Zimbabwe smallholders grow (except for maize) and included sorghum, pearl millet, groundnuts, cowpeas, bambara groundnuts, sugar beans and sweet potato (CIAT et al., 2009). The informal seed sector is dynamic and resilient in the midst of economic and political meltdown that the country continues to face.

Local NGOs work with smallholder farmers in this sector, supporting informal and formal seed initiatives (ACB, 2016).

The seed regulatory institutions in Zimbabwe include the Plant Quarantine Research Institute, Crop Breeding Institute and the Seed Services Institute under the Department of Research and Specialist Services of the Ministry of Agriculture, Mechanisation and Irrigation Development (DRSS, 2016). The Plant Quarantine Research Institute is responsible for providing services for plant protection technologies within the country and those that are imported. The Crop Breeding Institute develops, maintains and distributes varieties from 13 field crops to seed companies for further multiplication and certification. The key crops under this system include maize, groundnuts, wheat and potatoes. The Seed Services Institute is responsible for the administration of the Seeds Act, Chapter 19, Section 13, enacted in 1971, the Seeds Regulations and Seeds Notice 2000 (Certification Scheme), and the Plant Breeders' Act, Chapter 18, Section 16 (TASAI, 2015; DRSS, 2016). Through these Acts, the institute carries out seed testing, seed certification, and release of seed varieties. These seed regulatory institutions serve primarily to regulate and provide services to the formal seed system. There are no legal provisions for farmers' seed systems. Vernooy et al. (2020) noted that the Seed Act of Zimbabwe, Chapter 19, Section 13, allowed farmers to save, use, exchange and sell their own seed locally, within their communities, but not beyond. Visser (2015) argued that such a policy limits farmers' options to market their seed outside their local community and thus maintain farmers' varieties in small-scale systems. Though the Integrated Seed Sector Development (ISSD) study notes that there are exemptions in the Zimbabwean seed law that allows farmers not registered as seed sellers to sell seed, they can only sell the seed to other farmers through the farmer-led seed system and not the commercial channels (Herpers et al., 2017).

Zimbabwe is party to the Convention on Biological Diversity (CBD) and the International Treaty on Plant and Genetic Resources for Food and Agriculture. Mujaju (2010: 30) declared that membership of these conventions had resulted in facilitated access to germplasm by breeders and researchers, access to improved varieties, technology transfer, scientific collaboration, sharing experience and capacity building. Vernooy et al. (2020: 2) suggested that community seed banks

throughout Zimbabwe and other countries were effective in implementing farmers' rights concerning:

“...saving, using, exchanging and selling farm-saved seed and other propagating material, right to protect traditional knowledge and to participation in decision-making regarding, and in the fair and equitable sharing of the benefits arising from, the use of plant genetic resources for food and agriculture”.

In this study, it was necessary to compare and contrast the seed systems in Zimbabwe, and how they contribute to seed diversity and seed security of smallholder farmers. The question to interrogate was whether there was a relationship between the seed security and household food security, and how broader issues such as historical trajectory of agricultural development, socio-political and economic processes, and socio-ecological factors shaped and affected smallholder farmers' seed systems and their food security.

2.2.3. Seed-Based Interventions

According to Bengtsson (2007), the seed-based interventions implemented by governments, United Nations organisations, and international and national NGOs to address chronic and acute seed insecurity include emergency seed provision and agricultural capacity-building activities. Emergency seed provision is implemented usually on the justification that there is a lack of seed available owing to crises and/or that farmers' seed is of poor quality because of production constraints such as diseased seed (Remington et al., 2002). Agricultural capacity-building activities are framed usually under longer-term agricultural development programmes with the aim of enhancing farming practices and strengthening local agro-biodiversity and food security (Bengtsson, 2007). For this study, it was necessary to understand the influence of seed-based interventions and their contribution to farmers' access to seed for their planting requirements and whether this had an effect on household access to food.

2.2.3.1. Emergency seed provision

Emergency seed provision is delivered through direct seed distributions and the approach of seed vouchers and fairs (Remington et al., 2002; Bengtsson, 2007). Direct seed distributions have been perceived to be top-down and interventionist, bringing imported or external seeds and other inputs into local communities, based on the assumption of a lack of availability of quality seed (Bramel, et al., 2004). Such seed might however not necessarily be suited to local farmers' environments. Through seed vouchers and fairs, farmers obtained vouchers (access), which they exchange for local seed (availability) of their choice (utilisation) from sellers at a special market. The sellers comprise local seed sellers, local farmers and local stockists (Remington et al., 2002; Bramel et al., 2004; Bengtsson, 2007). Direct seed distributions are designed to address perceived availability constraints, while seed vouchers and fairs are designed to address seed access challenges (Longley 2006: 10). The seed vouchers and fairs make use of locally available seeds that are adapted to the environment, unlike direct seed distributions, and address the different dimensions of seed security (availability, access and utilisation). Seed fairs and vouchers increasingly use market-friendly approaches to ensure access to diverse seed for smallholder farmers (Mazvimavi et al., 2008).

2.2.3.2. Seed-Related Agricultural Capacity-Building Activities

Seed-related agricultural capacity-building activities have a long-term focus on the different components of the seed value chain aimed at improving seed production, seed management (conservation techniques), post-harvest handling to reduce storage loss, and developing new varieties on farms or within communities (Bengtsson, 2007). Bengtsson (2007) asserted that such seed interventions could be delivered within either the formal or informal seed systems. These seed-based developmental activities came about because of the failure of the public sector and commercial seed companies to provide an adequate range or supply of seed to smallholder farmers (Langyintuo et al., 2010; Poku et al., 2018). Their aim was to enhance production and provide incentives for farmers to produce and sell seed in their local area.

Local seed production manifests through two forms of production and supply, i.e. formal and informal seed production. Formal seed production has made it possible for smallholder farmers with access to adequate land to be trained to produce certified crop varieties in association with

contracting seed companies, government and non-governmental organisations (Nateebwa et al., 2017). The Food and Agriculture Organisation (FAO) affirmed that seed certification is a quality assurance mechanism within the formal seed system, whereby seed meant for use or sale is inspected and tested by the national certifying authority (FAO, 2018). Such formal seed production arrangements have been implemented through either community-based seed associations, or community-owned seed companies (Setimela et al., 2004; Munyaka et al., 2015). These models have enabled the increased availability of affordable open-pollinated and self-pollinated varieties of maize, small grains and legumes, and sometimes hybrid seed.

However, these models have not been without their challenges. These include provision of a limited range of crops and varieties, inability to maintain isolation distances to prevent contamination, difficulty in managing contractual relationships with farmers such as payment modalities, which inputs and forms of support to provide to farmers and sustainability issues (Setimela and Kosina, 2006; Munyaka et al., 2015; Napasintuwong, 2018). Nateebwa et al. (2017) concluded from their study in Western Uganda that community-based seed multiplication should be promoted as an effective approach for enhancing access to improved seed by farmers in remote locations.

Informal seed production has enabled farmers to produce, preserve, store and sell their traditional and local seed varieties, thus enabling improved availability and access to more diverse crops and varieties adapted to local conditions. Such forms of local seed production include farmer managed seed systems, development of local seed banks, local seed development techniques such as participatory plant cultivation and participatory variety selection, as well as forms of quality assurance such as the FAO quality-declared seed system, which has less stringent requirements compared with certified seed. In this system, the FAO conceded that it is the responsibility of farmers and seed companies to ensure seed quality, while the government plays a monitoring role (FAO, 2018).

Farmer-managed seed systems refer to any form of seed production and supply that are conducted with or by farmers, characterised by seed saving, seed selections, self-provisioning, exchanges and gifts among neighbours, as well as the informal market (Dawit, 2011; Mudzingwa and Mambeva,

2018). The benefits of farmer-managed seed systems across three districts in Zimbabwe were found to include provision of diverse seed and food, that was available locally and affordable, and not requiring a lot of fertilisers (Mudzingwa and Mambeva, 2018: 18). Alemu (2011a) in Ethiopia confirmed this further.

Vernooy et al. (2017) posited that, based on their research in Latin America, Asia and East and Southern Africa, community seed banks enhanced the resilience of farmers, while improving access to, and availability of, diverse, locally adapted crops and varieties. The seed banks include indigenous knowledge and skills in plant management including seed selection, treatment, storage, multiplication, and distribution (Vernooy et al., 2017). In an analysis of seed-bank activities in Zimbabwe, Andersen et al. (2017) expounded further on this by mentioning that seed banks in the country contributed to easy access to ecologically adapted seeds and opportunities for crop diversification for greater food and nutrition security.

2.3. FOOD SECURITY PILLARS

The Committee on World Food Security at the 1996 World Food Summit defined food security as follows:

Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (CFS, 2012).

The pillars of food security are similar to the pillars of seed security and include availability, accessibility, utilisation and stability (FAO, 2008; Capone et al., 2014). The focus of food security at national and global levels is on the supply side of the food equation (Pinstrup-Andersen, 2009: 5). Availability at household and individual level refers to adequate food that is physically available at their disposal, be it from own production or from the market (Weingärtner, 2004). Although availability of food at national level could be through local production, imports, food aid and local food stocks, the focus of this research was on the household level of smallholder farmers.

The indicators of food availability include the adequacy of average dietary supply, average protein supply, and indicators related to agricultural production (Pangaribowo et al., 2013).

Food access exists when households and individuals have sufficient resources to secure appropriate foods (through production, purchase or donation) for a nutritious diet (Capone et al., 2014; SADC, 2014). Food access includes both physical and economic access (Sharma, 1992). Sharma (1992) argued that food must be within the physical reach of vulnerable households, whether through their own production or through the market. Economic access is achieved when the capability to acquire food exists (Sen, 1981, cited in Sharma, 1992). Some researchers also stressed that access is mediated by institutions at different levels, such as national property laws, local rules on forest access, intra-household gender-relations, which shape entitlements (Leach et al., 1999; Ribot and Peluso, 2003). Just as seed availability does not guarantee seed access, food availability does not guarantee food access (FAO 2008). Sufficient food access can be achieved also without households being self-sufficient in food production (Weingärtner, 2004). The indicators of food accessibility include food prices, access to income and other social services (Pangaribowo et al., 2013)

Food utilisation refers to the ability of the human body to ingest and metabolise food. The food should be nutritious and safe for consumption (SADC, 2014). Utilisation of food refers to whether household members are able to use the food they access to sustain their bodies. Utilisation thus includes aspects such as nutritional composition of the food, the health status of the individual, food safety, preparation, and sanitation issues (Barrett, 2010: 825). Whether household members derive a sufficient intake and absorption of micro-nutrients can be assessed according to their diet variety and from the anthropometric outcomes (Pangaribowo et al., 2013).

Sustainability refers to the temporal dimension of food security, i.e. the period over which food security is considered (Weingärtner, 2004). Thus, sustainability includes the temporal dimension in all aspects of food security – availability, accessibility, and utilisation (Capone et al., 2014). The FAO (2008) categorised the temporal dimensions of food insecurity into chronic and transitory food insecurity. Chronic food insecurity exists when people are unable to meet their food needs over an extended period often because of structural causes such as poverty and lack of assets.

Maxwell and Smith (1992: 15) argued that chronic food insecurity means continual, high risk of being unable to meet household food requirements. Transitory food insecurity exists when people are unable to meet their food needs over a short period (temporary or cyclical) because of shocks and stresses (Weingärtner, 2004; FAO, 2008). Transitory food insecurity occurs for a limited time due to unforeseen or unpredictable circumstances (Maxwell and Smith, 1992:15). The food security indicators were used to measure the various food security dimensions of a household to understand the food security situation of Chimanimani households.

2.3.1. Status of Food Security in Zimbabwe

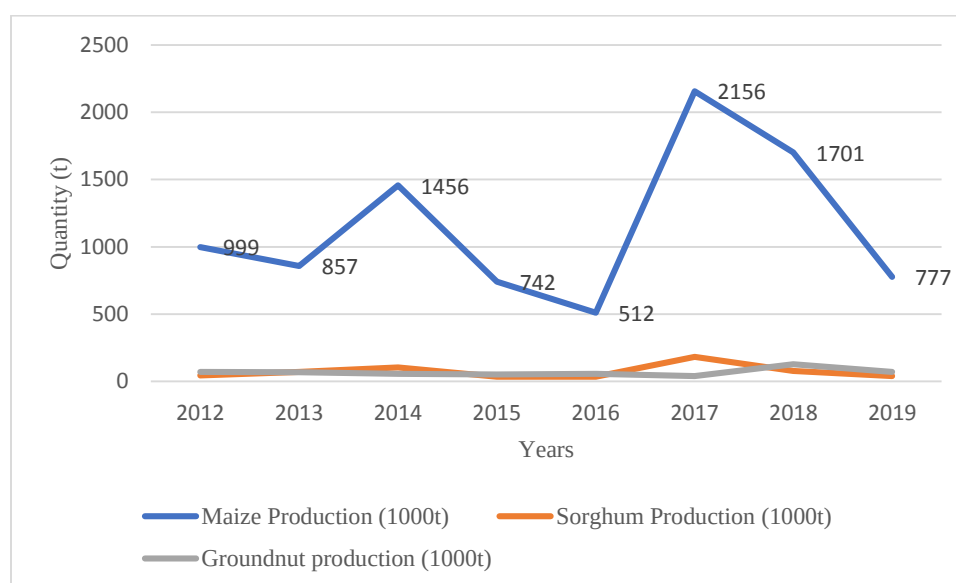
2.3.1.1. Contribution of agriculture to gross domestic product

According to Zimstats (2019), agriculture contributed on average 9.9% of the gross domestic product (GDP) between 2012 and 2016. Before 2012, it accounted for between 15% -18% of the GDP (Government of Zimbabwe, 2012). About 70% of the population derived their livelihood from agriculture, and one third of the formal labour force was employed in this sector (Government of Zimbabwe, 2012). Thus, largely, Zimbabwe's economic growth was underpinned by growth in the agricultural sector.

2.3.1.2. Agricultural production and productivity

The main commercial agricultural products in Zimbabwe are maize, tobacco, cotton, sugar, horticultural crops, beef, fish, and poultry, groundnuts, wheat, and soya beans. Food production in Zimbabwe has remained below subsistence levels since the year 2000 (Mudzonga and Chigwada, 2009). The greatest challenge to the agricultural sector in Zimbabwe is low productivity. The top six food crops grown in the country include maize, sorghum, pearl millet, finger millet, groundnuts and wheat (Government of Zimbabwe, 2012). The national cereal requirement for human consumption is 1.75 million metric tons, and for livestock production approximately 350 000 metric tons (MLAWCRR, 2019). Since 2012, the national cereal requirement has only been met once, in 2017 (see Figure 2.2) and, for most years, the government has had to rely on imports. Although it is the staple national food, maize has experienced a decline in production over the

years as shown in Figure 2.2, which shows a comparison with sorghum, another cereal, and groundnut, a legume. Maize production has been more variable compared with sorghum and groundnuts because it is more affected by climatic variations and price controls. The years of low production also corresponded to the drought years experienced in the country. Devastating droughts experienced over the past ten years included the 2011/2012 and 2015/2016 agricultural seasons which had a negative impact on agricultural production. In both cases, Government had to import cereals from neighbouring countries (Zimstats, 2019).



Source: Adapted from *indexmundi.com*

Figure 2.2: Crop production trends in Zimbabwe between 2012 and 2019

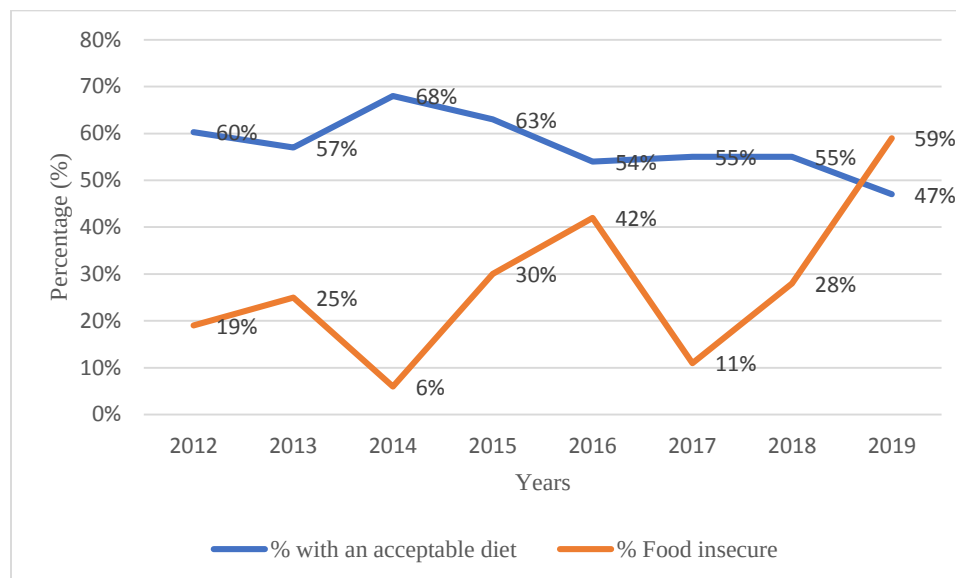
In terms of national crop productivity, since 2012, national average yields of most crops were below 1,000 kilograms per hectare, except for soya (Zimstat 2019). Over the years, the performance of the agricultural sector has been hampered severely by lack of agricultural inputs, high input costs, controlled prices for agricultural inputs and commodities, lack of finance, neglect of the sector by government, deteriorating land quality and recurrent droughts (Mudzonga and Chigwada, 2009; Mazarura et al., 2019; Zimstats, 2019).

2.3.1.3. Food security measurements

The two main measurements used nationally in Zimbabwe to determine rural food security are the food consumption score and the proportion of food insecure households. The food consumption score (FCS) is a composite score based on dietary diversity, food frequency and relative nutritional importance of the various food groups consumed by households (WFP, 2008; Kennedy et al., 2010). Based on the collation of the food consumption scores, the World Food Programme classifies households into three profile groups: poor, borderline and acceptable food consumption (WFP, 2008). The households with an acceptable food consumption score based on specific cut-offs are considered food secure, while those with borderline and poor consumption levels are considered to be less food secure (ZIMVAC, 2019).

The food security analytical framework used to measure the level of food insecurity in Zimbabwe was computed by estimating the household's likely disposable income (both cash and non-cash) in a consumption year from the various possible income sources. This was compared with the total energy that could be acquired by the household members from the cheapest available energy source (usually maize) using their potential disposable income, which was compared with the household's minimum energy requirements (ZIMVAC, 2019). When the potential energy that household members could acquire was greater than their minimum energy requirements, the household was deemed to be food secure. When the reverse was true, the household was defined as food insecure.

Figure 2.3 shows a comparison of the food consumption score (based on the proportion consuming an acceptable diet during the lean season) with the proportion of food insecure households from 2012 to 2019. The food-insecure line was very irregular showing that, during these years a large proportion of Zimbabwean households were experiencing high food insecurity levels, especially during 2015, 2016 and 2019, which were the worst years. This pattern corresponded with the low crop production, especially of the staple maize crop, experienced during this period (refer to Figure 2.2).



Source of data: ZIMVAC Reports 2012-2019

Figure 2.3: Proportion of Zimbabwean households consuming an acceptable diet vs food-insecure households

Although the graph of the proportion of food insecure households was high and irregular, the graph of the proportion of households eating an acceptable diet was consistent within the 54% - 68% range. This shows the importance of considering the dietary diversity, food frequency and nutrition of the various food to which households had access beyond the staple maize, as this provides a broader picture.

2.3.1.4. Determinants of food security

In the 2019 FAO State of Food and Nutrition Security Report, it was stated that more than 820 million people in the world live with hunger. It was also reported that two billion people in the world experience moderate or severe food insecurity (FAO et al., 2019). Levels of hunger are rising in almost all sub-regions of Africa and, to a lesser extent, in Latin America and Western Asia. According to the report, there are many causes of such high food insecurity, including economic slow-downs, conflict and instability that have increased and become more intractable, spurring greater population displacement, and the effects of climate change have compounded the

situation.

The study on the determinants of food security reveal that there are many and broader causes of food insecurity such as climate change, natural disasters, social factors, and economic and political instability (Israel and Briones 2012; Wheeler and von Braun 2013; Deaton and Lipka 2015; FAO et al., 2019; Popp et al., 2019). Many scholars have thus advocated for the use of a ‘socio-ecological niche framework’ for understanding the various dimensions of interaction that link the natural ecosystem and the social systems of smallholder farmers in accessing food (Ojiem et al., 2006; Lescourret et al., 2015; Nkurunziza et al., 2020). The socio-ecological niche is created by the convergence of agro-ecological, socio-cultural, economic and ecological factors, to describe a multidimensional environment under which aspects of seed systems and access to food can be analysed (Ojiem et al., 2006).

The schematic relationship proposed by Ojiem et al., (2006) illustrates that the agro-ecological factors include rainfall, temperature, solar radiation and soil type which directly influence the type of varieties that farmers can grow at any given location. The socio-cultural factors include values, norms, preferences and human relations which influence the compatibility of farmers with specific crop varieties and food. The economic factors consist of capital, cash-flow, input and output markets and labour that contribute to farmers’ economic access to seed and food. The last element in the concept by Ojiem et al., (2006) model are local ecological factors such as soil-micro-organisms, soil moisture, soil nutrients, pests, diseases and weeds. These have an impact on crop production performance such as yields. The socio-ecological niche can be used to understand the context of smallholder farmers and how this affects their farming systems, seed systems and food access. What has not received comprehensive empirical enquiry, however, is the relationship between seed security and food security (McGuire and Sperling 2011; Mucioki et al., 2018), a contribution that this study seeks to make.

When the food security determinants analysis is focused on Zimbabwe, the key indicators with available information showed that the prevalence of under-nourishment in the total population was 51.3%, while the prevalence of stunted growth was 27.1%. The most prevalent causes of food insecurity broadly were economic shocks (currency depreciation, high food prices, and lack of

labour opportunities) and climate-related stresses (low rainfall, drought, and heat stress) (FAO et al., 2019). The economic shocks affect purchasing power and, thus, access to food, while the effects of climate change manifest through increasing climate variability and extremes that affect agricultural productivity, food production and natural resources, with impacts on food systems and rural livelihoods.

At household level, the determinants of food security throughout Zimbabwe can be categorised as: demographic (household size, age and education of the household head, household labour); household assets (livestock ownership, size of land); income sources (remittances, on-farm and off-farm); and information (farming skills, market access information) (Tawodzera et al., 2012; Mango et al., 2014; Muhoyi et al., 2014). These determinants are not applicable universally across households nor are they always correlated positively to food security. Household size, for example, would benefit some households because it means that they have more members farming the land and providing the additional household income. For other households, especially poor households, having a large household size would make them food insecure because of the many mouths to feed. Thus, it is important to consider the determinants of food security in the context of the area and type of households being investigated. This was done for Chimanimani households to understand their food security constraints in their context.

2.4. THEORETICAL DEBATES ON SEED AND FOOD SECURITY

Remington et al. (2002) conceded that the definitions of seed security and food security are similar and that both cover aspects of availability, access and utilisation. It is important to note that, in as much as the two phenomena are linked, they are not necessarily the same. The FAO (2013) acknowledged that a key difference between seed security and food security was that there were no internationally recognised, measurable indicators of seed security, while for food security, indicators that could be used to differentiate between a food-secure and food-insecure household had been developed.

Researchers have argued that having access to seed that produces meaningful production of culturally appropriate food is an integral aspect of food security for smallholder farmers (Okello

et al., 2017; Mucioki et al., 2018). This was equally so for rural smallholder farmers in Chimanimani who relied on farming for the bulk of their food supply. It was thus important to emphasize the effect of seed security in food-security-related interventions and food policy. Owing to the complexity inherent in understanding the dimensions of seed security and food security, not many theories have been advanced by scholars to understand the relationship between food and seed security. In this section, the concepts and theories that have sought to understand the concepts of seed access, food security and the relationship between them are discussed.

2.4.1. Contribution of Seed Access to Food Security

Various researchers have investigated the contribution of seed access to food security. Bekele (2017) observed how improved seed access for project beneficiaries in Southern Ethiopia contributed to the food security of households. Bekele (2017) found that significant achievements resulted from increased access to improved varieties, ranging from harvesting higher yields, to improving dietary diversity, intake and meal frequency. Importantly, seed access was linked to having reduced months of food shortage, implying that the food-security situation improved. Based on a study in Kenya, Okello et al. (2017) showed similar findings in which access to certified sweet potato seed contributed to more potatoes per hectare of land, more sales and experiencing less food insecurity problems in comparison with non-beneficiaries. Other researchers such as Abebe and Alemu (2017), Shikuku et al. (2019) and Westengen et al. (2019), have showed similar findings in the region.

These studies have shown the important role of accessing seed. The commercial seed system enables access to improved varieties that are higher yielding and have nutritional attributes such as fortification with iron, zinc and vitamin A. Although certified seeds obtained from the formal seed system have been shown to contribute to increasing crop yields (Spielman and Smale, 2017; Lunduka et al., 2019), adoption rates of improved varieties have been mixed (Doss et al., 2003; Spielman and Smale 2017; Almekinders et al., 2019). Based on their study of the determinants of adoption of a sorghum variety in semi-arid regions of south-eastern Zimbabwe, Zivanomoyo and Mukarati (2013) deduced that these included: the price of the existing crop variety, level of education of farmers, the size of the farms, government policies and incentives, and credit

availability. Other studies found similar adoption determinants including awareness, access to capital, access to markets, access to information (for example, through farmer training, participation in on-farm trials, or extension), and attributes of the new varieties such as drought tolerance and storage performance (Doss et al., 2003; Mudombi, 2007; Pindiriri, 2018;).

Farmers' local seed systems, being the major source of farmers' seed for crop production (McGuire and Sperling 2016), provide a wider diversity in terms of food crops, and the varieties adapted to farmers' local environments (Cleveland et al. 1994). Access to local farmers' varieties is predicated on the ability to produce own seed, linkages via farmer seed networks and farmer social relations. Own seed production is possible for farmers who have the skills for seed production, seed selection, preservation and seed storage that maintain the acceptable seed quality standards preferred by farmers (Louette and Smale, 1998; Kiruba et al., 2006; Gill et al., 2013; Mathad et al., 2013).

Coomes et al. (2015) argue that farmer seed networks are quite efficient in seed dissemination by ensuring that the needs of farmers are met (in terms of choice, accessibility, cost, and non-economic utility) and by providing quality planting materials acceptable to farmers. However, they caution that access to seed by farmers through seed networks is not "friction-less" as it is grounded in cultural practices, institutions and social relations that could impede or enable seed flow and thus determine the social 'scarcity' of seed. David and Sperling (1999), Dennis et al., (2007) and McGuire (2008) elaborated these issues further.

Beyond farmer seed networks, social relations have been shown to play a critical role in facilitating access to seed by smallholder farmers. Based on a study of sorghum in Eastern Ethiopia, McGuire (2008) confirmed that access to seed was possible through publicly expressed norms (unconditional assistance to neighbours), kinship, and mutual aid institutions (such as labour sharing and oxen sharing). The social capital theory is useful in understanding how individuals benefit from certain associations, networks and relationships. Researchers have shown the influence of social capital on households attaining seed access and obtaining food security (Stromberg et al., 2010; Sperling and McGuire, 2010b; Dean and Sharky 2011; Dzanja et al., 2013). The question of why certain farmers have access to certain crop varieties that others do not

have within the same community is answered by the importance of social capital in seed access through different farmers' seed sources. Similarly, some farmers have acquired certain knowledge and skills in certain traditional methods of seed preservation and storage that ensure minimal losses of their seed or in managing the effects of dry spells. Coleman (1990) observed that social capital, similar to other forms of capital is productive and makes the achievement of certain ends possible that would not be attainable in its absence.

2.4.2. Competing Pathways to Seed and Food Security

Scoones and Thompson (2011) argue that there are competing pathways to attaining agricultural production in Africa, of which the dominant 'Green Revolution' narrative urges the delivery of new technologies such as improved seeds of hybrids and open pollinated varieties (OPVs) and synthetic fertilisers to drive agricultural development. This is typically complemented by public-private partnerships and public funds from national and international aid or philanthropic support invested to motivate private sector activity in favour of public policy aims. However, as Scoones and Thompson (2011) argue, this furthers the interests of a few private sector partners – the elite, prosperous agro-dealers and farmers. Scoones and Thompson (2011) contend that the political, social and institutional dimensions of seed supply are often ignored, which has hindered the emergence and spread of lasting improvements in agricultural productivity.

The new technologies are delivered through a formalised seed system as the informal seed systems are thought to be inefficient and cannot supply quality seed. In contrast, Almekinders and Louwaars (2002) have shown that informal seed systems are remarkably resilient and able to produce high-quality seed and planting material. Thiele (1999), Almekinders (2000), and Croft et al., (2017) advocate that recognition of the importance and potential of informal systems is essential to agricultural production. The lessons from five African countries summarised by Scoones and Thompson (2011) show that there are inherent challenges from the formalised seed systems and new technologies, which include focusing on commercial and agri-business models at the expense of public research and extension; use of formal seed marketing channels that include agro-dealers who stock a limited range of seeds and are concentrated in highly productive areas; use of subsidy programmes to make seed more affordable, while these subsidies are also a

significant drain on government resources and prone to exploitation as a source of political patronage and political capture; emergency seed aid measures that are implemented in a hurry and undermine longer-term recovery of the seed sector (Scoones and Thompson 2011). All these factors were also elaborated by researchers in Ghana, Ethiopia, Malawi, Kenya and Zimbabwe (Chinsinga, 2010; Alemu 2011b; Amanor, 2011; Muto nodzo-Davies and Magunda, 2011; Odame and Muange 2011).

Alternatives to green revolution approaches include technologies and practices that do not have adverse effects on the environment, and that lead to improvements in food productivity (Pretty et al., 2006). Pretty et al. (2006) argue that approaches such as integrated pest management, integrated nutrient management, conservation tillage, and livestock integration into farming systems, have shown promising returns such as increased productivity on farms, while improving the supply of critical environmental services. Andres and Bhullar (2016) and Pretty and Bharucha (2014) advocate for sustainable intensification which is defined as a ‘process or system where agricultural yields are increased without adverse environmental impact and without the conversion of additional non-agricultural land’. Although there are promises around this system towards increased production and productivity, achieving this at scale while balancing this with the quality of ecological services still requires further attention (Andres and Bhullar 2016).

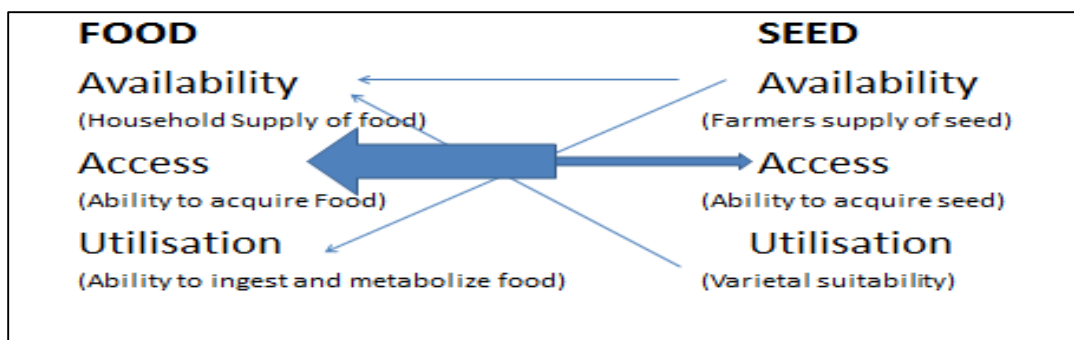
A study by Bezner-Kerr (2013: 868) in Malawi showed that “food sovereignty had been eroded for smallholder farmers through the liberalisation and privatisation of the seed system and the dominant role of the government’s subsidy programmes in influencing available seed types”. Food sovereignty is a call for people’s rights to increased political and economic control of food locally (Patel 2009). Chinsinga (2010) showed that the dominant Malawi seed industry offers a narrow range of products mainly hybrid maize seed at the expense of millet and sorghum. They advocate for farmer seed networks that consist of farmer-to-farmer exchanges that occur outside the commercial sector. Coomes et al. (2015) though taking a different position, have noted that farmer seed networks contribute high quality seed for agricultural production, are responsive to changes in contextual conditions, are resilient to environmental and price shocks, and are likely to persist over time in the face of commercialisation, legislation and regulation.

The arguments do not advocate one pathway or the other, but rather that support for smallholder farmers should consider a pluralistic vision informed by socio-economic, cultural and political dimensions that consider key role-players such as smallholders, governments and the private sector. Zerbe (2001) reinforces this argument by suggesting a two-tiered seed network in which formal seed networks provide improved varieties for large-scale producers and those that can afford them, and an informal network that provides appropriate, diverse varieties to smallholder farmers. Scoones and Thompson (2011) conclude that it is important to consider that some pathways are more equal than others, as politics and interests tend to shape what is funded and what is undermined.

2.4.3. Relationship between Seed and Food Security

Although the examination of food security occurs at different scales, the starting point is typically at the household level, based on the efforts of farming households, then scaling this analysis from micro to macro levels.

In order to do this, the “Relationship between seed security and food security” conceptual framework (McGuire and Sperling, 2011) was incorporated in this study. Since rural households tend to rely on agriculture for their food sources (either primarily or to some extent), initiatives to address their food needs are usually biased towards production and seed-based interventions. Drops in production and emergency crises are addressed through seed-related projects to address food-insecurity constraints (McGuire and Sperling 2011:495). McGuire and Sperling (2011) argue that, although there is a connection between food security and seed security, and that insecurity in one typically leads to insecurity in the other, this interface should be examined more closely in the context of farmers’ characteristics, farmers’ context and farmers’ seed system. They emphasise that the evidence of the connection between food security and seed security varies and is neither always strong, nor universal. Figure 2.4 shows the relationship between food and seed security as developed by McGuire and Sperling (2011).



Source: Adapted from McGuire and Sperling (2011).

Figure 2.4: Modified two-directional relationship between seed and food security

In the adapted framework shown in Figure 2.4, it is suggested that there might not be a direct, strong, two-directional link between food and seed security, but rather more limited and subtle links (McGuire and Sperling 2011). The main link is stronger in the access issues (purchasing power, broken social capital, poorly functioning markets) that have effects on both seed and food security. The other components are weaker (indicated by thinner arrows). According to the framework, there might be no relationship between seed utilisation and food utilisation, since food ingestion and use is not based on seed varietal suitability or seed quality.

The theory of seed security and food security, and their relationship, was applied to the smallholder farmer context in Chimanimani to assess how farmer seed systems contribute to seed security (measured by availability/supply/diversity), accessibility (delivery channels, affordability), and variety quality (adaptability, user needs, and seed quality) (Sperling et al., 2013b). The seed system was assessed also in terms of the extent it contributed to household food security of smallholder farmers, as well as to other, broader, livelihood outcomes.

The theoretical contribution of this study aimed to explore the role of farmer seed systems in ensuring household-level seed security and food security for households that rely primarily on agriculture for their food sources. Although many initiatives have used the provision of seed and seed projects as ways to address household food security (Baiphethi and Jacobs, 2009; United Nations, 2011; SADC, 2014), this relationship has not been proven empirically. It was thus critical to examine the relationship between seed security and food security to determine under which

circumstances one would lead to the enhancement and promotion of the other. In other words: are seed secure households also food secure? If so, under what circumstances and, if not, why not? What are the effects of wider macro issues, such as climate change, socio-political and economic environment, on seed security and food security and their relationship? It is intended that improved understanding of these facets will better inform practitioners and policy makers and enable the development of food programmes and policies that meet the needs and situations of smallholder farmers.

2.5. CONCLUSIONS

In this chapter, a review of literature about seed security and food security, and the conceptual framework that guided this study, were presented. The chapter includes definitions of the various concepts of food security and seed security. The seed systems were analysed to show the formal seed system (regulated by the State) and the informal seed system that is mediated by farmers and less controlled by the State. While these seed systems were defined as distinct, in reality, they co-exist and farmers interact with both systems in their endeavour to access and use different crop varieties for their diversified needs.

While the State and policies established serve primarily to support the formal seed system, it is necessary for policy to be inclusive and pluralistic in supporting the different forms of seed systems because farmers interact with all systems, depending on the crop types, circumstances and farmers' characteristics at any given time.

The conceptual framework of the relationship between seed security and food security served as the basis for this research. This relationship has been analysed and examined in the chapters that follow by tracing farmers' historical status of seed and food security, their household demographic characteristics and the seed systems with which they interact, on the one hand, while mapping this against the seed security and food security status of farmers. Empirical evidence was used to test this conceptual framework and build on it to propose an approach that includes an understanding of the complex interactions between seed security and food security and how these contribute to the status of household seed and food security.

CHAPTER THREE: RESEARCH METHODS

3.1 INTRODUCTION

This chapter contains a description of the methods used to collect empirical data about farmers' seed security and food security in the Chimanimani District of Zimbabwe. The ethical and protocol requirements followed during the research process are also elaborated. The instruments used during the research process are annexed at the end of this thesis, including: the household questionnaire, the agro-dealer questionnaire, and the interview checklists for the extension officers, farmer groups and individual life histories. The household surveys were conducted during the months of January and February 2017, while the other interviews were conducted during July and August 2017. These instruments were developed by adapting the Seed Security Assessment (SSA) data collection instruments for the purpose of collecting and analysing data to gain an understanding of the parameters of seed and food security (Sperling, 2008; FAO, 2016a). The full Seed Security Assessment involved collecting and analysing data from a number of sources including households, local markets, focus groups, key respondents, agro-dealers, seed grower groups, and seed aid agents (FAO, 2016a).

Two research sites were selected purposively, based on weather, soil, agro-ecological conditions and infrastructural characteristics. Chikukwa is located in a mountainous, cool and remote location on the eastern side of the Chimanimani District and is characterised by high rainfall (1,000 mm per annum). Chaseyama is located on the western side of the Chimanimani Mountains, characterised by high temperatures and low rainfall (300 mm per annum) and is easily accessible along the Mutare-Masvingo highway (Mukute, 2015). Each of these study sites provide a wide range of characteristics that is representative of the two extremes of agro-ecological zones of Zimbabwe, as described in Chapter four.

In order to understand the complex relationship between seed security and food security fully, primary and secondary data collection methodologies were used for this research study. This approach was informed by an initial literature review of various studies on smallholder seed

systems, seed initiatives and food security in the Southern African region, with an emphasis on literature from and about Zimbabwe.

Primary data were collected using intensive and extensive research approaches to understand the complex relationship between seed security and food security and other, underlying household and community factors. The focus of an intensive research approach is on a specific instance of the phenomena to be studied, or a handful of instances, in order to study the phenomena in great depth (Swanborn, 2010: 2). Each instance is studied in detail on its own merit in its own specific context. In order to understand farmers' seed systems, it was essential to assess how the seed systems of smallholder farmers have evolved over time, including the institutions, processes, relationships and knowledge spanning informal and formal systems (Scoones and Thompson, 2011). This required intensive research approaches such as in-depth life histories of selected farmers, extension officers and focus group discussions with farmer groups.

An extensive research approach involves collecting information about the relevant properties of a large number of instances of a phenomenon. Each survey respondent provides information based on a standardised set of questions. All the responses are aggregated to create information about relationships between the variables being studied to enable understanding and explanation of the phenomenon (Swanborn, 2010: 2). For this study, it was necessary to use a household survey questionnaire administered to a representative number of households in Chimanimani. This research instrument was modified from the SSA household survey to capture additional food security indicators such as self-classification of food security status, household dietary diversity scores, food consumption scores and the household food insecurity experience scale (Swindale and Bilinsky, 2005; FAO, 2011; Cafiero, et al., 2016).

3.2 SAMPLING AND SAMPLE SIZE

Probability and non-probability sampling methods were used (Caswell, 1995). The probability sampling method was used for the farmer household survey conducted in both Chikukwa and Chaseyama. This consisted of stratifying each study site by its respective villages, with a systematic random sampling approach to select the households. In stratified sampling, researchers

divide the population into groups (called strata) according to some characteristic important to the study. In a systematic random sample, the first subject is selected at random, then the other subjects are selected after every k^{th} subject till the desired sample size is reached (Bluman, 2004: 12). In this study, the strata used were the two study sites (Chikukwa and Chaseyama) and their respective villages. Durrheim and Painter (2006: 136) argue that a stratified sampling ensures that the sample adequately represents relevant strata within the population. The households to be surveyed were selected by using a systematic sampling of every 3rd household from each of the villages.

A household was the selected unit of enumeration in this study. The definition of a household used was adapted from the United Nations (2007: 182) that defines a household as a small group of people who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food.

The survey was administered to the sample households in Chimanimani (Chikukwa and Chaseyama areas) to gather information on seed and food security issues. The two communities of Chaseyama and Chikukwa, due to their different geographical and agro-ecological characteristics, showed the crops preferred, agro-ecological opportunities, challenges, and different seed sourcing strategies and their food security status. The sample was based on the population size (number of households) from both locations. Chikukwa, which is the eastern cluster, has two wards (Wards 10 and 11) and a population of 1052 households, while Chaseyama, part of the western cluster, is in Ward 3 with a population of 1946 households. The Chikukwa community is composed of eight villages: Chitekete, Rujeko, Munaka, Kubatana, Mabasa, Kwaedza, Juntia and Hangani. The Chaseyama community is composed of seven villages: Namire, Mubururu, Zvokuitirwa, Jinga, Nechitima, Musweweshiri, and Mutidzawanda. Households were selected randomly from each of these villages. By including every village, the researcher ensured that any key variations in village characteristics or their environments were not missed.

In addition to the sampling by location, the research was also structured to be able to differentiate the crops grown and years in which farming was practiced. The differentiation provided insights in understanding seed and food security in Chimanimani. The analysis based on ‘crops’ revealed

which seed crops were in short supply and the influence of formal and informal seed sources on various crops. The ‘years’ were able to show the seed security picture of the previous season (for example, what was planted, from where it was sourced and seed security aspects of availability, access and quality). The 2016-2017 season showed what had been planted but not harvested, while the 2016-17 season exposed the farmers’ future plans and expectations for the next season.

The number of households per area was selected through a probability in proportion to size approach to ensure that the number of households from each village was in proportion to the population of farmers (Durrheim and Painter, 2006). The calculated sample sizes are shown in Table 3.1. The sampling was done to ensure a 95% level of confidence in the estimates derived from the sample size. A total sample size of 184 households from a population of 2998 households was calculated with a 95% level of confidence and confidence interval of seven, using an online statistical sample size calculator¹.

Table 3.1: Sample size calculation per study site based on household population

Cluster	Ward No.	Population	Households	Calculated Sample Size
Chikukwa: Eastern	10	2,650	634	39
	11	1,567	418	26
Total Chikukwa	10 and 11	4,217	1,052	65
Chaseyama: Western	3	5,488	1,946	119
Grand Total	All wards	9,705	2,998	184

The settlement pattern was determined by asking the local community based organisations (CBOs) operating in the area and triangulating their information with information from the local village heads. The village heads also provided lists of the village households in their area. The settlement pattern across both locations was linear consisting of households settled along natural and man-made features such as foothills, along the riverbeds, adjacent to primary schools and along the trunk roads. Based on the settlement pattern of the homesteads, a systematic random sampling method was used to select the households that were surveyed from each village in proportion to

¹ The sample size calculator was accessed from the following website:
<https://www.surveysystem.com/sscalc.htm#one>, on 30 November 2016.

the number of households per village. This sampling approach is also recommended in the Seed Security Assessment Manual for similar settlement patterns (FAO, 2015b). After randomly selecting the first household to be surveyed per village, every third household was selected until the required sample size for that village was reached. The final number of households that were actually surveyed was 227, consisting of 114 from Chaseyama and 113 from Chikukwa. The enumerators ended up interviewing more households than planned.

The non-probability sampling method was applied in selecting the agro-dealers, extension officers, farmer groups, and individual farmers to participate in the in-depth, life-history interviews. These groups were selected on the basis of their capacity to respond to the research questions based on specific characteristics. The agro-dealers sold various farm inputs such as seed, fertilisers and tools. The extension officers were located close to the farmers and were knowledgeable of them and the study area. The farmer life-history groups comprised older farmers who had been staying in both locations for a long time. Although this method is open to bias, such as attitudes towards novelty and assets ownership, the emphasis in non-probability sampling is on the capacity of a small number of cases to illustrate the phenomenon under investigation clearly and comprehensively (Quinlan, 2011).

3.3 KEY RESPONDENT INTERVIEWS

Key respondent interviews were used to target the agricultural extension staff, under the Ministry of Agriculture, working with farmers. These key respondents possessed first-hand knowledge of seed issues and food security and had an understanding of the demographic features of the farmers. Interviews were held throughout Chaseyama and Chikukwa clusters. In Chaseyama, interviews were held with the extension supervisor for the area and two extension officers responsible for the three villages selected for the study. The interviews in Chikukwa were conducted with the extension supervisor for the area and the extension officer for two villages that fell under the study area. Responses from the extension workers provided contextual information about seed systems and food systems, challenges that farmers face and an overview of the stakeholders that work with farmers. In order to address the subjectivity of key respondent interviews, the information received from the extension workers in the field was triangulated with information from the district

agricultural extension officer and two representatives from local community-based organisations (PORET and CELUCT). The field representatives of community-based organisations provided contextual information about farming activities carried out by farmers, and the support they provide farmers such as training and seeds of small grains and legumes.

The interviews with the extension workers were qualitative and semi-structured in nature, guided by a list of topics (Kumar, 1989; ACAPS, 2011; FAO, 2015b). Key topics discussed included: their role as extension workers; their knowledge and skills in addressing farmers' constraints; seed crops grown by farmers in the area and seed strategies promoted; the food security situation in the area; and constraints that extension workers face in supporting smallholder farmers. The responses from the extension workers were recorded in a notebook and also captured on a voice recorder. The key respondent interviews set the basis for the other research methods such as the household survey, focus group discussions, and life-history interviews.

3.4 HOUSEHOLD SURVEY

Babbie and Mouton (2011) argue that a household survey is useful for the purposes of descriptive, exploratory and explanatory research. These purposes were all relevant for this research. In a household survey, respondents are engaged in one-to-one interviews so that the researcher develops a rapport with the interviewees. The rapport helps the researcher to observe and engage completely with the interviewee, while the interviewee has the opportunity and time to express their individual perspective and experiences of the phenomenon under investigation (Quinlan, 2011).

To enable an effective household survey, the researcher recruited, trained and supervised enumerators from both study sites to administer the household survey questionnaires to the households. The enumerators were knowledgeable of the local customs and Shona language and conducted interviews in Shona. Before the household survey was done, the questionnaire was pre-tested and refined to ensure that it captured the data required to achieve the research objectives. The adjustments included re-ordering some of the questions, deleting some that were redundant, and including additional codes for seed sources and ways of acquiring seed. The pre-test was

important also in guiding the research team in planning for the best period during which to conduct the interviews, addressing logistical issues such as transportation and local introductory protocols to be done in advance. The survey was conducted during the peak hunger season of January and February 2017. Food security studies have argued that the peak hunger season is the most useful period for assessing the food security situation as it is the time of greatest food shortage (Swindale and Bilinsky, 2005; Kennedy et al., 2011; Maxwell et al., 2013). To manage expectations of receiving food and seed, interviewees were informed on the purposes of the survey and that no benefits would be provided directly to participating households.

The household questionnaire was used to capture data about seed and cropping (what crops were planted, and the seed sources) based on the 2015 - 2016 season, the 2016 - 2017 season, and plans for the next season. This made it possible to trace the seed security situation of households across three seasons. Most seed questions for the household survey were adapted from the Seed Security Assessment tool that captures seed data related to availability, access, and utilisation (FAO, 2015b). Seed security assessment methodology was developed by the International Centre for Tropical Agriculture (CIAT) and the Catholic Relief Services (CRS) and formalised by Sperling (2008). Based on the FAO (2016a) guidelines, it consists of collecting and analysing information from a number of sources that include the household survey questionnaire, local market survey, focus group discussions, key informant interviews, agro-dealer questionnaire and the seed aid actors question guide.

The food information section included questions used to capture data about the food security self-classification, the dietary diversity score, food consumption score, and the household food insecurity experience scale. The food security self-classification question required households to choose a category of food security/insecurity based on their own perception. Studies have shown the importance of complementing objective food security assessments with subjective measures as the latter can capture psychological dimensions of food insecurity and are useful for gauging expectations (Migotto et al., 2005; Heady and Ecker, 2012;). These studies argue that households might regard themselves as being hungry, even if there are no recognisable signs of under-nutrition. The food security self-classification question thus enabled the researcher to assess this additional food security dimension.

The household dietary diversity score (HDDS) measures the number of food groups consumed over a given reference period, usually a 24-hour period (Swindale and Bilinsky, 2005; FAO, 2011). The food groups used ranged from 9 to 12, depending on the categorisation of the major food groups that included: cereals, starch, fruits and vegetables, meat, legumes, milk products, fats and condiments. For this study the HDDS questions captured data from all 12 food groups. The dietary diversity score has been proven to be a good and easy-to-use proxy for dietary quality, as it is positively correlated to the nutritional outcomes and to the pillars of food security (food availability, access, and utilisation) (Ruel, 2002; Sibhatu and Qaim, 2016). The HDDS has also been shown to be associated with various measures of household socio-economic status that are proxy indicators of household food security (Ruel, 2002; Jones et al., 2013).

The Food Consumption Score (FCS) aggregates household food data about the diversity and frequency of the food groups consumed over a previous seven-day period. These are then weighted according to the relative nutritional value of the consumed food groups (WFP, 2008; Leroy et al., 2015). The food groups containing nutritionally dense foods, such as animal products, are given a higher weight compared with less nutritionally dense foods such as tubers. Based on this score, households are then classified into three categories: poor, borderline, or acceptable food consumption. The weaknesses of the FCS are that it does not consider foods consumed outside the household, it does not provide information of intra-household food distribution and the seven-day recall makes it impossible to consider the quantity of food eaten (Brinkman et al., 2010; Mango et al., 2018). The advantage of the FCS is that it is able to capture both dietary diversity and food consumption frequency, and a comparable analysis between data sets can be made (WFP, 2008). It was possible to use the questionnaire to capture the food groups and the frequency of consumption with which each household ate over a seven-day recall period. A comparative analysis between Chikukwa and Chaseyama or across households from other areas or with different demographic characteristics could thus be made.

The household food insecurity experience scale (FIES) is an “experience-based metric of severity of food insecurity that relies on people’s direct responses to a series of questions regarding their access to adequate food” (Ballard et al., 2013: 1). Respondents are asked whether: they have

worried about their ability to obtain enough food; their household has run out of food; they have been forced to compromise the quality or quantity of the food they ate because of limited availability of money or other resources to obtain food (Ballard et al., 2013; Cafiero et al., 2016). A household is asked eight questions with simple dichotomous responses based on a recall period of between one and three months (Cafiero et al., 2016). Ballard et al. (2013: 1) argue that the strength of the household food insecurity experience scale indicator is that it is “based on real experiences that households have faced because of hunger”. The index has been shown also to provide the link between different sector perspectives, such as between nutrition and agriculture. For this study, the link between food security and seed security could thus be assessed. All the households in the sample were asked the eight questions, using a recall period of three months (during the peak hunger season). The respondents answered with either a ‘no’ or ‘yes’ to each question. The limitation of the FIES is that its specific questions must be linguistically adapted and translated carefully to ensure that respondents understand the questions well (Saint Ville et al., 2019).

Although there are many ways of measuring food security and seed security, these concepts are focused on the household level, which was the perspective of this research. The other questions captured household demographics, household assets and alternative livelihood strategies such as off-farm and non-farm income sources.

3.5 FOCUS GROUP DISCUSSION AND COMMUNITY TREND ANALYSIS

A focus group discussion makes it possible to generate a large number of ideas, thoughts, feelings and perceptions about the same issue from different people within a short time frame (Gibbs, 1997; Elliot and Associates, 2005). The method thus makes use of open-ended questions such as “what”, “why”, “how”, “when”, and “which” (Kumar, 1987: 4). Focus group discussions also make it possible to triangulate information obtained from household interviews. Two focus group discussions were held at Chaseyama and Chikukwa targeting a group of 8-10 farmers, comprising a balanced mix of men and women. Each focus group discussion took approximately half a day to complete, to give the participants enough time to share their experiences and contributions about

the historical developments in their areas. The farmers' group from Chaseyama included eight men and women from three villages, while the Chikukwa group consisted of 10 men and women from three villages. These participants were selected according to their willingness to participate, their demography (old age, and mixed males and females), historical knowledge of the area and farming experience.

The focus group discussion guide developed for the Seed Security Assessment (FAO, 2015b) was adapted to the Chimanimani context and incorporated questions about food and trends in historical events, economy, climate and weather patterns in the area. The focus group discussion was participatory in nature and used participatory tools such as historical trend/timeline analysis, the participatory four-cell analysis and pairwise ranking of crops that farmers grew (Henman and Chambers, 2001; Cavestro, 2003; Sadanandan et al., 2007; Sthapit et al., 2012).

3.5.1 Timeline

Timelines, also called historical profiles, indicate the changes over a previous few years related to variables concerned with a particular field. Thus, they can be used to summarise the major events and changes that have taken place during the life of a community (Sadanandan et al., 2007). The timelines were used to show the historical trends of farmers' experiences of seed (in) security and food (in) security, the underlying causes, the impacts and how communities responded. The age of the farmers and their ability to recall determined the starting period of inquiry, while the successive years were mapped according to key activities that had a bearing on seed (in) security and food (in) security. Information gathered from timelines was triangulated also with interviews with extension officers, individual life-history interviews and the literature review to remove any inherent biases of timelines or memory lapses that might have arisen from respondents providing inaccurate accounts.

3.5.2 Seed diversity wheel

The participatory four-cell analysis, also called the "seed diversity wheel", was used to understand the key crops that were important to food security and livelihoods of households. The four-cell analysis tool was developed by a project team in Nepal to determine the risk of genetic diversity

loss and the reasons why some crops or varieties are in the risk zone (Sthapit et al., 2012). Crops grown by farmers in a given location are categorised into groups that occupy large or small areas (based on average area), and those crops that are grown by many and few households.

Using this approach, the farmers from Chikukwa and Chaseyama were asked to list all the important crops for their food needs and livelihoods. From this list of crops, they engaged in a process to determine which crops were grown by many households in large areas, many households in smaller areas, by few households in smaller areas, and few households in large areas. Through this process, farmers were able to determine which crops were in abundance and which crops were threatened. This also showed the potential food diversity based on household crop production which is the main source of food for most smallholder farming households.

3.5.3 Pairwise ranking

Pairwise ranking was used to prioritise the key crops preferred by farmers for their food, income and nutrition needs. Using this method, people are asked to choose between items presented as paired comparisons, rather than ranking all items simultaneously (Pretty et al., 1995; Cremb and Purcell, 2001; Gay et al., 2016). Pairwise ranking has been used to help farmers choose a variety to grow by comparing traits of several varieties (Drinkwater, 1993).

The pairwise ranking was used in this research to develop a ranking summary grid, in terms of food/nutrition needs and income, for the list of the crops identified. By comparing two crops at a time, the participants were asked which was the most important for food/nutrition and for income. Disagreements were not settled by voting but if, after discussions there were still disagreements over a particular cell, half a point was given for each of the choices, indicating a tie. Ties did not have an adverse impact on the eventual ranked order. The crops were then ranked in terms of the scores each received according to the purpose of the crop (be it food, nutrition or income).

In order to conduct the focus group discussions effectively in both locations, the researcher facilitated the process while two assistants played the roles of observer and note-taker. All the

deliberations were captured also using flip charts and a voice recorder. Permission was sought from the participants to use the voice recorder.

3.6 LIFE-HISTORY INTERVIEWS

Life-history interviews use stories, “looking backwards and forwards into past life experiences and anticipating the future, to make sense of complex human conditions, and to create order out of competing and contradictory experiences” (Dhunpath and Samuel, 2009:3). Lewis (2008: 562) argued that life history interviews help to “humanise the research process and are also useful for challenging received wisdom by generating nuanced accounts that subvert established knowledge”. Seed systems and food systems in rural communities are not simply generated by the functions of pre-constituted structures of government and other local agencies but, rather, are produced culturally through people’s “everyday practices and encounters” at different levels. The human elements thus need to be brought to bear by bringing to the fore the marginalised voices and experiences of the community. By introducing life-history interviews, researchers and practitioners are able to question their assumptions through a deeper level of interaction with personal narratives (Lewis 2008).

The stories about farmers’ experiences and history are valuable for interpreting and understanding conditions and circumstances under which certain smallholder farmers are seed secure and why this might contribute to household food security while, for others, it does not. The selection of farmers to participate in the life-history interviews was purposive relying on those who were older (over 60 years) and had lived in the area most of their lives and ensured a good representation of men and women. Life-history interviews were conducted with purposively selected farmers from chosen villages in the study sample. The interviews provided in-depth knowledge about farmers’ characteristics, farming approaches, livelihood issues, and more in-depth knowledge of how their seed systems had shaped and contributed to their seed security and food security situation over the years. To aid the collection of life histories, the researcher used life-history interview guides and voice recorders with the assistance of a note taker.

3.7 AGRO-DEALER SURVEYS

The local extension officers and farmers assisted in identifying the local agro-dealers that supplied farmers with certified seed throughout both Chikukwa and Chaseyama. The survey was limited to agro-dealers located in these two areas although it is acknowledged that some farmers purchased their seed from as far as Chipinge and Mutare that are more than 100km away. The agro-dealer questionnaire was adapted from an agro-dealer input questionnaire developed by the FAO for assessing activities of agro-dealers in terms of their operations, prices and challenges, seeds and other inputs they sell (FAO, 2015b). The survey was limited to shops that stocked inputs such as seeds and fertilisers. The questionnaire was administered to a total of 12 agro-dealers, six from Chikukwa and six from Chaseyama. The initial plan was to interview all the agro-dealers throughout the villages represented by the survey sample, but not all villages had agro-dealers, and not all rural shops had an agro-dealer function. The questions asked were about what inputs they stocked, seed demand and supply, credit facilities offered, seed storage and fertiliser stocks, after-sales services provided, and opportunities and challenges experienced in the seed business. Data from the agro-dealer survey showed the type of seeds distributed through the formal markets and which crops and varieties were not provided through this channel.

3.8 DATA ANALYSIS

Qualitative data was analysed by developing thematic tree diagrams and comparing themes (Elliot and Associates, 2005; Boyce and Neale, 2006). The researcher did not have prior themes established, but only broader categories such as seed security and food security, and dimensions of availability, access and utilisation. The data were analysed for themes, categories, patterns, trends, and frequently mentioned and strong opinions cited on the record sheets and the voice recorder.

Quantitative data, collected from the household survey, were subjected to statistical analyses using descriptive statistics and measures of statistical inference, including correlations, comparison of proportions and means, chi-square tests, analysis of variance, cluster analysis, multiple and linear regression analysis (Durrheim and Painter, 2006). All the required assumptions of the statistical

tests used were first met before application, while in some cases the data had to be transformed in order for the specific tests to be applied. The household survey data were captured and analysed using the Statistical Package for Social Sciences (SPSS) Version 25. The University of Cape Town (UCT) Statistical Department provided support in the analysis of the household survey data. The researcher developed a table of the key variables and respective analyses procedures to be conducted, such as descriptive statistics, comparison of means, cluster analysis, correlation and regression analysis. These were presented, discussed and refined with the assistance of the consultants at the UCT Statistics Department. The chapters of this thesis containing results were also shared with the consultants and their feedback was incorporated.

Through an iterative process, the results from the quantitative data were interpreted and compared with the qualitative data to obtain a more holistic perception of the situation of smallholder farmers. Both approaches together provided the needed breadth and depth to examine the seed security-food security nexus.

3.9 RESEARCH PARADIGM

A pragmatic paradigm was adopted for this study. Within this paradigm, the external world is understood as being real, while it is knowable through our particular and practical engagements with it (David and Sutton, 2011). Unlike the Positivists and the Interpretivists who adopt two diametrically opposite views of research, within the Pragmatic Paradigm it is believed that reality is constantly renegotiated, debated, and interpreted, and, therefore, that the best method to use is the one that solves the problem (Patel, 2015).

The resources allocated to the various activities and interventions that development and humanitarian actors implement on supplying seed as part of their contribution to ensuring the food security of rural farming households has always been a topic of interest to the researcher (Remington et al., 2002; Sperling and McGuire, 2010b; AGRA, 2014). In Zimbabwe, the distribution of seed and fertiliser has been taking place in one or another part of the country during at least ten of the 24 years since the country achieved its independence in 1980 (Rohrbach et al., 2005). Could these seed assistance or seed related activities indeed be responsible for contributing

to the seed security of farming households and ultimately leading to their food security? Kelley (2012: 381) argued that:

“If we are deliberately looking to achieve an end... through our research to find ways to do it, the extent to which the actions indicated by the research bring about the desired results is a measure of the truth value of the research”.

The Pragmatic Paradigm is characterised by:

- i. The use of “what works” to allow the researcher to address the questions being investigated without worrying about whether the questions are wholly quantitative or qualitative in nature;
- ii. Adoption of a worldview that allows for a research design and methodologies that are best suited to the purpose of the study;
- iii. Seeking to utilise the best approaches to gaining knowledge by using every methodology that helps to discover that knowledge (Kivunja and Kuyini, 2017: 36).

Kivunja and Kuyini (2017) argue that these characteristics gave rise to a paradigm that advocates the use of mixed methods as a pragmatic way to understand human behaviour. This argument thus supports the combined use of quantitative and qualitative research methods that would answer the research questions best rather than using a one-sided approach. The quantitative approaches (used for the household survey and agro-dealer survey) provided reliable and valid tools to measure the reality of the farmers’ and stakeholder’s situation that was possible to measure. The qualitative approaches (such as life histories, focus group discussions and historical timelines) made it possible to make a complementary interpretation of reality, and discover the underlying meaning of events, circumstances and activities. The thinking that underpinned the research presented in this thesis is that combining qualitative and quantitative techniques is essential for obtaining a complete analysis of the relationship between seed security and food security.

3.10 ETHICAL ISSUES

Scientific researchers are required to be judicious in the design and implementation of research projects and to ensure that their research does not cause harm (Thompson, 1988). Some of the ethical issues to be taken into consideration in research include seeking permission and interest from all involved in the research, not misusing any of the information discovered, protecting the rights, privacy and confidentiality of participants (MacColl et al., 2005; Ramesh, n.d.). Ramesh (n.d.) argued further that every community has its own set of morals that need to be understood and upheld when interacting with them.

Ethical clearance for this research was sought from the Faculty of Humanities at the University of Cape Town. Prior informed consent was obtained at all stages of data collection for this study. Before conducting the research process in both sites (Chikukwa and Chaseyama), permission was sought from the local authorities that included the representatives for the chief and village heads and the district agricultural extension officer for Chimanimani. A memorandum of understanding that specified the researcher's role, expectations, and community's expectations was developed and agreed between the researcher and the farmer representatives.

The principle of prior informed consent was upheld throughout this study. Prior to commencing the study, respondents and participants were informed of the purpose of the research, the timeframes involved and the uses of the data and research findings. The potential risks and benefits of participating in the research study were discussed. Respondents were made aware of their rights to accept or decline the invitation to participate, to ask questions before, during and after each interview, and to terminate an interview at any point if they so wished.

No concealment or deception was used when seeking information, and respondents were not coerced in any manner whatsoever to participate in any aspect of the research. The principle of confidentiality was upheld at all times i.e. respondents were not identified as the source of information unless they had specifically given permission for this to occur. Respondents were assured before the interviews that data would be stored in an anonymous format and kept confidential. This was maintained throughout the research process.

All participants and respondents in the research study were treated with full respect and regarded as autonomous agents. All researchers involved in the study affirmed that the well-being of human subjects takes precedence over the personal or professional gain of researchers. The study was not carried out with the vulnerable and disadvantaged in order to benefit the privileged. Researchers ensured that they did not raise the expectations of participants and respondents unduly in relation to the potential benefits of the research. Initial feedback was provided to the participating farm communities during November 2020 with planned follow-up community engagements planned in 2021.

The researcher acknowledges his unusual role, being employed by the Swiss Agency for Development Corporation (SDC), which is one of the donors of CELUCT² and PORET that are located and work in Chikukwa and Chaseyama respectively, on the one hand, and being a researcher on the other. The SDC funding is provided to Biowatch South Africa as a 50% contribution to implement the Seed and Knowledge Initiative (SKI) project in Zimbabwe, Zambia, Malawi and South Africa. The objective of the Seed and Knowledge Initiative project is to contribute to improved food security for participating farmer communities through more resilient, farmer-led seed systems and agro-ecological farming practices. This is achieved by supporting and building the capacity of smallholder farmers in agro-ecological farming and farmer-led seed systems. Agro-ecological farming combines organic soil management, farmers' seed and water management as well as training for smallholder farmers in agro-ecological practices such as integrated pest management, organic soil fertility management, conservation tillage, water harvesting and polycultures. Farmer-led seed systems include support for quality seed production, participatory variety selection, community seed banks and seed fairs (SKI, 2019).

The Seed and Knowledge Initiative project is implemented throughout the four countries mentioned by twelve non-governmental organisations and the University of Cape Town under the Bio-economy Research Chair led by Professor Rachel Wynberg. These thirteen organisations, in

² Refer to Chapter 4 for the details of these two NGOs that work with smallholder farmers promoting farm varieties and agro-ecological practices.

turn, receive small grants from Biowatch South Africa to implement the Seed and Knowledge Initiative in addition to raising their own complementary funding.

Through working with the Swiss Agency for Development Corporation (SDC), the researcher was exposed to the Seed and Knowledge Initiative project which led to his interest in studying some of the communities who received support from the project. The funding of the researcher's role did not unduly affect the research process on the following basis: (1) the communities in Chimanimani had been working on seed issues since 1996, while SDC funding support was started towards the end of 2015 (SDC funding has had no significant impact on the seed activities in Chimanimani District and all the farmers located in the study area), (2) the sampling of interview participants extended beyond the farmers currently targeted by the Seed and Knowledge Initiative support, (3) SDC funding is a relatively small contribution of funding for the project and is provided indirectly to the project via their third-party, partner organisation (Biowatch, South Africa), and (4) SDC funding is not evident/visible in the project as it is focused on training and capacity development rather than physically erecting structures. Owing to the funding modality, the farming households in the study area were generally unaware of the SDC funding source and were unlikely to withhold useful information to enable the research team to understand their seed systems and food systems.

3.11 LIMITATIONS AND CHALLENGES FACED DURING THE RESEARCH STUDY

The data collection process took place smoothly as a result of good communication and collaboration with key stakeholders that included local authorities, extension officers and farmers who were supportive. Some agricultural extension officers were reluctant initially to be interviewed as they did not have clearance from authorities in Chimanimani District. The practice in the area was that researchers had to obtain prior clearance from the district office before engaging the field teams. Although this authorisation was obtained, communication between the district office and the field teams had not been established. This was later resolved once the district office communicated with the field teams.

When the researcher introduced the research process to the leadership and farmers in Chikukwa, there was initial reluctance to authorise it and participate. This was because previous researchers in the area had not provided feedback from their research findings to benefit the farmers. This was resolved by developing a memorandum of understanding that specified the roles and expectations of the research, giving an opportunity to the local communities to participate in the research, and an agreement to share the results with the communities after conclusion of the study.

During the household interviews, not all the farmers were present in their households at the time of the visits. These were later followed up after interviewing those that were present. Other households from the same village were visited to replace the households that were absent for the day in order to meet the sample quota. Replacement of missing households resulted in travelling longer distances as the homesteads were quite dispersed.

The household interviews were conducted during the rainy season, which made it difficult to access homesteads and limited movement, especially in Chikukwa that experienced heavy, daily downpours of rain. This resulted in the household survey requiring five additional days than was initially envisaged. The terrain in Chikukwa characterized by hills also slowed down the household interview process.

3.12 CONCLUSION

The research methods and approaches used in generating the empirical data and probing the research questions have been explained in this chapter. A case study assessment of the two study sites in Chimanmani (i.e. Chaseyama and Chikukwa) was used to develop an in-depth understanding of the issues being investigated. Extensive and intensive research approaches were used to gather data. These were informed by the research objectives and similar studies done in the past by other researchers.

The extensive research methods involved a household survey of 227 farming households, and 12 agro-dealer shops throughout Chikukwa and Chaseyama. The intensive research methods included key respondent interviews with extension officers and field staff of the local organisations in the

area, farmer group interviews, and in-depth life-history interviews with selected individual farmers. The use of research assistants, voice recorders, and flip charts was an immense help in enabling the research to be undertaken successfully.

The use of both extensive and intensive research methods added rigor to the study. The household surveys were conducted between January and February 2017, while the other interviews were conducted in July and August 2017. Taking a break between these research processes allowed for critical reflection on the research methodology and the emerging results. Building a good rapport with respondents, interviewees and local leadership resulted in their active participation in the study.

CHAPTER FOUR: STUDY AREA PROFILE

4.1 INTRODUCTION

In this chapter, the socio-economic and demographic profiles of the study site in Chimanimani District are described with a focus on the two areas selected for the research: Chaseyama and Chikukwa. These two areas were selected because of their different bio-physical characteristics and agricultural potential. Chaseyama is dry and semi-arid with sandy soils, while Chikukwa is very wet during the rainy season and has red clay soils. The purpose of this chapter is to provide a descriptive analysis of household demographic characteristics, the livelihood features and the community-based organisations supporting farmers in Chimanimani. This analysis establishes the wider socio-economic and livelihood context within which smallholder farming in Chimanimani is practiced and how it contributes to seed security and food security. This background information provides the necessary understanding for further analysis in Chapters five, six, seven and eight.

4.2 BIO-PHYSICAL CONDITIONS

Rainfall decreases across Chimanimani District from a high of 1509 mm per annum in the east, to a low of 400 mm per annum in the west (Mashapa et al., 2013; Oxfam-UNDP/GEF, 2015). In terms of ecological potential, the communal and resettlement areas are divided into two: one with good rainfall for agricultural activities and another that is semi-arid. The latter is the larger part of the district (Mate, 2001).

Some of these features are a result of environmental practices such as indiscriminate tree felling for energy, construction and for clearing for farming (Mate, 2001). The district is traversed by five, main, perennial rivers: Wengezi and Umvumvu in the north and Nyahode, Haroni and Rusitu in the eastern part of the district (Chimanimani RDC, 2019). The district has a total of 48, small, dry dams, 95% of which are silted, and one, medium-sized dam, namely: Mhakwe (Chimanimani District Profile, 2018).

The landscape consists of a high and rugged terrain in the eastern area with an altitude of up to 6,000 metres above sea level and a low, flat terrain especially in the Save and Odzi Valleys that is 1,600m above sea level. The district consists mainly of dolerite and silica clays in the high terrain, and quartzite sands and aluminum in the low-lying areas. There are three vegetation categories: (1) low-lying areas, in the dry region with mixed deciduous woodland consisting of baobab and Mopani trees predominantly; (2) escarpment, consisting of savanna woodland and montana grassland with broad-leafed, evergreen forests; (3) highlands, with broad-leafed, montana forests and exotic trees of pine, wattle and eucalyptus trees (Chimanimani RDC, 2019).

Table 4.1 shows the agro-ecological classification and characteristics of each area in Chimanimani as well as the land distribution, land holdings per household and population density by agro-ecological zone. A reclassification of the agro-ecological regions of Zimbabwe by Mugandani et al. (2012) revealed that the main food producing Natural Regions II and III decreased compared to the other regions. This points to evidence of climate variability and change and possible problems of food insecurity.

Table 4.1: Agro-ecological Natural Regions of Chimanimani District

Classification	Characteristics	Area in 000 ha (and % of total area)
Region I - Specialised and Diversified Farming	Rainfall in this region is high (> 1,000 mm per annum) in areas lying below 1,700 m altitude, and more than 900 mm per annum at greater altitudes, normally with some precipitation in all months of the year. Temperatures are comparatively low and consequently favourable for fruit and intensive livestock production.	613 ha (1.56%)
Region II- Intensive Farming	Rainfall is confined to summer and is moderately high (700 -1,000 mm). The region is suitable for intensive systems of farming based on crops and/or livestock production.	7,343 ha (18.68%)
Region III - Semi-Intensive Farming	Rainfall in this region is moderate (550 – 700 mm) but, because much of it is accounted for by infrequent heavy falls, and temperatures are generally high, its effectiveness is reduced. The region is also subject to fairly severe, mid-season, dry spells and, therefore, is marginal for maize, tobacco and cotton production or for enterprises based on crop production alone.	6,855 ha (17.43%)

Classification	Characteristics	Area in 000 ha (and % of total area)
Region IV - Semi-Extensive Farming	This region experiences fairly low, total rainfall (450 – 600 mm) and is subject to periodic, seasonal droughts and severe dry spells during the rainy season. The rainfall is too low and uncertain for cash cropping except in certain, very favourable localities where limited, drought-resistant crops can be grown.	13,010,036 ha (33.03%)
Region V - Extensive Farming	The rainfall in this region is too low and erratic for the reliable production of even drought-resistant fodder and grain crops, and farming has to be based on utilisation of the veld alone. An extensive form of cattle ranching, or game ranching is the only sound farming system for this region.	10,288,000 (26.2%)

Source: Adapted from Mugandani et al (2012), Zuwarimwe (2009) and OCHA (2012).

4.3 SOCIO-ECONOMIC AND DEMOGRAPHIC PROFILE OF CHIMANIMANI DISTRICT

Settlement patterns in Chimanimani District are categorised into forestry estates (42 %), communal areas (34 %), resettlement areas (17 %), national parks (5 %), commercial farming areas (1 %) and semi-urban settlements (1 %) (Chimanimani RDC, 2017a). The demographic characteristics of Chimanimani District in comparison with Manicaland Province are shown in Table 4.2. The characteristics of Chimanimani are similar to all the provincial characteristics except for the unemployment rate and access to safe sanitation, which are lower in Chimanimani.

Table 4.2: Demographic characteristics of Chimanimani District

Characteristic	Chimanimani District	Manicaland Province
<u>Men (%)</u> :	48	47.4
<u>Women (%)</u> :	52	52.6
<u>Total population</u> :	205 685	1 752 698
Unemployment rate (%)	1.6	6
Average household size	4.1	4.2
Access to safe sanitation (%)	36.5	80
Households with access to safe drinking water (%)	74.3	74
Fuel for cooking (%)	93.4	81
Households with access to electricity for lighting (%)	30.7	37

Source: Zimstats (2012a).

The unemployment rate in Chimanimani is lower than in Manicaland Province and both are lower than the national rate of 11.1% (Zimstats, 2012b). The definition of the economically active population by Zimstats (2012b) includes paid employees and employers, unpaid family workers, own account workers and those unemployed. The unemployed group is what is used to determine the unemployment rate. In contrast, universally, unemployment is referred to as the share of the labour force that is without work but available for, and seeking, employment (Global Economy, 2019). In a study carried out in 2014, the way in which unemployment is calculated in Zimbabwe was criticised as it showed that, depending on the source (whether the World Bank or National Statistics office), unemployment could range between 4% and 95% (Chiumia, 2014). Chimanimani, being rural, has most of its labour force engaged in different livelihoods including farming, migratory labour and gold panning (Chimanimani RDC, 2017b).

The rate of access to fuel for cooking is very high in the district compared with the province but households have low access to electricity for lighting. This high reliance on firewood is one of the probable causes of deforestation in the district (Chimanimani RDC, 2017b). Chimanimani District has already witnessed significant changes in its climatic conditions as evidenced by increased

temperatures in the once cold highlands, frequent droughts in the low veld, and changes of rainfall patterns across the whole district, and siltation of water courses and bodies (Chimanimani RDC, 2017a). In an Oxfam study of Chimanimani District, it was noted that the increase in human population has resulted in pressure on natural resources, particularly land. As a result of this increase, areas that had been reserved for livestock grazing are now being opened up for crop farming and for homesteads, thereby reducing the already limited grazing area (Oxfam-UNDP/GEF, 2015). This was further noted by Leahy (2013), whose research noted that a constant clearing of the original forest vegetation, combined with over-grazing and cropping, had destroyed the landscape of Chimanimani, especially in Chikukwa.

4.4 HOUSEHOLD CHARACTERISTICS OF FARMERS IN THE STUDY AREA

4.4.1 Ethnicities in the study area

The people in Chimanimani are of Ndaou origin and came from South Africa via Mozambique. Their *Sadunhus* (leaders) are of chief Mutambara's lineage (Campbell et al., 1995). The ethno-history of communities occupying Chimanimani traces their origins to the area known as Mbire (Wedza District) and appear to be an offshoot of the Varozvi who migrated eastwards and have a common history with the people in Chipinge (Kozanayi, 2018). The history of the term "Ndaou" as an ethnic name remains obscure and there are divergent opinions on the term's origin. Two prominent versions are: that the name arose from the way the people greet each other, "*Ndauwe*", meaning "We salute you"; and a derogatory derivation from the Nguni, "*Indawo*", used in referring to people of Nguni descent who had invaded and conquered previous inhabitants, dispossessing them of their land in the process, using an almost prescribed expression, "*Indawo yethu le*", meaning "This is our place" (MacGonagle, 2007; Kozanayi, 2018; Sithole, 2018).

4.4.2 Household composition

Table 4.3 shows the main demographic features of the Chimanimani farmers sampled from the Chaseyama and Chikukwa clusters. The mean household sizes at Chaseyama and Chikukwa were slightly larger than the mean household size in the district, which was 4.1 household members. There is almost an equal number of adults and children in these households, and over 75% of

households sampled throughout Chaseyama and Chikukwa were male headed households. The mean age of household heads was slightly higher in Chaseyama compared with Chikukwa.

Table 4.3: Demographic features of households surveyed in Chaseyama and Chikukwa

Variable	Chaseyama (n = 114)	Chikukwa (n = 113)
<i>Standard deviations in parentheses</i>		
Mean household size	5.2 (2) Range: 1-13	5.2 (2) Range: 1-11
Mean number of adults	2.7 (1.2) Range: 1-6	2.5 (1.4) Range: 1-7
Mean number of children	2.5 (1.7) Range: 0-7	2.5 (1.5) Range: 0-6
Sex of household head	24.6	23
Females (%)	75.4	77
Males (%)		
Mean age of household head (Years)	55 (16) Range: 27-97	50.5 (14) Range: 24-80

Source: Field survey. Standard deviations in parentheses.

4.4.3 Marital status

As shown in Table 4.4, the majority of household heads surveyed in Chaseyama and Chikukwa were married, followed by the widowed, while a few were single or divorced. The high proportion of couples in both locations meant they had more opportunities to access alternative income sources such as formal employment, other livelihood opportunities and additional household labour. The high proportion of widows was consistent with the high mean age of household heads, which was 55 years for Chaseyama and 50 years for Chikukwa, showing that the majority of household heads were mature. The existence of this older age group amongst household heads brought the advantages of experience and well-developed networks in the community. The drawback was the reluctance of older people to adopt new technologies and skills quickly, compared with those of a younger age group.

Table 4.4: Comparison of the marital status of household heads at Chaseyama and Chikukwa

Marital status	Chaseyama (n = 114)	Chikukwa (n = 113)
Married (%)	74.6	78.8
Widowed (%)	20.2	17.7
Divorced (%)	1.8	0.9
Single/Not married (%)	3.5	2.7

Source: Field survey

4.4.4 Agricultural crop production practices

The main agricultural practices that farmers are engaged in include integrated pest control management, multiple soil improvement techniques, soil erosion control, intercropping and crop rotation, diversified cropping systems (mixing annuals and perennials and growing herbs, fruits, pulses, small grains and oil crops), relay cropping, water harvesting, and growing crops that are adapted to the agro-ecological environment (Mukute 2015). The farmers grow a wide range of crops in their drylands fields and horticultural plots. In Chimanimani, small-scale farmers grow at least 73 different types of crop species comprising: 20 herbs and condiments, 17 types of vegetables, 12 kinds of fruit trees, eight pulses, six cereal types, four root crops, three oil crops and three sugar crops. The top twenty crops according to the number of households that grew them were maize, 91 %; sugar cane, 81 %, onion, 73 %; groundnut, 73 %; pumpkin, 72 %; ginger bush, 72 %; bean, 69 %; stinging nettle, 69 %; cowpea, 65 %; sweet sorghum, 60 %; tomato, 57 %; avocado, 54 %; banana, 53 %; mango, 53 %; Jugo bean, 49 %; sorghum, 46 %; yam, 46 %; sunflower, 39 %; guava, 38 %; and aloe, 37 % (Ibid). Table 4.5 shows the diversity of crops grown by smallholder farming households in Chimanimani district.

Table 4.5: Diversity of crops grown in Chimanimani district

Crop type	Number of crop varieties	Types of crops
Cereals	5	Maize, sorghum, wheat, finger millet, pearl millet
Pulses	8	Sugar beans, Mung beans, Jugo beans, peas, pigeon pea, cow peas, soya beans, Bambara nuts
Vegetables: leafy, root and fruit	17	Calabash, cabbage, green pepper, spinach, lettuce, pumpkin, butternut, carrots, onion, garlic, tomatoes, tree tomato, beetroot, okra, black jack, covo, tsunga
Oil crops	3	Groundnuts, sesame, sunflower

Root crops	4	Sweet potato, Irish potato, yams, cassava
Sugar	2	Sugar cane, sweet sorghum
Fruits	13	Banana, mango, avocado, loquat, strawberry, peach, lemon, nartjies, orange, guava, grapes, pineapple, water melon
Herbs and condiments	20	Coffee, fennel, rosemary, celery, lavender, mints, thyme, geranium, chilli, nasturtium, rhubarb, aloes, lemon grass, parsley, wild garlic, ginger, stinging nettle, moringa, lemon verbena, wormwood

Source: adapted from Mutuke 2015.

The agricultural practices in Chimanimani should be understood in the context of land appropriation and subsequent struggles that have characterised the area. Chidakwa (2003) and Hughes (1996) traced the history of land dispossession in Chimanimani in three phases. The first phase was the arrival of white colonial settlers from South Africa between 1892 and 1893. This phase saw the seizure of land and eviction of inhabitants from their original places of residence on the Chimanimani Highlands. This resulted in the former inhabitants being left to occupy areas unsuitable for white settlement and agriculture. This was followed in the 1950s by the acquisition of land by the colonial government and private companies such as Border Timbers Pvt. Ltd, the Tarka Forestry Estate and the Rhodesia Wattle Company. In the 1960s, the appropriation of land was related to the establishment and expansion of the Chimanimani National Park. This led to further land alienation and concentration of smallholder farmers in small areas of land that were infertile.

After independence in 1980, the new government enforced the *status quo*. Backed by (and recognising) colonial legislation and policies, the government revalidated both the national parks' and the botanical reserves' boundaries. Attempts to exclude local people from the reserves were met with resistance and were largely ignored (Chidakwa, 2003).

Chimanimani has been known for producing many crops for export such as fruit, vegetables, flowers, tea, coffee and timber (Manjengwa et al., 2012). The timber industry has faced several downturns, forcing many people to leave work unpaid. Angry workers started burning the pine trees clearing land for farming as a way of compensating for their lost jobs and money. The District activities have gradually shifted from being purely timber processing to farming (Masawi, 2017).

The predominant agricultural system in the Chimanimani District is cropping that is dependent on the summer rainfall. A variety of crops, such as maize, sorghum, pearl millet, groundnuts, rapoko, cowpeas, sunflower, watermelons and pumpkins, are grown under rain-fed agriculture in the communal areas (ZIMVAC, 2011; Oxfam-UNDP/GEF, 2015; Chimanimani RDC, 2017b). Chimanimani farmers continue to grow maize, which is the preferred staple crop, though not suitable for the western part of the region (Masawi, 2017). Maize yields among smallholder farmers are generally low, at below 500 kg per hectare (MOA, 2014; Oxfam-UNDP/GEF, 2015). This is mainly due to low rainfall especially from the western part of the district, low use of fertilizers and unsuitable farming practices. The main maize varieties grown are hybrid, medium-maturing varieties. Most farmers opt for medium-maturing varieties with higher yields, hoping that they will receive good rains (Oxfam-UNDP/GEF, 2015). Small grains (sorghum and millets), which have a potential of 910 – 980 kg per ha under rain fed conditions are recommended for the area (Chimanimani RDC, 2017b).

Farmers in Chimanimani acquire seed from their own retained seed, seed aid from government and non-governmental organisations, local markets and agro-dealers (Mukute, 2015; Oxfam-UNDP/GEF, 2015; Kusena et al., 2017). According to a study by the Oxfam-UNDP/GEF (2015), farmers were inclined to wait for free or subsidised seed from government before buying their own. However, owing to logistical challenges, free seed tends to arrive late after the effective rains for first planting (Oxfam-UNDP/GEF, 2015; MOA, 2019).

4.4.5 Livestock production

The livestock reared were cattle, goats, sheep, poultry (local chickens, ducks, turkeys, broilers, guinea fowls, and pigeons), guinea pigs and rabbits (ZIMVAC, 2011; Oxfam-UNDP/GEF, 2015; MOA, 2019). Marketing of cattle was problematic because of the scarcity of formal markets as well as taxes deducted on sales by the Livestock Division of the Ministry of Agriculture, Mechanisation and Irrigation Development and by the Council for conducting auctions and maintenance of the market (Oxfam-UNDP/GEF, 2015).

Sixty four percent of rural households owned cattle in April 2016 (ZIMVAC, 2016). This gave them easier access to drought power, and they could sell animals in times of food shortages. However, most livestock owners do not follow an income-oriented stocking and destocking regime, because livestock ownership is governed more by cultural and status motives than by economic considerations (Chimanimani RDC, 2017b). Livestock was sold according to fluctuating household needs. Households on average derived 10.6 % of their cash income and 7 % of their food income from livestock. Poultry and other small livestock were regarded as assets for building household resilience, especially under dry conditions (Chimanimani RDC, 2017b).

Table 4.5 shows the distribution of livestock ownership amongst the households sampled in Chaseyama and Chikukwa. The households generally owned a small quantity of livestock. This corresponded to the very few farmers that earned an income from livestock in Chaseyama and none that mentioned income from livestock in Chikukwa. Comparatively, Chaseyama households owned more livestock than Chikukwa households. The most-owned livestock was poultry, followed by goats then cattle.

Table 4.5: Livestock ownership by households in Chaseyama and Chikukwa

Type of livestock owned	Chaseyama mean livestock ownership	Chikukwa mean livestock ownership
<i>Standard Deviations in parentheses</i>		
Cattle owned	3 (4.2)	2.4 (3.6)
Goats owned	6.2 (7.1)	2.8 (3.2)
Sheep owned	0.1 (0.8)	None
Pigs owned	1 (9.8)	0.1 (0.9)
Donkeys owned	0.1 (1)	None
Poultry owned	15.7 (13.4)	10.3 (8.8)
Rabbits owned	2.7 (6.6)	0.4 (1.3)

Source: Field survey. Standard deviations in parentheses.

Figure 4.2 shows the proportion of farmers, surveyed in 2017, who owned livestock.

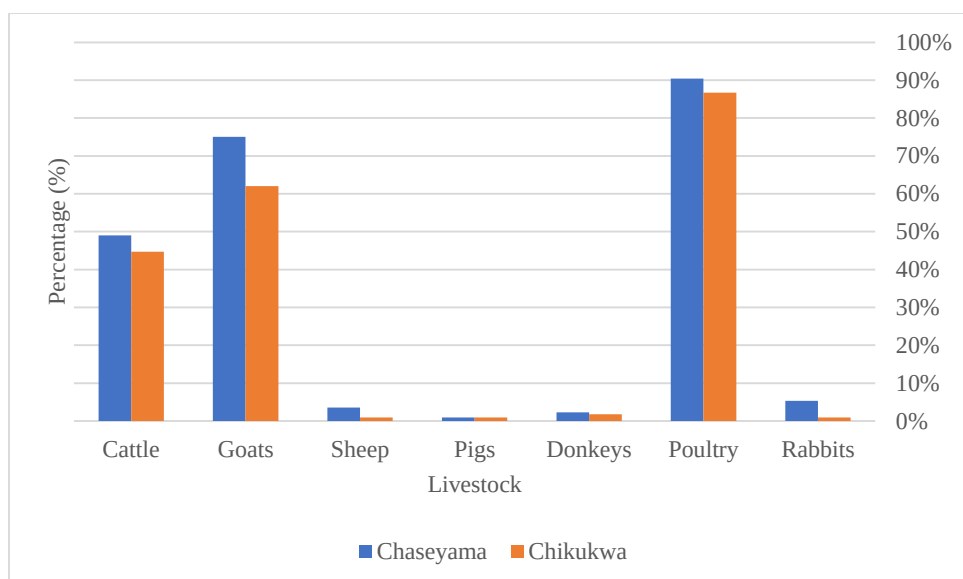


Figure 4.1: Proportion of farmers owning different livestock

Similar to the data in Table 4.5, most farmers owned poultry followed by goats then cattle. Except for pigs, more farmers from Chaseyama own livestock across all the livestock categories than farmers in Chikukwa. The only draft animals owned were cattle and donkeys, while at least 45% of farmers across both locations owned cattle and a very insignificant number of farmers owned donkeys (2 % across both locations). The other livestock were reared for meat and income. The chickens were mostly reared by the women and did not require large spaces to keep, or a lot of food compared to the other livestock types, and had high reproduction rates. This could be the reason for their high ownership.

4.4.6 Ownership of farm assets

Traditional leadership has the authority to allocate communal land. Land for crop fields and homesteads can be owned privately but grazing areas, rivers, boreholes, wild fruits and firewood are owned communally, and use is controlled by the community through the chief (Oxfam-UNDP/GEF, 2015).

Smallholders own two to five different pieces of land per household. The cause of this fragmented land ownership is that “farmers are proud to own several pieces of land, locally called *Marozhi*, demarcated by contour ridges” (Chimanimani RDC, 2017b: 28). As population increases, parents

divide their land to give to sons, or *Zvabuya*, and plots are shared between the father and mother in line with “men’s crops” and “women’s crops”. About 75 % of farmers own the land (through customary inheritance) on which they work, while more than 20% rent the land (the practice of renting land is especially prevalent in irrigation schemes) (Chimanimani RDC, 2017b).

The average land holding per household in Natural Region I, in which Chikukwa is situated, was very small, with population density per square kilometre equally very high. On the other hand, Natural Region IV, in which Chaseyama was situated, had a much greater, average, land holding per household and, consequently, they were more sparsely populated, and used land mainly for extensive cattle and subsistence crop farming (Zuwarimwe, 2009). Results from the household survey indicated that smallholder farmers in Chaseyama owned 2.3 ha of land, on average, compared with 1.8 ha in Chikukwa (significantly larger at $t_{217} = 2.16$, and $p=0.032$). The topography of Chikukwa consists of mountains and valleys while Chaseyama is much flatter. Although the farmers from Chaseyama own larger pieces of land than Chikukwa farmers, on average, the former used less land in proportion to what they owned during the 2016 -2017 cropping season. The differences in land sizes cropped were not significantly different between the two locations. Table 4.6 shows the differences in land sizes.

Table 4.6: Land sizes owned by households and years of farming in Chaseyama and Chikukwa

Characteristic	Mean land sizes owned and used	
	Chaseyama (n = 114)	Chikukwa (n = 113)
<i>Standard deviations in parentheses</i>		
Land size owned (ha)	2.3 (1.7)	1.8 (1.9)
Land size used (ha) 2016-17 season	1.6 (1.3)	1.4 (0.7)

Source: Field survey

Farmers were assessed in terms of the farm and transport assets that they owned. The farm assets owned included ploughs, wheelbarrows, sprayers, oxcarts, and hoes. Hoes were the assets owned in large quantities by the majority of households (98%) throughout Chaseyama and Chikukwa. There is a higher proportion of households from Chaseyama that own farm assets compared with Chikukwa, except for sprayers and hoes.

Table 4.7: Mean number and type of assets owned in Chaseyama and Chikukwa

Asset	Mean number owned Chaseyama	Proportion owning asset (%)	Mean number owned Chikukwa	Proportion owning asset (%)
<i>Standard deviations in parentheses</i>				
Ploughs	0.6 (0.6)	55.3	0.4 (0.6)	38.1
Wheelbarrows	0.7 (1.1)	57.9	0.4 (0.6)	36.3
Sprayers	0.4 (0.6)	35	0.4 (0.7)	38
Oxcarts	0.3 (0.5)	25.4	0.2 (0.4)	15
Hoes	4.5 (2.3)	98.2	5.3 (2.2)	98.2
Bicycles	0.4 (0.7)	29.8	0.3 (0.6)	19.5

Source: Field survey

The transport assets provide mobility for a household to travel between places, either for commercial or for social reasons, and also for hauling. This is particularly important in agriculture for transporting goods and for accessing inputs, information or training. The transportation assets owned by farmers included bicycles and oxcarts. Table 4.7 shows that more farmers from Chaseyama owned transportation assets than Chikukwa farmers, implying higher mobility in the former compared to the latter. The terrain in Chaseyama is more level and easier to navigate with available transport.

4.4.7 Poverty and income sources

According to the 2016 Poverty Atlas, Chimanimani District had a poverty prevalence³ of 70.8%, which is similar to Manicaland Province at 70.6% under which Chimanimani falls (UNICEF, Zimstats, World Bank, 2016: 119). This shows a high level of poverty in the district as well as in the province. The wealth of households is determined mainly by the quantity of livestock owned, the size of land cultivated and the quality of the soils. Employment in the commercial sector in forests and sawmills in Manicaland provides for the livelihoods of 3,249 households and can be estimated at about half of that (about 1,800 households or 5% of the district) in Chimanimani District (Chimanimani RDC, 2017b).

³ Prevalence (or incidence) of poverty (also known as the headcount index) represents the total population (either people or households) whose consumption expenditures fall below the poverty line as a proportion of the total population. Source: Zimstats (2015).

The livelihood activities characteristic of Chimanimani include cereal production, animal husbandry, remittances from migratory labour, sales of wild fruits such as wild loquat, jujube, and baobab, artisanal gold panning, legal gold mining, handicraft and casual labour (Zuwarimwe, 2009; Manjengwa et al., 2012; Kozanayi, 2018). According to the Central Statistical Office (Zimstats, 2012a), 61% of employed people in Chimanimani were in agricultural occupations, 15% were in service occupations, 6% in mining and construction and 3% in manufacturing. The agricultural occupations are related to plantations and fruit production found in the most productive region of Chimanimani.

Based on the household survey, the mean number of income sources in Chaseyama was 1.8 (0.7), while in Chikukwa it was 1.7 (0.5). This showed a very singular and limited number of income sources for the households throughout these two locations. Figure 4.3 shows the proportion of households receiving the various income sources.

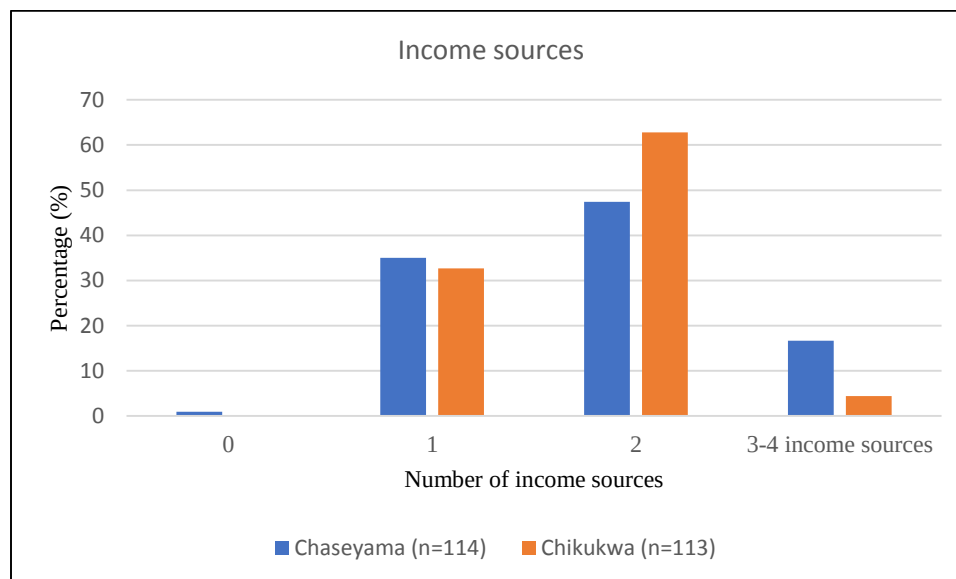


Figure 4.2: Proportion of household income sources

The major income sources for Chaseyama are farming, livestock, piecework and gardening, while for Chikukwa they are farming (100% of all farmers interviewed) and labour provision in the fields. These proportions are shown in Table 4.8. The proportions show clearly that, for Chikukwa farmers, farming plays an important and distinctive role in contributing to household income while, in Chaseyama, the proportions are similar across different income sources. This

finding is probably related to the climate and soil type in Chikukwa that is more favourable to crop production while, in Chaseyama, which is drier with sandy, shallow soils, is more suited to a mixed type of farming, and other livelihoods.

Table 4.8: Major income sources for households across Chaseyama and Chikukwa

Income source	Chaseyama (n = 114)	Chikukwa (n = 113)
Farming (%)	28.9	100
Livestock (%)	25.4	-
Piecework (%)	24.6	15
Garden (%)	20.2	-
Labour (%)	11.4	31.8
Salary (%)	6	15.9

Source: Field survey

4.5 LOCAL COMMUNITY - BASED ORGANISATIONS SUPPORTING FARMERS IN CHIKUKWA AND CHASEYAMA

The Chikukwa Ecological Land Use Community Trust (CELUCT), Participatory Organic Research, Extension and Training (PORET) and Towards Sustainable Utilisation of Resources (TSURO) are the three, locally based organisations that work with farmers in Chimanimani on agro-ecology, permaculture and seed systems. The other actors include local government and extension officers, all described below.

4.5.1 Chikukwa Ecological Land Use Community Trust (CELUCT)

CELUCT is a locally driven and community-based organisation that began operating in Chikukwa in 1991 and was registered in 1996 (Leahy and Seed, 2013). It is owned by local people in Chikukwa and is funded mostly by European donors, such as Bread for the World, through their partnership with a German couple based in the area. The work of the CBO is focused on ecological agriculture, sustainable utilisation of natural resources, seed and food security and building community cohesion and collaboration for improved livelihoods. The CBO values and uses indigenous knowledge and resources and works with both elders and the youth to enable inter-generational learning.

The CELUCT project was formed after there was widespread hunger and high rates of malnutrition in the Chikukwa villages. They began to implement permaculture activities with support from outsider facilitators (Leahy, 2011). Before the project interventions, bare hills (mostly because of deforestation), dry springs, poor harvests, floods, silting and erosion characterised the area. Permaculture practices, such as agro-forestry, inter-cropping, mulching, holistic design and the use of open-pollinated, local crop varieties, were implemented to reverse the damage that had been wrought by previous over-grazing, mono-cropping and poor environmental conservation practices (Sustainability Initiatives, 2013a). Nutrition gardens, home orchards, seed sharing, hedging and terracing became common practices and, as a result, hunger and apathy in the community were reduced greatly. According to Leahy (2011), the area is now comprised of abundant tree cover in the form of wood-lots, sacred springs, orchards, vetiver strips and bunds on contours. Farmers are now also obtaining good yields from their planted crops. Complementing these strategies for food security, they have built their community strength through locally controlled and initiated programmes for permaculture training, conflict resolution, women's empowerment, primary education and HIV management (Leahy, 2011).

The emphasis of the CELUCT seed security project is on seed saving, conservation, sharing and improvement. This has been motivated by the impact of climate change, associated droughts, and increasing household food insecurity in the area. The project involves seed fairs and food fairs to stimulate interest in seed saving. Most of CELUCT's work is implemented in Agro-ecological Region I, which has high rainfall and agricultural potential (Mukute, 2015). CELUCT has a staff complement of 10 with competence to support farmers in learning more about seed, agro-ecology, and food and nutrition security in the eastern cluster.

4.5.2 Participatory Organic Research, Extension and Training (PORET) Trust

The work of establishing PORET commenced in 1998 and was inspired by the achievements of CELUCT and Towards Sustainable Utilisation of Resources (TSURO). PORET is also a local community-based organisation funded mostly by a Swiss NGO, called FEPA, and European individual volunteers. The main motivation of the project was to extend the application of sustainable agriculture and principles of natural resources management in the drier and low-

potential parts of the district, specifically in the Chaseyama Community in the lowveld. PORET Trust was registered officially in 2006 with the mission to develop environmentally sound agricultural projects, to facilitate the equitable and wise use of ecosystems, to promote the conservation of agro-biodiversity and natural resources, and sustainable, community-based creation of wealth, using local resources. The project has also used seed fairs to promote agro-biodiversity. PORET is responsible for the Lowveld Cluster in the district. Its twin challenges related to capacity for implementing the project were linked to human resources, who operate on a voluntary basis, and to mobility (Mukute, 2015).

The PORET trust uses a 14 ha permaculture site that acts as a model project for training local farmers in Chaseyama in seed-saving and permaculture practices such as zero-tillage, mulching, use of nitrogen-fixing crops such as sun hemp, pigeon pea and comfrey that are grown to enrich the soil organically. A key aspect of the land rehabilitation project has been the recovery, harnessing and intelligent management of the local natural water sources and catchment flows. The project uses swales and tree-planting to reduce soil erosion during the rains. The community are now protecting the forest around the springs to help stabilise the area's water supply (Sustainability Initiatives, 2013b).

4.5.3 Towards Sustainable Utilisation of Resources (TSURO)

TSURO Trust is a local community based organisation established in 2000 in Chimanimani district based on the learned successes of CELUCT. It works with village farmers groups who are represented at ward and district levels. It focuses on permaculture as means of improving food security, nutrition and other livelihood activities for smallholder farmers. The key permaculture interventions promoted at TSURO include integration of livestock and crop management, agroforestry, mulching and rainwater harvesting (Sustainability Initiatives, 2013c). TSURO's mission is to empower communities in Chimanimani district to improve their livelihoods through programmes in sustainable agriculture, natural resources management, agro-processing and marketing, and community health (Mukute, 2015). TSURO covers Nhedziwa, Central and Rusitu villages of Chimanimani district.

4.5.4 Local government

The Ministry of Local Government, Public Works and National Housing is responsible for promoting sound local governance, undertaking and coordinating rural and urban development to enhance the socio-economic development of Zimbabwe (MLGPWNH, 2018). The decentralised government branches in Chimanimani District consist of the office of the District Administrator, the Chimanimani Rural District Council, and traditional leadership. The District Administrator (DA), is a civil servant responsible for the overall planning, development and co-ordination of district affairs.

Section 8 of the Rural District Councils Act of 2002 (Chapter 29:13) provides for the establishment of Rural District Councils by the President. The Rural District Councils (RDCs) form the local government structure closest to the people. Zimbabwe, at the time, had 60 rural district councils and 31 urban local authorities (Kurebwa, 2015; ARDCZ, 2019). Council areas are divided into wards, each represented by an elected councilor. The operational committee at district level is the Rural District Development Committee (RDDC). This committee comprises the following:

- a) The District Administrator, who chairs the Committee;
- b) The chairmen of every other committee established by the Council;
- c) The Chief Executive Officer of the Council and such other officers as the Council may determine;
- d) District heads of national security services such as the Police, Army and Central intelligence;
- e) The district head of each ministry and department of a ministry within the district that the Minister may designate by notice in writing to the DA; and
- f) Such further persons representing other organisations and interests as the Minister, on the recommendation of the District Administrator, may permit (Section 60(1) Rural District Councils Act, 2002).

The Rural District Development Committee is represented at ward level (Ward Development Committees) and village level (Village Development Committees) that serve to develop plans, co-

ordinate and channel resources and communication at their level (Kurebwa, 2015). These are provided for under Section 18 of the Traditional Leaders Act 2000 (Chapter 29:17).

The traditional leadership in Chimanimani, as in other districts, consists of the chief, the headman and village head as enshrined in the Traditional Leaders Act of 2000 (Chapter 29: 17) as well as the Constitution of Zimbabwe Amendment 20 (Chapter 15: 2013). The Chief (*Mambo or Mutape*) has a council called the *dare*, whose role is to advise on community development and conflict resolution. The headman (*Sadunhu*) is below the chief and also has a *dare*. The village head (*Sabhuku*) is below the headman and also has a *dare* at the village level (Chidakwa, 2003). Succession with regard to traditional leadership is on a hereditary basis as opposed to elected local council structures that are instituted on the basis of Acts of Parliament.

Two practical roles played by traditional leadership that have a bearing on local food security include the management of the chief's granary and the protection of sacred forests. The chief's granary (*Zunde raMambo*) located in the chief's residence, is used in developing the self-sustenance of communities and decreasing the vulnerability of local people to food shortage (Chakova, 2013; Musarandega et al., 2018). The granary is decentralised to villages, where each village head has allocated land for cultivation by the community. The local chief provides land for the *Zunde raMambo* project while community members render their labour services through a collective action approach (Mavhura, 2017). Crops grown as part of the scheme are mainly cereals in the form of maize and sorghum that form the staple food that is provided for the destitute, orphans and child-headed families.

Section 5 of the Traditional Leaders Act 2000 (Chapter 29:17), provides for custodianship of natural resources as a strategy to protect and preserve them and combat the negative effects of climate change. This has enabled the protection and preservation of scared shrines and forests in Chimanimani District.

4.5.5 Agricultural extension

The District Agriculture and Extension Office (Agritex), led by the District Agricultural Extension Officer is located in Chimanimani town and is responsible for the entire district. The mandate of the Officer includes the provision of technical and advisory services, farmer training, and food technology (including post-harvesting processing and product development), dissemination of technologies and provision of market-oriented extension for sustainable farming (MOLAWCRR, 2017). The major extension approaches include on-farm trials, field days and look-and-learn tours to support both crops and livestock. The district office works through a lean, decentralised extension team, comprised of extension supervisors (responsible for 2-3 wards) and extension workers (responsible for 2-3 villages whereby each village would have a minimum of 100 homesteads). In reality, Chimanimani District has seven extension supervisors that cover the entire district of 23 wards.

According to Hunyani-Mlambo (2002), Agritex has been incapacitated to perform over the years since the introduction of the Economic Structural Adjustment Programme (ESAP) in 1991 that led to gradual reduction in government spending and subsequent budgetary cuts to specific departments, of which Agritex was part. Most of the Agritex budget (80%) goes to salaries, while donor funding has shown signs of donor fatigue and withdrawals for political and socio-economic reasons. Focus group discussions with Chikukwa and Chaseyama extension staff revealed that the main challenges to executing their work include:

- Transport to access farmers. Extension staff travel on foot throughout their villages to reach farmers (usually greater than 10 kilometers). This reduces their ability to cover the number of farmers under their supervision. This is compounded further by the topography and mountainous terrain, especially in Chikukwa.
- Mobile communication is a challenge in the area as most sites are not reachable. This makes it difficult for extension staff to communicate with each other, their district office, or with farmers.
- Lack of resources to use when training farmers, such as stationery and training materials. These are no longer provided by the government as a result of budgetary cuts. Extension

officers either use their own resources or are supported by other donor-funded projects of NGOs.

- Although houses are provided to accommodate extension staff, they have no electricity and are quite dilapidated without sanitation and potable water. Offices are also derelict.

4.6 CONCLUSIONS

This chapter contains an overview of Chimanimani District and the socio-economic and agro-ecological characteristics of the households sampled for the survey in the study sites. In this study, the respondents were categorised into Chaseyama and Chikukwa cluster locations that served as the study locations. The socio-economic and agro-ecological differences influenced the kinds of smallholder farmers, and their respective farming enterprises.

Chimanimani represents all of the five agro-ecological regions of Zimbabwe from the east, characterised by high rainfall suitable for intensive crop production, to the west with low rainfall suitable for extensive farming of livestock and crop production, especially small grains and legumes. Changes in climatic conditions have been noted throughout Chimanimani, informing the need for farmers to be conscious of their farming practices and better ways of preserving their environment. Chimanimani has been experiencing frequent droughts in the low-veld and changing rainfall patterns across the whole district. This has been compounded by increased clearing of land for farming that has affected grazing areas and increased exposure of the soil to weather elements.

The two study sites, Chaseyama and Chikukwa represent two extremes in terms of the agro-ecological profiles found in Zimbabwe i.e. Chaseyama being dry and semi-arid with sandy soils, and Chikukwa very wet during the rainy season, with red clay soils. In Chaseyama, the households produce crops (mostly small grains) that are suitable for the environment as well as small livestock and pursue livelihood diversification strategies that hedge farmers against risks associated with rain-fed crop production in dry areas. This concurs with Scoones (2009) who contends that households in dry areas adopt several livelihood strategies in order to reduce risks. Chikukwa, characterised by high rainfall, is suitable for intensive crop production that is matched with crop diversification beyond maize because farmers are limited in the size of their land holdings.

This chapter provides background for the next chapters, in which a more detailed analysis of the farmers' seed systems, and the dynamics between seed security and food security will be discussed.

CHAPTER FIVE: SEED SYSTEMS OF SMALLHOLDER FARMERS IN CHASEYAMA AND CHIKUKWA

5.1 INTRODUCTION

In this chapter, the seed systems of smallholder farmers in Chaseyama and Chikukwa are described. The description begins with the historical trajectory of seed systems in these study sites and how seed security has changed over the years to the present. The different seed sources on which smallholder farmers rely have also been defined. The seed systems of farmers were assessed over three seasons during a previous season at the time (2015 - 2016), a current planting season (2016 - 2017) and a future cropping season (2017 - 2018). For the future cropping season, farmers were asked where they expected to source seed for their three, key crops for the next planting season.

5.2 HISTORICAL ASPECTS OF FARMERS' SEED SYSTEMS

Focus group discussions were held with groups of smallholder farmers from Chaseyama and Chikukwa between September and October 2017. The purpose of the focus groups was to understand the historical development of their areas in terms of agriculture, food security and seed security. Table 5.1 shows the historical timeline as recounted by the focus groups, supplemented by a literature review of national events that occurred in Zimbabwe. The timeline is discussed below in three phases: the pre-independence period (1960s -1979), the period immediately post-independence (1980 - 2000) and the recent historical period (2007-2019).

Table 5.1: Combined historical timeline for Chaseyama and Chikukwa within a national context

Period	National event	Local events in study sites⁴	Response/Impact⁵
1960s	Government prohibits use of farmers' own seeds as a way of promoting use of commercial seed.	Local government extension enforced planting of certified seed and modern crop husbandry practices	- Planting less land area - Farmers hiding own varieties
1970 - 1971	Currency change from British pounds to local Rhodesian/Zimbabwean dollars	Drought prevalent in Chaseyama area	Households faced difficulty in purchasing commodities, including seed
1975 - 1977	War of liberation (Chimurenga)	Most able-bodied community members participate in the war including youth	Disruption of smallholder agriculture caused by war
1979	Ceasefire	- Daily curfews from 6pm to 6am - People relocated from their permanent homes into concentration camps	Temporary disruption of farming activities
1980	Independence of Zimbabwe from colonial rule		Displaced people return to their homes and farming resumes
1981 - 1982	- Agricultural Technical and Extension services formed to focus on support for smallholder farmers - Seed Co-op Company of Zimbabwe Ltd formed through amalgamation of 164 members of the Zimbabwe Seed Maize Association and 80 members of the Zimbabwe Crop Seeds Association	- Distribution of food by Social Welfare department - Seed distribution (maize, sorghum, pearl millet, cowpeas, groundnuts) by government - Construction of schools and clinics	Seed Co-op became a certifying agency on behalf of the Seed Services department and managed a seed laboratory and research station.
1985	Development of agricultural policies that supported land redistribution and conventional farming practices (such as adoption of short season planting varieties, improved pest	Strong role of extension support using group extension methods for smallholder farmers Housing schemes developed by government	

⁴ Unless indicated, this refers to both Chaseyama and Chikukwa.

⁵ Impacts occurred at multiple levels nationally and/or at the study sites.

Period	National event	Local events in study sites ⁴	Response/Impact ⁵
	management techniques, increased use of minimum tillage techniques	Dip tanks constructed for farmers	
1990s	Trade liberalisation through the Economic Structural Adjustment Programme (ESAP)		- Job losses and retrenchments - Expansion of number of seed companies to include Pioneer, Pannar, Cargill.
1992	National drought	- Drought (which also affected Chaseyama) - Increased deforestation (Chaseyama)	Distribution of food to affected households by government and NGOs
2000	Cyclone Eline	Cyclone Eline affected the Chikukwa community with flooding, washing away houses and crops	Distribution of food and non-food items by NGOs
2007-2008	- Drought - Price controls, inflation, currency constraints, and an unfavorable policy/regulatory environment.	Increased cross-border trade between Chimanimani residents and Mozambique	Difficult to obtain adequate seed from retail outlets
2009	Liberalisation of the regulatory/policy environment and introduction of US\$/ZAR currency		Stabilisation of prices on the market (including seed and food)
2015	Strongest El Niño event of the last 35 years	Chimanimani is part of the 20 most affected districts and had a global, acute malnutrition rate of 6.9%.	2.8 million people, 30% of the rural population, required urgent humanitarian assistance
2016 - 2017	Government introduces bond notes and coins (a version of local currency) at par with USD	- High rainfall similar to 1950 (at least over 500mm on average⁶) in Chaseyama - Received good rainfall especially 2010-2016 (750-800 mm⁷ per annum) in Chikukwa	Introduction of local currency led to price instability of both food and crop inputs as sellers try to maintain value in United States dollar terms.

⁶ Based on the Meteorological Office data from Zimbabwe National Statistics Agency (ZimStats, 2017) Facts and Figures.

⁷ Source: MSD, 2017.

Period	National event	Local events in study sites ⁴	Response/Impact ⁵
			• Increased crop production • Improved grazing fields for livestock • Improved condition of livestock
2018 - 2019	National drought compounded by extended dry spells, the Fall Armyworm, livestock diseases and Tropical Cyclone Idai; cash shortages, and hyper-inflationary environment	Cyclone Idai experienced in Chimanimani district	• Flooding, houses, schools, roads and bridges washed away • damage to field crops, storage barns • People missing while some lost their lives

Source: Adapted from Poulton et al., 2002; Havazvidi and Tattersfied, 2006; CIAT et al., 2009; ZIMVAC, 2019); Chaseyama and Chikukwa focus group discussions during September and October 2017.

5.2.1 The pre-independence period (1960s - 1979)

The Chimanimani farmers who participated in the survey could recall as far back as the 1960s when the then Rhodesian Government prohibited farmers from using their own seeds and only allowed farmers to plant new, improved seed varieties from the shops (such as the maize hybrid variety SR52). This prohibition was enforced through restrictive agricultural practices and policies established by the colonial government. These included the systematic release of improved hybrid maize varieties, the Land Apportionment Act of 1930 and the Land Husbandry Act of 1951 (Duggan, 1980; Kramer. 1998; Smale and Jayne, 2003). The agricultural laws restricted land use, while landholding in communal areas was decreased, making it difficult for farmers to continue their traditional agricultural practices of inter-cropping farmers' varieties.

Although this phenomenon was cited specifically by Chikukwa farmers, other studies noted the post-independence ban on the sale of open-pollinated maize varieties, mainly in commercial seed channels such as agro-dealers, as a strategy to maximise national food security by enforcing production using higher-yielding, hybrid maize varieties (Cromwell, 1992; Zerbe, 2001). These

studies also noted that this led to a considerable increase in the cost of maize seed for communal farmers.

The Chikukwa farmers mentioned that the apparent ban on the growing of traditional crop varieties by the Rhodesian Government brought hunger to households, as many farmers could not afford to purchase seed for their planting needs from the shops. Those that were able to purchase seed planted seed in smaller land sizes than usual because of their inability to purchase adequate seed quantities. This was the beginning of the loss of farmers' own seed varieties through substitution with formal sector seed purchases. The impact of this phenomenon was not only evident in the reduced area planted and reduced crop diversity, but was also reported to have reduced dietary diversity, contributing to malnutrition, and households were left facing challenges in paying school fees for their children. The government provided relief hampers for starving households, but they were not adequate for all. Two female participants in the focus group revealed the following:

“Some farmers tried to conceal and preserve their own varieties regardless of the government laws. Other farmers that were growing their own varieties (though at limited scale) used to de-tassel the new crop varieties to prevent cross-pollinating and polluting their own varieties. This way they were able to maintain their own varieties”. (Focus group female farmer participant one, Chikukwa, October 2017).

“The government of the day also discouraged us from inter-cropping within the same field preferring that crops are planted separately from each other. This made it difficult for farmers with small areas of land as they could not plant all the different crops they wanted for food”. (Focus group female farmer participant two, Chikukwa, October 2017).

During the 1970s, the government implemented a currency change from British pounds to local Rhodesian dollars. The effect of the currency change was that the weak local currency led to decreased purchasing power. It became difficult to purchase food from the shops as well as farm inputs (seeds and fertilisers). In addition, payment of school fees continued to be difficult, especially given that there were limited high schools nearby (in rural areas), so households relied

on church mission boarding schools far away. In order to cope with this situation, households began to engage in various activities to raise income, such as brewing and selling beer, making and selling handicrafts such as winnowing baskets, carrying and storage baskets, and mats. Some households hunted wild animals in the forest, kept bees, and fished. A number of people also started working in urban areas instead of relying on communal farming.

The drought in 1970 affected Chaseyama more than Chikukwa. The drought resulted in low rainfall with a Standardised Precipitation Index of between -1.5 and -1, which signifies a moderate drought (Murwira, 2014). This drought affected crops, caused cattle deaths, and rivers and boreholes also dried up. The households in Chaseyama were not able to harvest enough grain, resulting in their travelling to other areas in Zimbabwe in search of food to purchase. One of the participants in the focus group discussion explained:

“Drought is something that we live with in this area. We have experienced drought during the years of 1981, 1992, 2002, and 2013-14. These droughts have been characterised by rivers drying up (particularly the Odzi River), livestock deaths, stampedes when purchasing food locally, and the need to purchase food from other areas. We have had instances of varied ways of coping such as cooking unripen papayas for food and eating sausage tree fruits (usually eaten by donkeys, baboons and other wild animals)”. (Focus group farmer participant one, Chaseyama, September 2017).

These accounts corroborate other studies describing the drought in the later years of 1991 - 1992 (77% below normal rainfall) and 2001 - 2002 (during the period of the fast-track land reform programme), and during 2004, 2007, 2008 and 2012 (Manjengwa et al., 2012; Nangombe, 2014). The only notable year that had high rainfall (1,670 mm on average) in Chaseyama was the 2016 - 2017 season. This was compared with rainfall that was last recorded in 1950 that had a similar peak. This season was characterised by good yields, livestock in good health and appearance, as well as negative attributes such as high rates of erosion in the fields, and the formation of gullies.

From the accounts of the focus group, the war of Chimurenga (Liberation War of Zimbabwe) that occurred between 1972 and 1979, further compounded the drought situation in these communities. Few households could participate actively in farming, cattle dips were closed, and some households migrated to towns for security reasons. It was difficult for those in towns to communicate and provide support to their rural relatives and families. Many households were kept in security concentration (*Keep*) camps⁸. Socially life was also difficult as rural schools and rural clinics were closed without medical staff and medication.

5.2.2 The period immediately post-independence (1980 - 2000)

The Independence of Zimbabwe from colonial rule was attained on 18 April 1980. During this period until 1985, people returned from the concentration camps to their homes to live in peace. Churches were established and farmers began sharing the different seed varieties that they had preserved and stored. The government of independence supported farmers with free seed (especially improved maize varieties) and fertilisers, and constructed dip tanks. This facilitated the re-integration of households back into farming. Other social support activities from the government included housing schemes, the construction of secondary schools in the villages, offering free education, and food aid assistance and the establishment of feeding points for the malnourished. This resulted in better accommodation for households, more children were able to attend secondary education, and farmers were able to grow their own seed varieties again.

As households were free to farm and to engage in other livelihood activities in peace, some negative impacts on the environment developed during the 1990s. The interviewed farmers mentioned that deforestation increased as households cleared land for farming and sought firewood for fuel. As noted by the Chimanimani District Climate Change Response and Watershed Management Strategy, causes of land degradation in the area were found in relation to agriculture and cutting down trees (Chimanimani RDC, 2017b). This led to flooding, gully development and soil erosion, especially in Chikukwa, where the terrain is characterised by mountains and hills. This was also noted by Leahy (2013) on a study of the Chikukwa village. Farmers from the focus

⁸ These were protected villages developed by the colonial government that kept blacks together in large numbers and restricted their freedom of movement and communication with the outside world as a way of oppressing and controlling them and preventing a war.

group mentioned that their productivity declined, and hunger increased. To resolve these environmental problems, farmers, agricultural extension staff and the chief met to plan how to address hunger issues in the area. Some of the activities in which the community engaged included tree planting, awareness and training in permaculture and practice, and development of group nutrition gardens for food diversification.

Between 1996 and 2000, women's social clubs became prevalent in the area, while exchange visits and seed fairs restored lost crop varieties for farmers. This was also the period when Cyclone Eline affected the area. Farmers mentioned that the cyclone damaged houses, crop fields, livestock, and some people died. Other NGOs such as Christian Care and Red Cross provided food assistance to affected households. Another NGO, CADEC, provided blankets and household items to assist affected people. The Ministry of Health, together with CELUCT and Red Cross, supported the construction of latrines. As noted in an Oxfam study, the area (Chikukwa) is prone to flooding. The most memorable flooding in the area occurred in 2000 (Oxfam-UNDP/GEF, 2015). Most recently, the Cyclone Idai weather system affected Eastern Zimbabwe on 15 and 16 March 2019, with Chimanimani and Chipinge districts in Manicaland Province being hardest hit (OCHA, 2019). Cyclone Idai brought heavy rains and strong winds. The storm caused high winds and heavy precipitation in Chimanimani and Chipinge districts, causing riverine and flash flooding and subsequent deaths, destruction of livelihoods and properties. In the Southern Hemisphere, Cyclone Idai was ranked as the third-deadliest, tropical cyclone on record since the 1892 cyclone in Mauritius and the Flores Cyclone in 1973 (Funes, 2019; Masters, 2019).

5.2.3 Recent historical events (2007 - 2019)

The period leading up to the 2008 national, presidential and parliamentary elections and immediately after, was one of the worst experienced by Zimbabweans post-independence. It was characterised by the worst forms of political violence, a hyper-inflationary environment, and shortages of basic commodities in the shops, fuel unavailability, and electricity power cuts (FEWSNET, 2007; CIAT et al., 2009). In addition, a severe drought was experienced that left many households food insecure. CIAT et al. (2009) notes that the formal seed sector nearly shut down because of price controls, inflationary currency constraints, and an unfavourable

policy/regulatory environment. Commercial seed production within the country was extremely limited and, essentially, all retail seed outlets closed. In the midst of this chaotic environment, the informal seed sector continued to be vibrant and active. It supplied over 95% of the seed that Zimbabwe farmers grew (excluding maize), hybrid maize made inroads into the informal seed markets, while processes such as participatory variety selection, on-farm trials, cross-border trade, and seed fairs continued to play an important role in ensuring access to seed for smallholder farmers (CIAT et al., 2009).

The socio-economic conditions improved after the ZANU PF government, led by Robert Mugabe, formed a government of national unity with the two main opposition parties – the Movement for Democratic Change (MDC-T), led by Morgan Tsvangirai, and the Movement for Democratic Change (MDC-M) led by Arthur Mutambara (Dodo et al., 2012). This forced coalition lasted for five years and served to temporarily relieve the hardship and suffering of Zimbabweans. It was characterised by the liberalisation of the regulatory environment and introduction of a multiple-currency system, dominated by the USD and ZAR currencies. This resulted in increased donor support and investment in the private sectors of agriculture, tourism and mining. This, in turn, led to the return of basic commodities and seeds in the market and a stabilisation of prices (Mukuhlani, 2014; Tumbare, 2014).

In summary, during the period under review, Chaseyama was characterised by chronic droughts that resulted in widespread hunger and people searching for food from other areas. The war of independence was experienced as a shock that compounded the drought situation and negatively affected the availability of food. On the other hand, Chikukwa was characterised by a few episodes of drought with frequent flooding, particularly recently (2019). The initial ban of farmers' crop varieties brought in the forced adoption of improved crop varieties, though farmers were able to save their own varieties in secret. Ultimately, the farmers' seed system continued to be resilient in the face of an unpredictable policy framework, a harsh socio-political environment and in the midst of natural hazards such as drought and cyclones.

5.3 SEED SOURCES USED BY FARMERS IN CHASEYAMA AND CHIKUKWA

A well-functioning seed system is often cited to be one that uses a combination of formal and informal channels to meet farmers' demands for quality seeds of suitable crop varieties (Sperling et al., 2013c; Subedi et al., 2013). Smallholder farmers obtain their seed and planting material from a variety of sources that comprise both informal and formal seed sources. The informal seed system includes farmers' own seed that they store, seed accessed from farmers' social networks and seed purchased from informal markets (Louwaars and de Boef, 2012; Mazvimavi et al., 2017). The formal seed system includes seed aid and agro-dealers that provide access to certified seed for farmers (Sperling et al., 2013c). Seed aid encompasses seed sourced through government channels, non-governmental organisations and community-based seed groups.

5.3.1 Farm saved seed

Farmers' own saved seed refers to the seed that a farmer plants, preserves and stores year after year (FAO, 2015b; McGuire and Sperling, 2016). Crop varieties from such seed have desired characteristics such as taste, storability or good agronomic qualities that attract the farmer to store and preserve them. Farmers' own seed thus consists mostly of open-pollinated varieties of maize sorghum and pearl millet and self-pollinated varieties of legumes. The initial source of such seed could be from anywhere, including relatives, neighbours, friends, seed fairs, associations and organisations.

Chaseyama and Chikukwa farmers use many ways of selecting and preserving their own seed for future use. This is also done at various stages of the cropping cycle. Some farmers identify a good crop from the field in terms of its phenotypic structure and resistance to pests and diseases. When the crop matures and produces a harvest, be it cob or legume grains, the panicle that is whole, and of the right size, is selected for further drying and treating. One of the Chikukwa farmers who relied exclusively on farm-saved seed gave the following account about her local, maize seed selection process:

“When harvesting maize seed from my crops, I select the seed from the middle part and the lower parts of a cob as these are fuller grains, and not easily susceptible to being diseased and weevils. The upper part of the cob is used, separated and stored as grain for food as it has smaller grains in addition to being susceptible to disease and also has problems of requiring more fertility for it to produce a good crop in future compared to the middle and lower parts of the cob”. (Christy, life-history interview, Chikukwa, October 2017).

The selected seeds are then treated using locally prepared herbs and ashes of cactus, gum tree or mopani tree leaves or storage chemicals such as Cooper Shumba powder (*pirimiphose-methyle 2% dust*) before being stored in permeable sacks. Farmers who kept seed in cobs and heads (e.g. sorghum and pearl millet), hang the seed in kitchens to take advantage of the smoke, while some of the seed was stored in permeable sacks. The heat and smoke from the kitchens help to prevent seeds from spoiling and being infested by pests, while the permeable sacks provide ventilation and promote drying.

Through the support⁹ of local non-governmental organisations, such as PORET and CELUCT, some farmers were able to participate in organised, local seed production and seed exchanges. This is usually community based seed production without the participation of any regulatory authority. Farmers either identify which seeds they intend to multiply or are provided with open-pollinated and self-pollinated seed material that they allocate to isolated fields. The agronomic practices employed are more stringent than those in the fields for food crops. This includes separation of the seed crop by distance or by time, rogueing¹⁰, application of manure/fertiliser and ensuring that the crop is harvested when it has dried thoroughly. Farmers that participate in seed production have access to large pieces of land in order to allocate space to different uses and crops. These farmers also tend to have adequate seed for their needs and sell excess locally and through seed fairs.

⁹ Support has been focused mostly on farmer training, mobilisation for seed fairs and exchanges.

¹⁰ This is the process of selecting and removing plants with undesirable characteristics in the field such as diseased plants or off-types.

5.3.2 Local informal markets

Local markets refer to informal traders and individual farmers who are known to sell seed and grain to other farmers locally (FAO, 2015b; McGuire and Sperling, 2016). The seed from these suppliers includes a varied mixture of seed¹¹ of different quality and cleanness. Some individual farmers who were selling this seed were seed producers¹², farming specific, traditional farmer varieties. Local seed markets were not a main source of seed in Chimanimani probably because of the remoteness of the area. They included informal grain traders and individual farmers that produced and sold their seed to other farmers. Informal grain traders were located usually near and around local shops. These were observed in Chaseyama in 2017, selling mostly maize seed and grain. For example, Christy, a farmer from Chikukwa, sold seed from her home or through organised seed fairs in the villages. Such farmers were referred to as “key-seed suppliers” known for producing good quality seed of specific crops (McGuire, 2008; Sperling and McGuire, 2010b). The highest income earner for Christy’s household was seed sales.

Transactions in these local informal markets are carried out through cash and a barter exchange system. The seed sold is usually of a high standard and usually less expensive than seed purchased from agro-dealers. Informal grain traders sell any quantities requested by buyers, using tins and buckets. It is difficult to verify the source of seed sold by informal seed and grain traders, although Sperling and McGuire (2010b) have shown that some traders will know their source exactly be it from the farmers themselves, other traders and millers, depending on the type of trader and seed type.

5.3.3 Seed from social networks

“Social network” is an inclusive term that refers to seed being provided through social relations amongst farmers such as neighbours, friends and relatives (FAO, 2015b; McGuire and Sperling, 2016). Seed from this network is quite varied and can include farmers’ own varieties and recycled, previously certified seed. At a national level, social networks of exchange have remained strong

¹¹ This might be ‘potential seed’, or might be sold specifically as ‘seed’, with different management by the vendor and different pricing.

¹² These farmers were initially supported by local Community Based Organisations to be good seed producers.

and during the 2008 - 2009 season, provided 10% to 38% of the seed sown for maize, groundnut, finger millet, cowpea, sorghum, pearl millet and bambara groundnut (CIAT et al., 2009). Kevin, who comes from Chikukwa, inherited maize seed from his uncle and proudly described the seed transfer as follows:

“My uncle under whose roof I grew, never purchased any seed from the shops but relied on his own farm-saved seed. When I established my own home, he gave me some of his good maize varieties such as chiseresende, mutsuragudo, and madzande¹³ that I am still growing today”. (Kevin, life-history interview, Chikukwa Village, October 2017).

The exchange of seed through such social networks is backed by the social relations that farmers have with each other. McGuire (2008: 217) argues that seed systems are “social systems where key practices, particularly seed exchange among farmers, are affected by local norms”. Farmers thus share and exchange seed with other farmers with whom they relate. Households that have weak relations in the local village might thus be excluded from access to certain types of seed varieties through this mechanism. The farmers who benefit from this association tend to trust the quality of seed as they know the supplier very well. Seed can also cement social relations. For example, Jackie came to Chaseyama with her husband from Mutare District in search of farming land and accommodation. She narrated her welcome as follows:

“In 1997 I came with my husband to live in Jinga village of Chaseyama. A friendly neighbour welcomed us with a local maize and groundnut variety that performs well in this area. Though we have added other varieties since then, these initial varieties from our neighbour enabled us to set the stage for farming in this area”. (Jackie, life-history interview, Chaseyama, September 2017).

Most of the seed from social networks is obtained free, although some seed can be purchased or exchanged. Social networks are formed through conditional relationships with expectations of reciprocity or support through other means. Some farmers confirmed that they still kept and

¹³ These are names of local traditional maize varieties.

preserved seed varieties that they had acquired from their grandparents. Such varieties are valued and preserved for specific attributes such as taste, storability and tolerance to drought and are rarely subject to commercial transactions.

5.3.4 Agro-dealers

Agro-dealers are the formal seed suppliers of certified seed mostly from seed companies (FAO, 2015b; McGuire and Sperling, 2016). These are rural shops that usually supply seed in addition to other farm inputs and other rural supplies such as groceries and hardware. In this study, the certified seed that was purchased from urban centres is also classified as “agro-dealer” seed. The agro-dealer survey in Chimanimani was limited to shops that stocked inputs such as seeds and fertilisers.

The inputs stocked at the 12 agro-dealers throughout the two study sites included field crops, vegetables, fertilisers, agro-chemicals, hand tools and sprays. Seeds of field crops were stocked by all agro-dealers, while a large number also stocked vegetable seed, fertilisers and agro-chemicals. The field crops stocked by the agro-dealers were maize, beans, cowpeas, groundnuts and sorghum. Maize seed was stocked by all 12 agro-dealers, while seven stocked beans, and only two agro-dealers in Chaseyama had cowpeas, sorghum and groundnuts, albeit in very limited quantities compared with maize. As shown in Figure 5.1, the most common seed package sizes stocked by agro-dealers were 10 kg and 5 kg. The top selling field crops were maize and beans. The criteria used by agro-dealers to stock specific types of seeds included suitability for the area, farmers’ requests and expected yield.

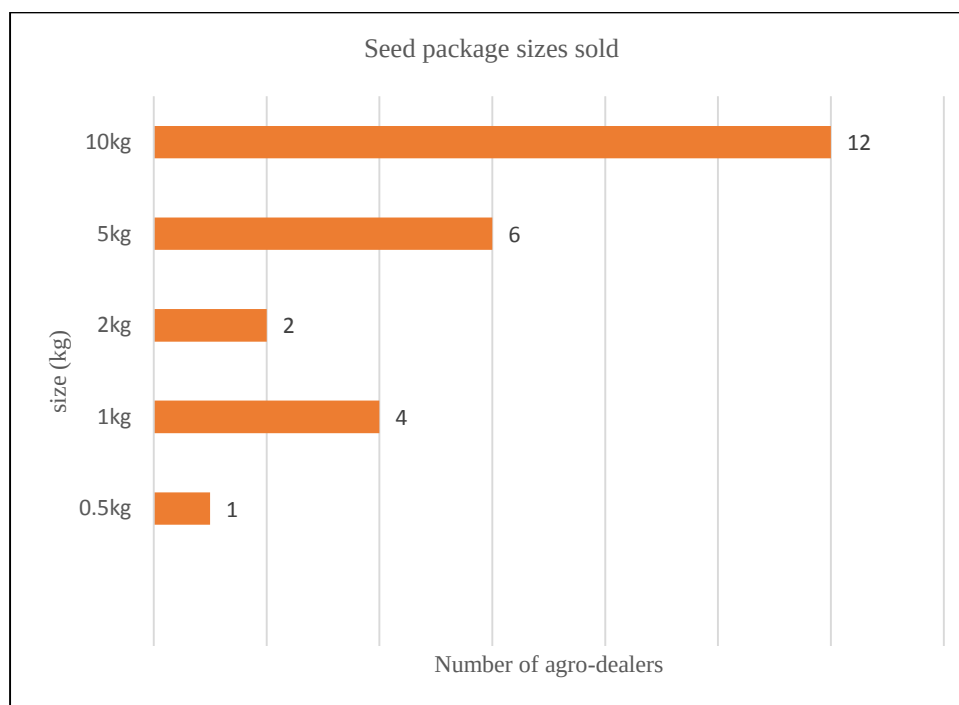


Figure 5.1: Number of agro-dealers stocking different seed packages

The vegetable seed stocked by the interviewed agro-dealers comprised green leafy vegetables, tomatoes, onions, cabbages, butternuts, peas, and carrots. These were in small quantities (50 g packs). Leafy green vegetables (kale type) were the top-selling vegetable seeds compared with the other vegetable seed types, given that these are usually planted throughout the year.

The agro-dealers were asked which types of seed were not stocked but were sought by farmers. These included certain maize varieties (short and long-season, open-pollinated and hybrids), vegetable seeds (carrots, peas and onions), and other field crops (sorghum, cowpeas, wheat, sunflower, groundnuts and bambara groundnuts). This range of diversity is much broader than that supplied by agro-dealers and seed companies. Formal seed channels tend to concentrate on just a few crops and even fewer crop varieties.

The agro-dealers in Chaseyama and Chikukwa sourced their seed from Mutare and Chipinge towns. These towns are approximately 160 km from both the study sites. The majority of the seed

was sourced from Mutare town compared with Chipinge. As agro-dealers did not source large quantities of seed at a time, their seed was not procured from seed companies but large seed traders/wholesalers in these towns such as Farm and City, Prime Seeds, Seedco outlets and Windmill. Stocking and re-stocking of seed is a challenge in rural areas coupled with high transportation costs. The Stichting Nederlandse Vrijwilligers (SNV), piloted an agro-dealer-re-stocking exercise between 2009 and 2011 in Matabeleland North and South, Masvingo and Manicaland provinces, targeting 750 agro-dealers and at least six wholesalers and two insurance companies (Maunze, 2012). The insurance was for wholesalers so that they could place consignment stock with agro-dealers who were considered to be high-risk business partners. The challenges experienced by agro-dealers in the SNV study were similar to those experienced by agro-dealers in the present study. An agro-dealer from Chaseyama confirmed that she experienced the following challenges:

“The seed and input suppliers from Mutare and Harare sell their stock to us on a cash basis due to lack of collateral and long distances from the suppliers. The few shops that have been able to get seed on consignment basis are those that are linked to a donor-funded programme or have some security. For me I stock my shop with seed and other inputs based on the cash that I have. This thus limits the stock that I hold at any given time”. (Agro-dealer interview at Chaseyama, September 2017).

This account shows the ways in which agro-dealers manage the risk and uncertainty in predicting demand for seed. The priorities of agro-dealers were also divided, compounded further by the fact that dealing is seasonal (except for vegetable seed, which is sold in smaller quantities, and is not the main business for the majority). Most of the so-called “agro-dealers” were actually general-purpose shops that stocked a broad range of items needed by rural households, such as groceries, hardware and some farm inputs.

By virtue of their small size, the agro-dealers in Chaseyama and Chikukwa sold the bulk of their seed and fertilisers to individual farmers. Only two agro-dealers also sold their seed to other agro-dealers. Five out of the 12 agro-dealers interviewed sold some of their seed to farmers on credit. This was not their usual custom and was limited to a few farmers whom they knew. Of the five

agro-dealers that offered credit, this was offered to four out of every 10 of their customers based on personal relations.

5.3.5 Seed aid

Seed aid involves the distribution of either free or subsidised seed to beneficiary households at the start of a cropping season. This occurs typically after a disaster, with the assumption that farm communities are seed insecure (Bramel et al., 2004; ACB, 2016). Seed aid can be undertaken as emergency (relief) aid or developmental aid, which may be linked to subsidies. Seed aid has been a constant phenomenon in Zimbabwe during at least fifteen of the 39 years since the country gained independence in 1980 (Bramel and Remington, 2004; Rohrbach et al., 2005; Langyintuo and Setimela, 2007; CIAT et al., 2009). Most recently, the Government of Zimbabwe has been providing seed aid assistance to rural areas through two programmes dubbed the Presidential Input Support Scheme and the Command Agriculture Programme (Mutonodzo-Davies, 2010; Government of Zimbabwe, 2013b; Chinyoka, 2017). The focus of the Presidential Inputs Support Scheme is on supporting vulnerable groups at household and community level, by ensuring that farmers have access to free and affordable inputs (Government of Zimbabwe, 2013b). The Command Agriculture Programme, on the other hand, headed by the military, operates in the following manner:

“Under this scheme, farmers are given inputs including seeds in order for them to grow targeted crops such as maize and wheat. The programme is mainly targeting model A2¹⁴ resettlement schemes and the Agricultural and Rural Development Authority (ARDA¹⁵) farms. The farmers are required to pay back after harvesting their crops at a certain interest rate, but with an option of paying with produce through the Grain Marketing Board (GMB) or with cash. The GMB input scheme

¹⁴ In Zimbabwe, the land reform of 2000 created a category of medium-scale farms – the A2 schemes. Approximately 25 000 such farms were allocated, ranging in sizes from approximately 20 ha (especially with irrigation) to over 500 ha, in dry areas. Source: <https://zimbabweland.wordpress.com/tag/a2-farms/> Accessed on 30 August 2020.

¹⁵ The Agricultural and Rural Development Authority is a government parastatal that manages several government farms in the country on behalf of the Ministry of Agriculture.

facilitates access to inputs, including seeds, to farmers by dispatching the inputs to GMB depots countrywide”. (Mutonodzo-Davies, 2010: 9).

Seed aid is an important source of seed for smallholder farmers from Chaseyama and Chikukwa, who accessed 48.2% of their maize seed and 17% of their sorghum seed from this source during the 2016-2017 season (see Table 5.8). Seed aid suppliers include government and non-governmental organisations that provide seed to smallholder farmers. This seed is usually provided to pre-selected farmers for free accorded to specific criteria, although provision could also be tied to a pre-condition, such as a subsidy or work norms to be provided by farmers. Seed aid has been provided as seed packs directly to benefiting households, as noted by Rohrbach et al., (2005), since 2003, although, increasingly the aid is offered through vouchers redeemable through agro-dealer shops (Remington et al., 2002; Bramel and Remington, 2004; ACB, 2016). The following is an account from the Chaseyama Agricultural Extension Officers about the government seed aid that was provided in 2017 to smallholder farmers:

“Maize, though not a main crop in this area is mostly obtained from seed aid programmes, particularly the Presidential input scheme and a few farmers that purchase seed from agro-dealers. In addition to maize, the Presidential scheme in 2016 also had a bit of pearl millet and sorghum. Distribution of seed from the presidential scheme was through councilors and village heads, while the role extension staff was in documenting and reporting on type seed received and number of farmers that benefited”. (Interviews with Chaseyama Extension Officers at Chakowa Village, September 2017).

Extension Officers also described the seed aid assistance from a Non-governmental Organisation, World Vision as follows:

“The Food for Assets (FFA¹⁶) Programme in 2016, through World Vision, provided certified seed (sorghum, cowpeas, and groundnuts) through our office to sell to

¹⁶ Food for Assets is a form of food for work programme in which farmers are provided either food or seed in exchange for providing labour for developing specific community assets such as dam rehabilitation and

farmers in order to use the proceeds to purchase material for canal construction. As not a lot of seed was sold through this process, most of the seed was given to farmers as payment for participating in providing their labour in FFA activities”. (Interviews with Chaseyama Extension Officers at Chakowa Village, September 2017).

Over the last five years (2012 - 2016), the Government of Zimbabwe has played the main role in providing seed aid to farmers in Chaseyama and especially Chikukwa (Interviews with extension officers and household interviews, 2017). On the other hand, the number of farmers receiving seed aid from NGOs was higher in Chaseyama than in Chikukwa. Most farmers from Chaseyama (83%) and Chikukwa (99%) had benefitted from seed aid in the previous five years. The proportion from Chikukwa was higher with almost all farmers interviewed benefitting from seed aid in the previous five years. Over these years, Chikukwa farmers had benefitted approximately 3.6 times more than Chaseyama farmers (1.9 times). This was based on the household interviews with the sampled farmers.

Figure 5.2 shows the proportion of farmers receiving seed aid in Chaseyama and Chikukwa from 2012 to 2016. The highest proportions from Chaseyama were those that received the seed once and those that received seed twice. In contrast, the highest proportion of farmers from Chikukwa received seed aid every year. Chikukwa, given its high rainfall and suitability for cropping, is more commonly targeted with seed aid interventions than Chaseyama.

environmental conservation works. These community assets are identified with households in a participatory manner.

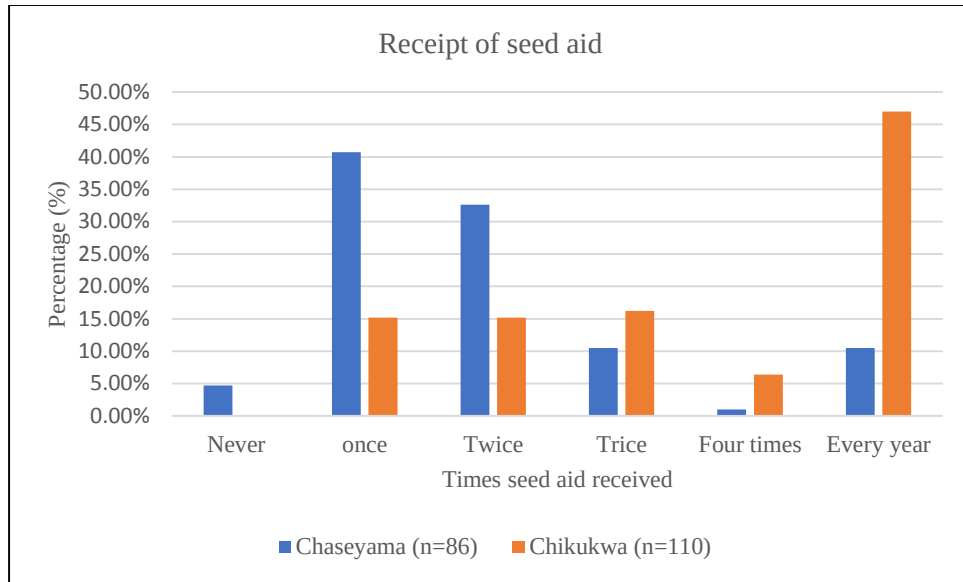


Figure 5.2: Proportion of farmers receiving seed aid from 2012 to 2016

The modes of seed aid assistance were through free distribution mostly and some through vouchers and seed loans. As shown in Figure 5.3, free seed aid distribution dominated throughout both locations (at least 88% of all seed aid deliveries) followed by seed vouchers.

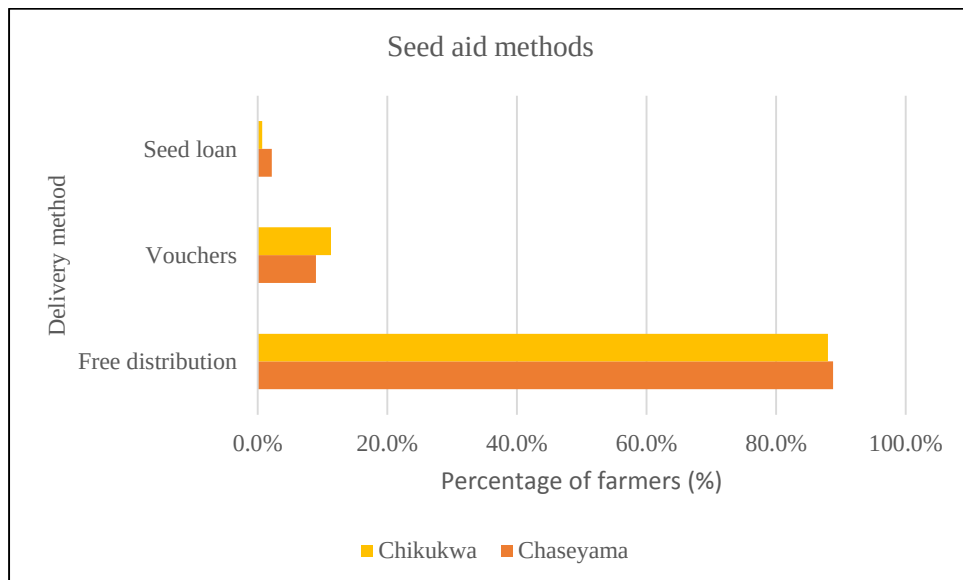


Figure 5.3: Seed aid delivery throughout Chaseyama and Chikukwa from 2012 to 2016

The seed crop types that the majority of farmers from Chaseyama received were maize and sorghum, while all seed recipients from Chikukwa received maize seed primarily (Table 5.2).

Table 5.2: Proportion of households receiving seed aid per crop in Chaseyama and Chikukwa during 2012 - 2016

Name of seed crop	Chaseyama (n = 91)	Chikukwa (n = 107)
Maize (%)	94.5	100
Sorghum (%)	29.7	2.8
Cowpeas (%)	6.6	2.8
Pearl millet (%)	6.6	-
Groundnuts (%)	5.5	2.8
Finger millet (%)	-	4.7

Source: Field survey. ‘-’ refers to not applicable.

There appeared to be differences in the types of seed supplied by different role-players. For example, in Chaseyama, most of the farmers received maize seed through government sources (87.1%) or NGOs (61.7%), whereas only NGOs seemed to supply sorghum. Many farmers from Chaseyama received sorghum compared with Chikukwa farmers. This could be related to the semi-arid and dry conditions prevalent in Chaseyama. Seed aid for groundnuts, cowpeas and pearl millet was supplied exclusively by NGOs. In Chikukwa, every household that received seed aid was given maize seed as part of the crops provided. Most of the maize seed received by farmers in Chikukwa in the previous years was from government sources (95.5%) compared with NGOs (33%). All the other seed types (sorghum, groundnuts, bambara groundnut, cowpeas, and finger millet) were received from NGOs.

5.4 CROPS GROWN BY HOUSEHOLDS IN CHASEYAMA AND CHIKUKWA

The cropping season 2015-2016, was the most recent year when households had planted and harvested their crops. This cropping year was a drought year induced by the El Niño¹⁷. Zimbabwe, together with most parts of the Southern Africa Region, experienced extreme, above-normal temperatures, resulting in large decreases in areas planted, widespread crop failures, and reduced

¹⁷ The agricultural season 2015-2016 was an El Niño year characterised by very low rainfall in the Southern African region compared with the previous 30 years.

crop production (ZIMVAC, 2016). In the ZIMVAC Report (2016), it was noted that the El Niño resulted in a 160% increase in the number of food insecure people nationally, compared with May 2014, when a bumper harvest had been recorded.

The quantities of seed that farmers planted during the 2015-2016 season were compared with quantities planted in other non- El Niño years to determine whether the El Niño year had an impact on seed access. As shown in Figure 5.4, the same seed quantities were planted for most crops during 2015-2016 compared with normal years, although less were planted for legumes (especially groundnuts, bambara groundnut and beans). Despite the El Niño effect, farmer continued obtaining their seed from the same sources and growing the same crops across the two years. Planting less seed during a season with adverse conditions could be related to late planting, as some farmers would be waiting for the first rains before planting their seed for fear of high rates of poor germination. The overall result is low production and yields expected after a drought season. Farmers predict whether the season will be a drought year through their traditional knowledge systems and information from extension and meteorological services. These findings showed differentiated responses and resilience to drought conditions amongst farmers.

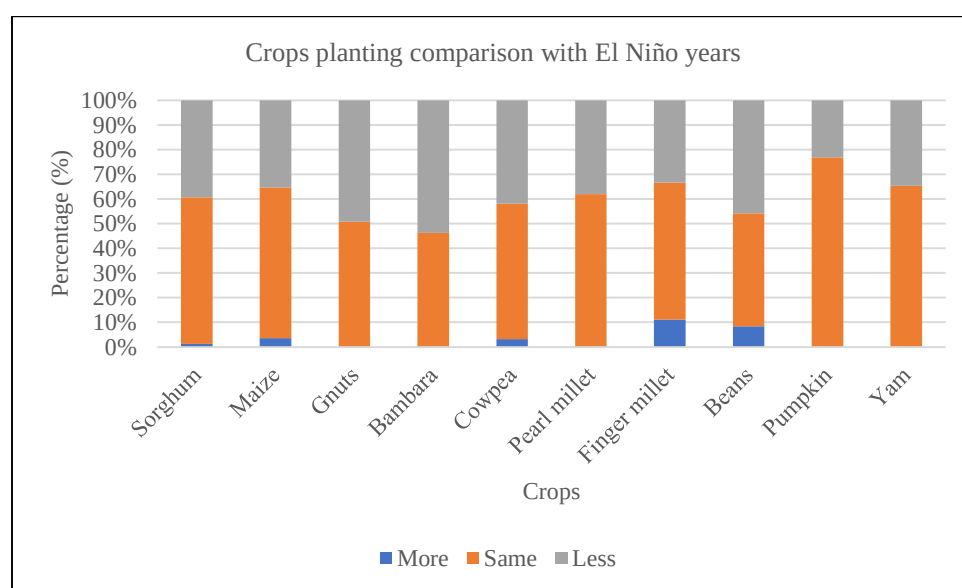


Figure 5.4: Analysis of major crops planted during the 2015 - 2016 season

The proportion of seed sources for farmers' key crops in Chaseyama and Chikukwa are shown in Table 5.3 below. Home-saved seed dominated in both sites in almost equal proportions. This was followed by agro-dealers, with a higher proportion in Chikukwa than Chaseyama. The balance of seed provision was from seed aid, social networks and local markets. When compared with the national seed security assessment survey carried out in four districts in Zimbabwe that were representative of the national agro-ecological zones and areas with high food insecurity (Mazvimavi et al., 2017), there were similarities in terms of the proportion of home-saved seed as a source. This serves to underscore the significant role played by home-saved seed in Zimbabwe.

There were however differences in the proportion of other seed sources such as social networks and local markets (both lower in the study area compared with the national profile) and agro-dealer and seed aid (that were much higher in the study area compared with the national profile). These differences serve to highlight the importance of location, social relations, and infrastructure in sourcing seed in an area, and the influence of seed interventions from the private sector, government and NGOs.

Table 5.3: Sources of seed in 2015-2016 season, as % of total seed supplied in each location

Seed source	Chaseyama	Chikukwa	In 4 districts across Zimbabwe*
Home saved (%)	41.6	46.2	44.1
Social network (%)	12.2	10.6	22.8
Local market (%)	11.5	6.7	17.8
Agro-dealer (%)	19.5	26.3	10.9
Seed aid (%)	15.2	10.2	4.4

*Source: Adapted from Mazvimavi et al., (2017) National Seed Security Assessment Survey

If the proportions of the seed sources are aggregated into formal and informal seed sources, as shown in Figure 5.5, informal seed sources dominated overall in almost equal proportions in both Chaseyama and Chikukwa. The informal seed sources included home-saved seed (comprising the highest seed source across all locations), seed from social networks, and seed from local, informal markets. The formal seed sources comprised seed from agro-dealers and seed aid.

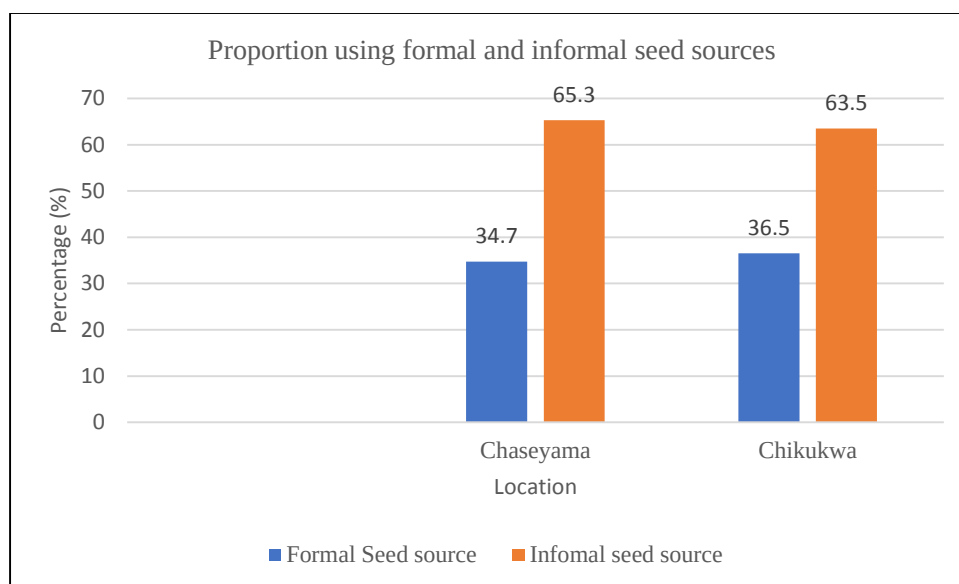


Figure 5.5: Proportion of seed sources used by farmers during 2015-2016 season

The crops grown by farmers in Chaseyama and Chikukwa during the El Niño year (2015 - 2016) are shown in Table 5.5. The prevalent cereals in Chaseyama were sorghum (72.3%), maize (58.9%) and pearl millet (25%) while, in Chikukwa, these included maize (all farmers) and finger millet (46%). The prevalent legumes in Chaseyama were bambara groundnuts (60.7%), groundnuts (58%), and cowpeas (54.5%) while, in Chikukwa, they were beans (80.5%), groundnuts (33.6%), and bambara groundnuts (32.7%). Thus, beans and cowpeas were the legumes unique to Chikukwa and Chaseyama farmers, respectively. The roots and tubers (yams, sweet potatoes and Irish potatoes) were recorded only in Chikukwa and not in Chaseyama.

These findings serve to demonstrate the importance of linking the agro-ecology of an area to the type of seed supplied. Chikukwa, due to its high rainfall is more favourable to maize, beans and root crops. Chaseyama, due to its semi-arid nature, is more suitable to small grains and the hardy legumes such as Bambara groundnuts and cowpeas. Use of the crop (food, sales and religious/cultural uses) also has a bearing on prioritisation. The finger millet, although a small grain characteristically grown in drier areas of Zimbabwe (Mukarumbwa and Mushunje, 2010; Svodziwa, 2015), was grown by many farmers in Chikukwa because of its importance in traditional ceremonies that include beer brewing and communication with ancestors.

Table 5.4: Proportion of households growing different crops in 2015-2016 season in Chaseyama and Chikukwa

Crop	Chaseyama (n = 114)	Chikukwa (n = 113)
Sorghum (%)	72.3	11.5
Bambara groundnuts (%)	60.7	32.7
Maize (%)	58.9	100
Groundnuts (%)	58	33.6
Cowpeas (%)	54.5	19.5
Pearl millet (%)	25	1.8
Watermelon (%)	12.5	1.8
Beans (%)	10.7	80.5
Finger millet (%)	0.9	46
Pumpkins (%)	3.6	54.9
Yams (%)	-	46.9
Sweet potato (%)	-	23.9
Potato (%)	-	22.1

Source: Field survey

The average number of crops grown per household was significantly higher ($P < 0.05$) in Chikukwa (5.6) compared with Chaseyama (3.6) with a t-value of -8.6 and degrees of freedom of 218. In addition, most farmers in Chikukwa grew 4-6 crops (61%) compared with Chaseyama (49%). There were also more who grew six or more crops in Chikukwa (27.4%) than Chaseyama (15%). These findings are shown in Figure 5.6.

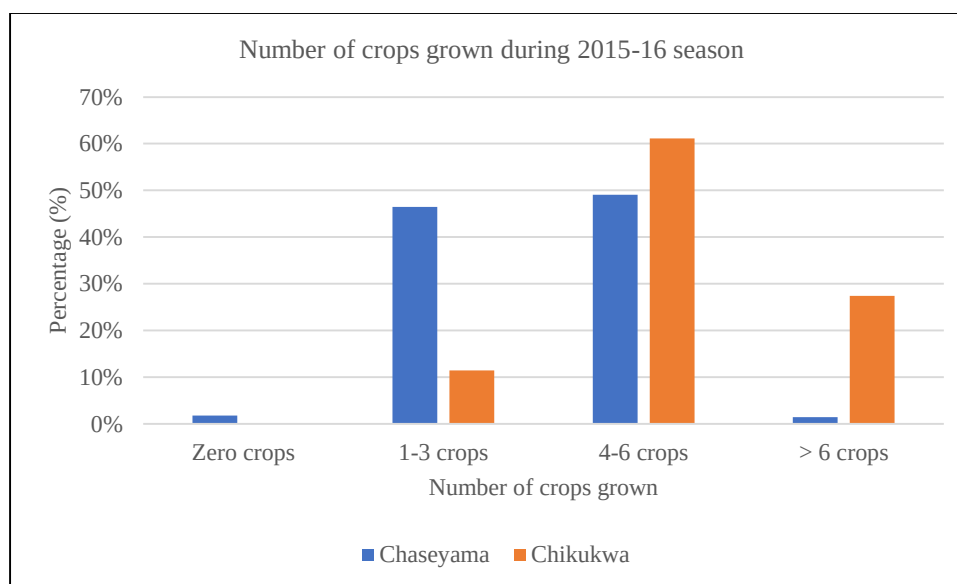


Figure 5.6: Proportion of households growing different crops: 2015 - 2016

5.5 CROPS GROWN DURING THE NOVEMBER 2016 - FEBRUARY 2017 SEASON

5.5.1 Crops grown

Farmers from Chaseyama and Chikukwa were surveyed in terms of the three most important types of crops grown during the 2016 - 2017 cropping season. Farmers had already planted their crops in the field but had not harvested them yet. These crops were similar to what farmers stated as being the most important crops grown during the previous 2015 - 2016 cropping season.

Table 5.5: Proportion of farmers planting various crops during the 2016 – 2017 season in Chaseyama and Chikukwa

Crop	Chaseyama (n = 114)	Chikukwa (n = 113)
Sorghum	67.9%	8.0%
Maize	74.1%	99.1%
Groundnuts	56.3%	37.2%
Bambara groundnuts	54.5%	28.3%
Cowpeas	51.8%	20.4%
Pearl millet	21.4%	1.8%
Finger millet	3.6%	39.8%
Watermelon	23.2%	-
Sunflower	5.4%	3.5%

Beans	0.9%	78.8%
Pumpkins	7.1%	74.3%
Yams	-	40.7%
Sweet potato	-	19.5%

Source: Field survey

5.5.2 Seed sources

The distribution in the number of seed sources for farmers across Chaseyama and Chikukwa is shown in Figure 5.7. The few farmers with no seed sources did not grow any crops during the 2016 - 2017 season. The distribution shows that, while the majority of farmers from Chaseyama had three or fewer seed sources, the majority of farmers from Chikukwa had three or more seed sources with the largest percentage of farmers having five or more seed variety sources across the three major crops grown. A bi-variate correlation, based on the number of seed sources and number of different crops grown, produced a highly significant ($P < 0.05$) Pearson correlation of 0.66, showing that farmers with a higher number of seed sources also grew a higher number of different crops.

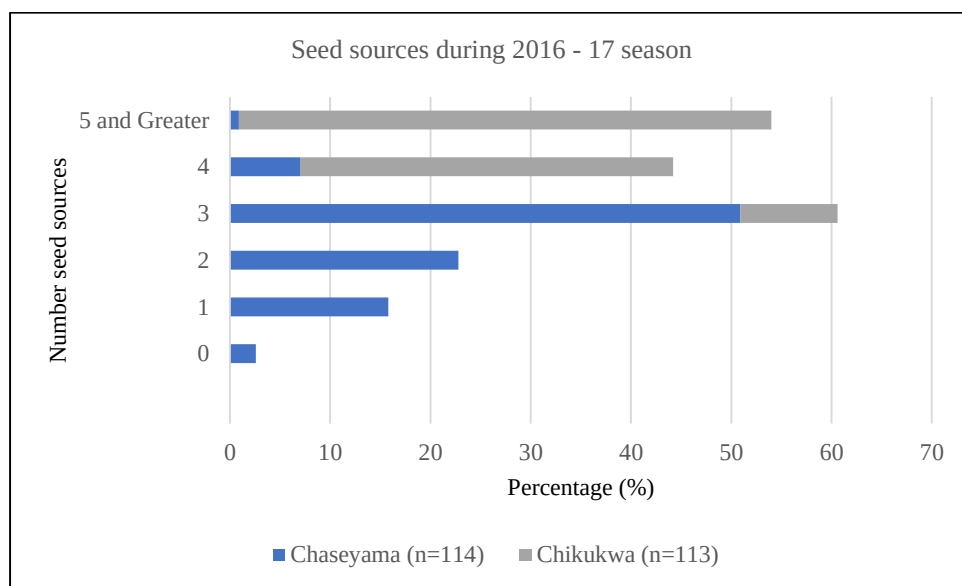


Figure 5.7: Number of farmers' seed sources in Chaseyama and Chikukwa during 2016-2017 season

On average, farmers from Chikukwa grew a significantly larger number of different crops (mean = 5.4, $p < 0.05$) compared with those from Chaseyama (mean = 3.7) with a t-value of -7.14 and degrees of freedom of 225. This is also shown in Figure 5.8 by the distribution of the number of crops grown. In Chikukwa, 88.5% of the farmers interviewed grew at least four crops while, in Chaseyama, the proportion of farmers growing at least four crops was comparatively smaller at 51.8%. This could be related to the varied climatic and weather patterns – Chaseyama is drier (relying on fewer suitable crops and livestock) and Chikukwa is wetter (favouring more diverse crop production).

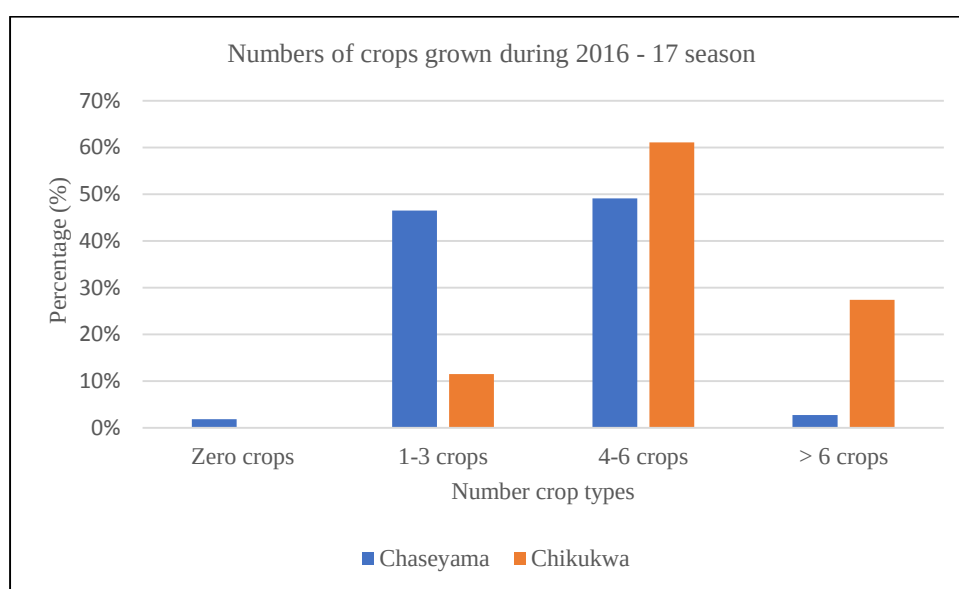


Figure 5.8: Proportion of farmers growing different numbers of crops: 2016 - 2017

5.5.3 Proportion of farmers' seed obtained from different seed sources

Table 5.6 shows the proportion of seed (kg) obtained from the different seed sources in Chaseyama and Chikukwa during the 2016 - 2017 cropping season. The largest quantities (in kg) of seed sown were maize, followed by yams¹⁸, beans and sorghum. As shown in Table 5.7, the importance of seed sources varies by crop category. Own stock was the most important seed source, contributing at least 41% of all seed sources except for maize seed, of which the bulk came from seed aid (48.2%) and agro-dealers (32.1%).

¹⁸ Vegetative planting materials usually sow less area than commodity crops of equivalent kilograms.

Table 5.6: Sources of seed in Chaseyama and Chikukwa in the 2016 – 2017 season

	Seed Source: 2016 - 17 (%)					
Crop	Own stock	Local market	Social network	Agro-dealer	Seed Aid	Total all sources (kg)
Sorghum (n=87)	67.3	1.9	13.3	0.0	17.4	470.0
Maize (n=197)	15.7	1.6	2.4	32.1	48.2	3850.0
Groundnut (n=107)	41.4	22.8	12.8	23.0	0.0	313.0
Bambara groundnut (n=95)	82.3	1.2	9.0	7.5	0.0	207.7
Cowpeas (n=82)	64.4	4.2	3.2	12.7	15.5	142
Pearl Millet (n=28)	65.5	22.6	7.9	0.0	4.0	88.5
Finger Millet (n=49)	89.6	5.5	2.2	0.0	2.7	91
Beans (n=91)	56.0	20.5	15.3	8.2	0.0	856.5
Pumpkin (n=92)	72.7	0.2	21.7	5.4	0.0	9.23
Yam (n=46)	92.2	0.0	7.8	0.0	0.0	1545

Source: Field survey

When these categories of seed source are aggregated into formal and informal seed sources, as shown in Table 5.7, informal seed sources (at least 71.8% of the seed) dominate the supply of seed to the farmers except for the maize seed. This finding is similar to those for the previous 2015-16 season. Other studies have shown that informal seed channels, such as own stock, social networks and local markets are the main sources of seed for small grains and legumes providing above 80% of the seed grown in Zimbabwe (McGuire and Sperling, 2016; Mazvimavi et al., 2017).

Table 5.7: Comparison of seed supply from formal and informal sources

	Seed Source: 2016-2017 (%)		
Crop	Formal sources	Informal sources	Total all sources (kg)
Sorghum (n=87)	17.4	82.6	470.0
Maize (n=197)	80.3	19.7	3850.0
Groundnut (n=107)	23.0	77.0	313.0
Bambara groundnut (n=95)	7.5	92.5	207.7
Cowpeas (n=82)	28.2	71.8	142
Pearl Millet (n=28)	4.0	96.0	88.5
Finger Millet (n=49)	2.7	97.3	91
Beans (n=91)	8.2	91.8	856.5
Pumpkin (n=92)	5.4	94.6	9.23

Yam (n=46)	0.0	100.0	1545

5.6 WAYS OF ACQUIRING SEED

The ways of acquiring seed, cited by farmers, included cash, barter, free and credit. These were compared across all seed sources, as well as formal and informal sources. The ways in which seed was acquired for each type of crop is shown in Table 5.8. Most cereals (sorghum, maize and the millets) were acquired mostly for free, while most legumes (groundnuts, Bambara groundnut and beans) were acquired by cash purchases. The majority of maize acquired for free was from seed aid sources.

Table 5.8: Ways of acquiring seed (% of each crop grown)

	Sorghum (n=87)	Maize (n=197)	Ground nut (n=107)	Bambara groundn ut (n=95)	Cowpeas (n=82)	Pearl Millet (n=28)	Finger millet	Beans (n=91)	Pumpkin (n=92)	Yam (n=46)
Cash	3.4	44.2	67.7	57.1	40.0	14.3	16.7	74.4	66.7	0.0
Free	89.7	54.7	19.4	21.4	60.0	71.4	66.7	5.1	33.3	0.0
Barter	6.9	0.4	9.7	21.4	0.0	14.3	16.7	17.9	0.0	100.0
Credit	0.0	0.8	3.2	0.0	0.0	0.0	0.0	2.6	0.0	0.0

Source: Field survey

Most of the seed from the local market and agro-dealers was acquired using cash, while most of the seed acquired from the social networks and seed aid was provided for free.

5.7 FARMERS' CROPPING PLANS FOR THE NEXT SEASON (2017 - 2018)

Farmers in Chaseyama and Chikukwa were also asked about their seed procurement plans for the following season of 2017 - 2018. Farmers from both areas expected to source most of their seed material from their own stored seed, followed by purchases from agro-dealers. Few farmers mentioned seed aid, social networks and local markets. These estimations are shown in Figure 5.9 and indicated that informal seed sources are expected to continue to be the dominant seed source for the farmers in the near future.

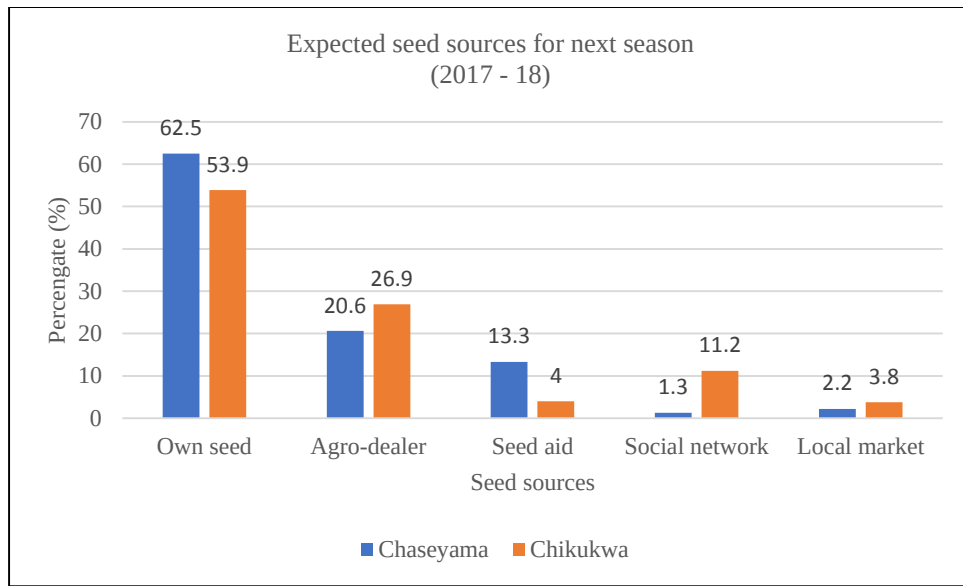


Figure 5.9: Farmers' expectations of seed source for the next planting season (2017 - 2018)

When both study locations were compared in terms of seed sources, as shown in Figure 5.10, there was an equal proportion of seed likely to be sourced from own seed stock. Chikukwa farmers expected more seed to be sourced from agro-dealers, social networks, and local markets, while Chaseyama farmers expected more seed to be sourced from seed aid.

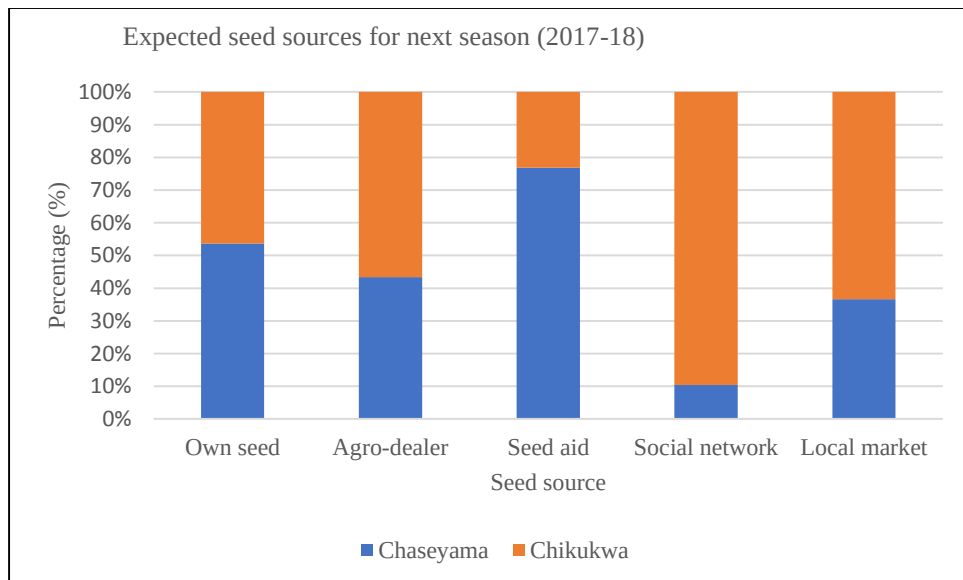


Figure 5.10: Proportion of different expected sources of seed for the next season: 2017 – 2018

5.8 CONCLUSIONS

An overview of the seed system of farmers surveyed for this study was provided in this chapter. This began with the historical context of the farmers' seed systems in Chaseyama and Chikukwa. The overview included a consideration of the existing seed system during the previous agricultural season (2015 - 2016), the current season (2016 - 2017) and the next agricultural season (2017 - 2018).

In the historical profile of Chaseyama, several episodes of drought were recorded that affected the cropping of the farmers negatively. Droughts are chronic in the area, both in history and at present. In the historical profile of Chikukwa, drought was recorded as more of a recent event (1992 and 2008), and the area also had instances of cyclones that were accompanied by flooding that destroyed crops, agricultural structures, houses, roads and bridges.

The household survey showed informal seed sources (own seed, local markets and social networks) played a dominant role throughout Chaseyama and Chikukwa, over the three agricultural seasons (2015 - 2016, 2016 - 2017 and 2017 - 2018). This observation underscores the importance of informal seed systems in accessing seed among smallholder farmers. The farmer seed system has shown resilience over time in the face of an unpredictable policy framework, a harsh socio-political environment, and in the midst of natural hazards such as drought and cyclones. However, the formal seed system, although of lesser importance, should not be undermined in terms of its influence on farmers' accessing certain seed varieties through seed aid and agro-dealers, especially with regards to improved maize seed varieties.

The ways of acquiring seed by smallholder farmers have implications for how seed systems are structured. Free seed sources are largely dependent on social networks between farmers, while purchases are dependent on availability of seed markets, the seed prices and ability of farmers to purchase the seed.

CHAPTER SIX: SEED SECURITY OF CHASEYAMA AND CHIKUKWA FARMING HOUSEHOLDS

6.1 INTRODUCTION

The focus of this chapter is on household seed security using the framework of seed availability, seed access and seed utilisation. The purpose of the chapter is to quantify and classify households in Chimanimani according to their seed security status. In addition, the determinants of household level seed security are examined. The content follows from the previous chapter in which the seed systems of smallholder farmers were considered within farmers' contexts. A cluster analysis¹⁹ differentiated households into those that were seed secure, seed insecure, and a mixed group, during the 2016 – 2017 farming season. These farming households represented a broad range of seed security status across the continuum from seed security to seed insecurity, depending on their individual characteristics.

6.2 SEED SECURITY COMPONENTS

The components of seed security that were examined included seed availability, seed access and seed utilisation. Indicators of seed security were identified from a survey of 227 households from Chaseyama and Chikukwa. These were grouped according to common seed security themes using the classification of seed security by the FAO (2015b) that considers availability, access and utilisation. Cluster analysis was used to segregate households into groups based on their seed security characteristics. Clustering was done at two levels, i.e. by hand and through use of an algorithm. Clustering by hand consisted of selecting specific variables to cluster households into groups for each of the seed security components, i.e. access, availability and utilisation. For each component, variable selection was based on aligning the variables to the definition and sub-elements of the seed security domain. For example, the seed availability component included seed proximity, timely provision and seed presence at the level of the seed supplier. Based on this initial variable selection, the algorithm was developed from the cluster analysis in SPSS to determine the

¹⁹ Cluster analysis identifies homogenous sub-groups of cases in a population. It seeks to identify a set of groups, which both minimise intra-group variation and maximise inter-group variation (Hair et al., 1998; Garson 2014).

number and size of clusters under each domain of seed availability, access and utilisation. The details of this analysis are shown in appendix 6.

6.2.1 Seed Availability

According to Remington et al. (2002:319), seed availability is when there is sufficient seed of desired crops within reasonable proximity (spatial availability) and in good time for sowing (temporal availability). In this study, seed availability was assessed by identifying the variables that were closely related to this definition. As it was possible for farmers to recall two seasons, investigations centred on the seasons 2015 - 2016 and 2016 - 2017. The 2015 - 2016 year was the farmers' previous season, while 2016 - 2017 was the current season when farmers had planted their crops (that had not been harvested at the time of the interviews).

The variables identified under seed availability for 2015 - 2016 included different types of crops grown; seed quantities planted, which were then aggregated into different cereals (maize, sorghum, pearl millet, and finger millet), legumes (groundnuts, bambara groundnuts, beans and cowpeas) and tubers (potatoes and yams); amounts harvested and the amount remaining at the time of the interview (which was during the peak hunger period of January and February 2017).

The variables developed for 2016 - 2017 were similar to the 2015 - 2016 season, except that the harvest data for the 2016 - 2017 season were not yet available. The 2016 - 2017 season made it possible to examine seed availability further in terms of timeliness, proximity of the seed to the farmers and adequacy of seed from different seed sources. These were considered as associated factors or aspects to obtain a more nuanced understanding of availability using the guidelines of Remington et al. (2002) and the FAO (2016a). These variables are listed in Appendix six, including a description of how they were analysed.

A cluster analysis was conducted using the seed availability variables to determine the possibility of clustering households into groups with similar seed availability characteristics. From the cluster analysis the variables used to place households into distinct groups were 'seed timeliness', 'seed proximity' and 'sufficient seed from different seed sources. Temporal availability, spatial

availability and sufficiency of seed (in terms of quantity) available have been identified as key variables for assessing seed availability in previous seed security assessment studies (e.g. Remington et al., 2002; FAO, 2016a).

The timeliness of seed availability variable was derived from household responses to a question about when a particular seed was available to them. Responses ranged from the seed being available before the 2016 - 2017 planting season began, at the start of the season, mid-season, and towards the end of the planting season. This classification was adapted from the FAO (2015b) seed security assessment, household survey questionnaire. The preferred scenario is that seed is available before the planting season, while seed available at the start of the season is also acceptable (both of these were coded '*On time*'). The other periods (mid-season and towards end of the season) are typically too late for useful crop production (and were coded '*Late*'). Although some crops have a longer planting window and could be sowed later on, this cut-off suggests that farmers' seed should be available earlier for planning purposes (for land preparation and allocation of crops to the fields and accessing other inputs such as fertilisers). To obtain an overall indication of temporal availability of seed to the households, the timeliness variable was coded '0' if a farmer received one of his/her seed types late, considering all crops planted, and was coded '1' if all his/her seeds were accessed on time.

Seed proximity was assessed in terms of how far farmers had to travel to get their seeds from different sources. For each seed type that farmers used, they were asked about the proximity of seed sources, such as obtaining it from their own village and neighbouring village (both coded '*Near*'), while neighbouring district and beyond were coded '*Far*'. This was adapted from the FAO (2015b) seed security assessment guidelines. To obtain an overall indication of spatial availability of seed, the proximity variable was coded '0' if a farmer received one of his/her seed types from far, considering all crops planted, and coded '1' if all his/her seeds were accessed nearby.

Seed adequacy was assessed by asking farmers about the quantity of seed they planted and whether there was enough seed from the particular source. To obtain an overall picture of the adequacy of seed supplied to households, the variable was coded '0' if a farmer claimed that there was not

enough seed from a least one source and coded ‘1’ if the farmer claimed that there was enough seed from all his/her sources. The assumption was that, for households that said that a particular seed was not sufficient from one of their sources, they were facing challenges of seed availability.

Table 6.1 shows the cluster analysis derived from the three seed availability variables. The other variables were excluded from the development of the clusters but were reintroduced when determining the characteristics of the households in each cluster (Section 6.4).

Table 6.1: Results of two-step cluster analysis of Chaseyama and Chikukwa households based on seed availability status for crops grown during 2016 - 17 season

Variable	Cluster 1 (45%; n = 101)	Cluster 2 (36%; n = 81)	Cluster 3 (19%; n = 43)
Seed timeliness	On time (100%)	Late (100%)	On time (100%)
Seed proximity	Near (100%)	Far (57%)	Far (95%)
Seed adequacy²⁰	Yes (57%) No (43%)	Yes (22%) No (78%)	Yes (63%) No (37)

²¹Predictor Importance Timeliness = 1; proximity = 0.56; adequacy = 0.13.

Cluster 1 consisted of 45% of the farmers from the study area that accessed their seed on time, in close proximity and whose seed sources had adequate seed for their needs. The households falling under this cluster were categorised as ‘seed secure’ in terms of seed availability since they had positive indicators of seed availability. Seed availability was not a challenge to the households under this cluster as all of them (100%) received their seed on time for their planting needs and their source of seed was nearby. Over half of these households (57%) claimed also that the seed from all their seed sources was adequate.

Cluster 2 comprised 36% of the sampled households that accessed their seed late, sourced it far by the majority of them (57%), with 78% claiming that the seed was inadequate. The households falling under Cluster 2 were categorised as ‘seed insecure’ in terms of seed availability since they had negative indicators of seed availability. Seed availability was a challenge to the households under this cluster as all of them (100%) received their seed either mid-season or towards the end

²⁰ Bold indicates the larger proportion of farmers.

²¹ Predictor importance ranges from 1 (most important) to 0 (least important) predictor of the cluster. It thus has the most impact on determining the clusters (i.e. grouping of the households). The predictor importance output was generated from the SPSS two-step cluster analysis.

of the planting season. Over half of these households (57%) also claimed that the seed was far from them and inadequate from all their seed sources (78%).

Cluster 3 households constituted 19% of the sampled households. These households accessed their seed on time, although this was far from them, and 63% indicated they received adequate seed for their needs. The households falling under this cluster were categorised as ‘diverse’ in terms of seed availability since they indicated a mixed picture of seed availability. Altogether, the three clusters showed that there is a wide range of seed availability between households that were seed secure, households with mixed results and households that were seed insecure, depending on the farmers’ crops, seed varieties and seed sources.

The households were spread across the two study areas to determine a site-specific indication of seed availability. Figure 6.1 shows the proportion of Chaseyama households categorised in terms of their seed availability status where: 61% of households were regarded as seed secure while fewer households were seed insecure (9%) in terms of seed availability; 30% of the households depicted mixed indicators of seed availability (diverse). The construction of these categories was based on the cluster analysis of Table 6.1. Overall, it was found that seed availability was not a constraint for most of the households in Chaseyama. Thus, most were able to access their seed on time, near to them and the seed obtained from various sources was adequate for their needs.

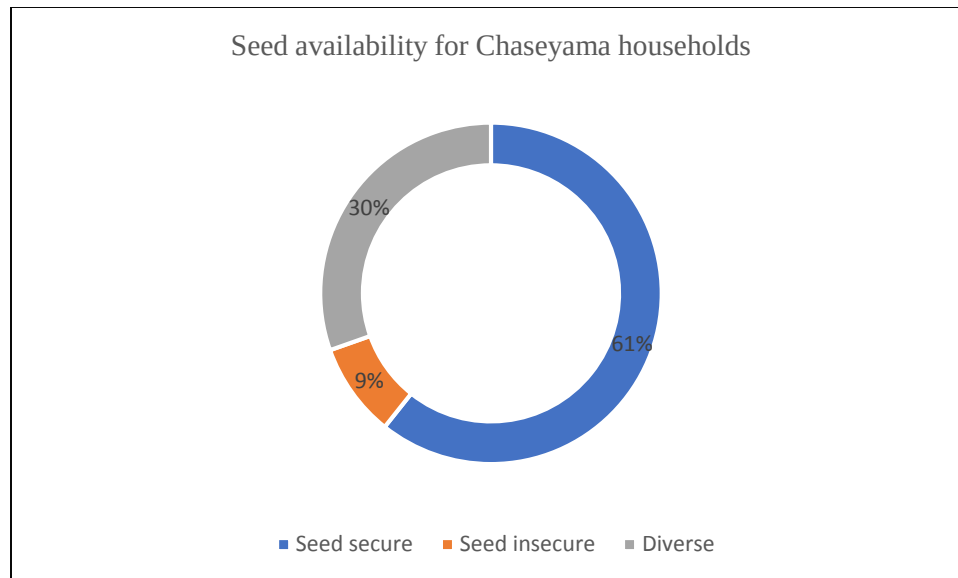


Figure 6.1: Proportion (%) of Chaseyama households categorised in terms of their seed availability status (n=114).

Figure 6.2 shows the proportion of Chikukwa households categorised in terms of their seed availability status, where: 63% of households were seed insecure while the smallest group of households (8%) were those indicating diverse seed security in terms of seed availability; and 29% of the households were seed secure in terms of seed availability. These categories were based on the cluster analysis of Table 6.1. The overall situation for Chikukwa was that most of the households faced challenges in obtaining their seed on time and near to them, and the seed quantities available from various sources were insufficient for their needs. This could be related to the geographical position of Chikukwa. Leahy (2013) considered Chikukwa as being at the ‘edge of the economy’ as it is located on the foothills on the edge of a mountainous region on the far eastern border of Zimbabwe, next to Mozambique, that borders a national park and a pine plantation. It is very rural, accessible by a dirt road, with limited social amenities and few general-purpose shops.

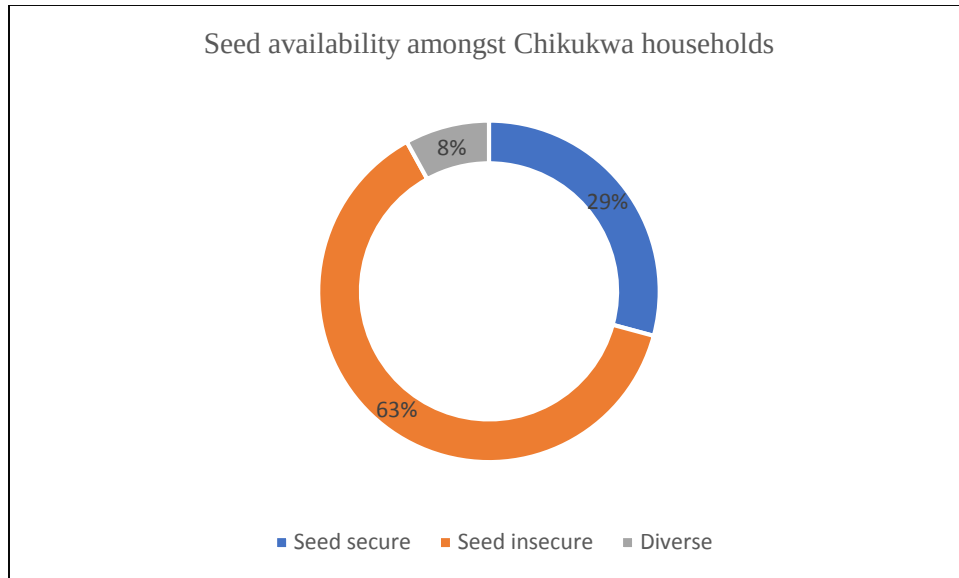


Figure 6.2: Proportion (%) of Chikukwa households categorised in terms of their seed availability status (n=113).

6.2.1.1 *Timeliness of seed availability for crops from different seed sources*

Figure 6.3 shows the timeliness of seed availability for different crops planted by farmers from Chaseyama and Chikukwa during the 2016 - 2017 season. The results showed that most seeds were acquired before the planting season for all crops. Approximately 73.5% of the seeds were obtained before planting season with 9.7% acquired at the start of planting season. Between 78% and 100% of the seeds were acquired before the planting season, except for maize for which 54.4% was acquired before the planting season. This was probably related to the prominence of farm-saved seed for most of the farmers' crops. These results suggested that farmers acquired their seeds in time for planting. Timely seed and input acquisition are crucial for farmers' planning and timely planting. The relatively lower proportion of maize seed that was acquired was cause for concern given that it is the most commonly grown crop (in terms of kg planted) and is very susceptible to climatic and weather variations. Maize seed thus needs to be acquired on time so that farmers can plant appropriately, depending on the seasonal outlook.

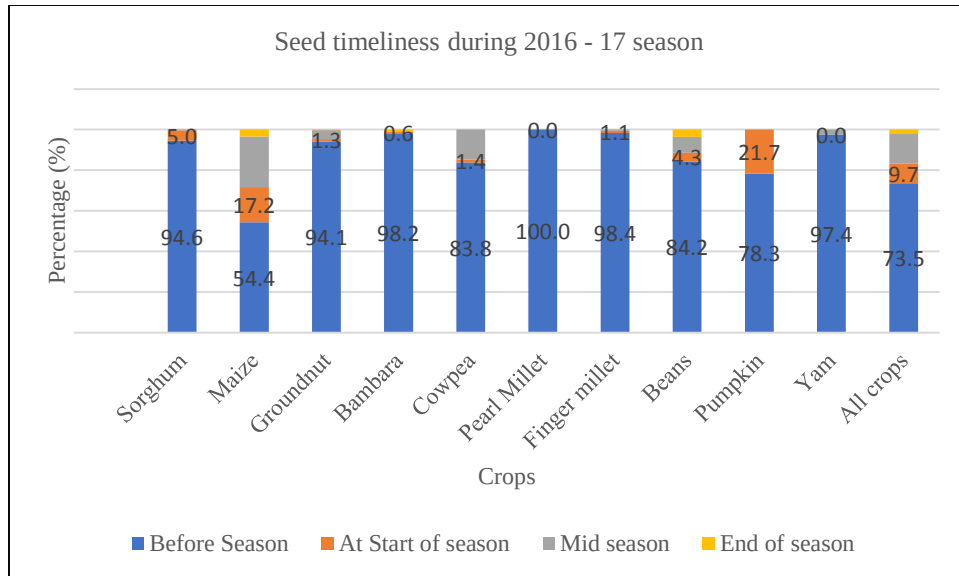


Figure 6.3: Timeliness of seed availability for crops planted as % kg planted (n=227)

Figure 6.4 shows a comparison of the timeliness of the availability of different seed crops from formal and informal seed sources. The seed sources used by farmers to obtain their seed (see Chapter 5) included own seed, local market, social networks, agro-dealers and seed aid. Own seed, local markets and social networks constitute the ‘informal’ system, while the agro-dealer and seed aid are classified as the ‘formal’ seed system (as most of the seed from these sources was certified).

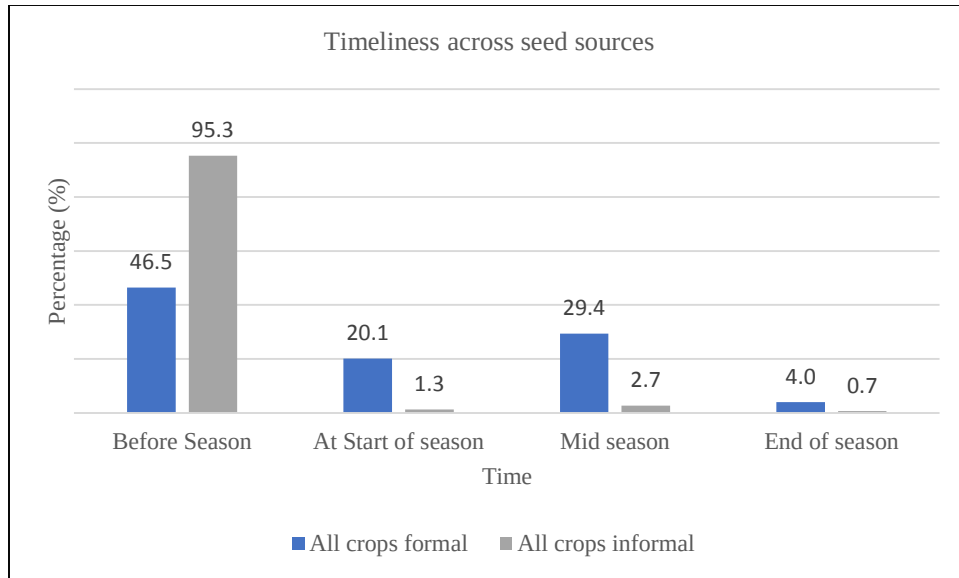


Figure 6.4: Timeliness of seed provision by formal and informal sources as percentages of kilograms planted

The results showed that the bulk and a higher proportion (95.3%) of seed planted was obtained from informal seed sources before the planting season compared with seed from formal sources (46.5%). These results suggest that there was a higher probability of farmers acquiring their seed in time for the planting season from informal seed sources. Own seed, local markets and social networks provided a readily available source of seed for farmers, while there were delays in supplying seed on time by agro-dealers and provision by seed aid was late. The following is an account from a farmer from Chikukwa who never lacked seed because of own seed production, storage and preservation that ensured timely availability for her planting needs:

“I never lack any seed as I have seed stored from the previous year that I replace with new seed that has been harvested. Had I lost seed due to poor germination, I would have had enough for replanting. I own a seed plot and food plot. For my maize seed, I observe isolation distance and time to prevent contamination. In early November before most farmers had planted their crops, I already had planted my seed plots. I have 2 acres for the seed plot. My best land (good soil and wetland) is used for seed production. The plot for food production is about 1 ha”. (Christy, Life Case History Interview, Chikukwa, 2017).

In order for such farmers to observe isolation distances they tend to either plant their seed crops as a block with other farmers or plant the seed crop in fields where other different crops are planted.

6.2.1.2 Proximity of seed availability from formal and informal seed sources

Figure 6.5 shows the proximity of seed sourced during the 2016 - 2017 cropping season. More than 81% of seed for all crops was obtained within the village in which the farmers resided. This implies that seeds were sourced from nearby sources, thereby reducing transaction costs.

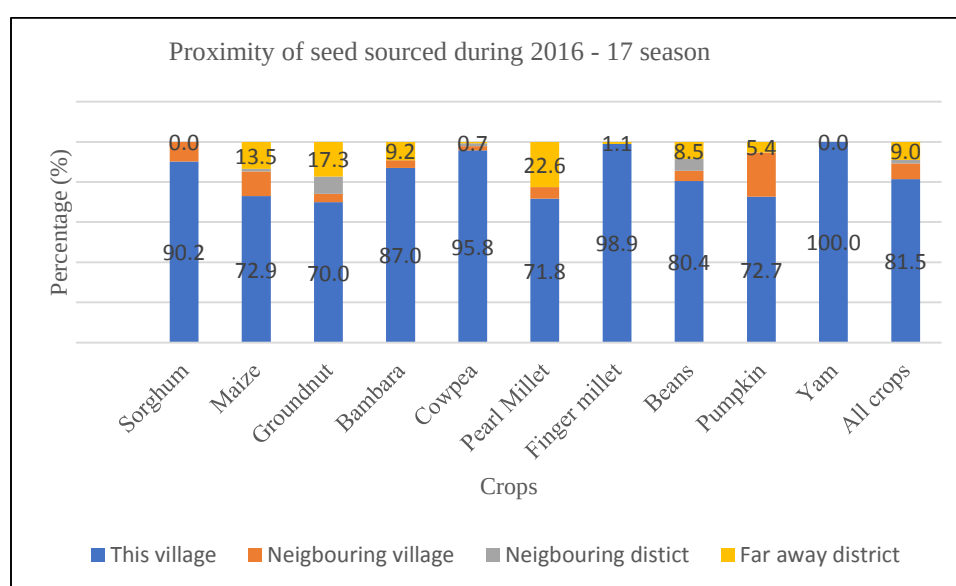


Figure 6.5: Proximity of seed sources as percentages of kilograms planted

When comparing formal sources (agro-dealers and seed aid) with informal seed sources (own seed, local markets and social networks), a higher proportion of seed was acquired from informal sources (92.9%) within the village compared than from formal sources (66.7%) as shown in Figure 6.6. Although both seed sources were within adequate proximity, the informal seed sources provided the highest quantities.

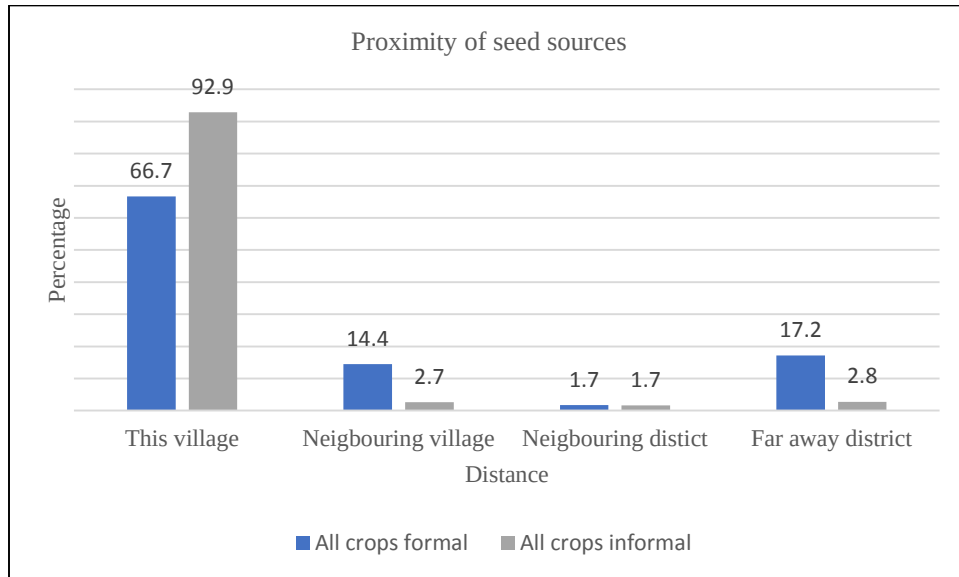


Figure 6.6: Proximity of seed availability from formal and informal seed sources as percentages of kilograms planted

The results showed that the bulk, and a higher proportion, of seed planted was accessed from informal seed sources in close proximity to the farmers compared with seed from formal sources. These results suggest that there was a higher probability of farmers acquiring seed for their planting needs from informal sources in close proximity to them compared with formal seed sources.

6.2.2 Seed Access

Seed access refers to the ability to acquire seed by farmers. This could be through purchase, exchange, loan, barter or use of influence (social capital) in social networks (Sperling et al., 2013b; FAO, 2015b). As a first step in clustering households into groups based on seed access, variables that were related to the definition of seed access and had a bearing on the ability of farmers to acquire seed were selected. These included seed price (affordable or expensive), access to seed aid, the number of times a farmer accessed seed aid, income, asset variables (livestock, homestead assets and land), and demographic variables (sex and age of household head), see Appendix six. The second step was to use all these variables to cluster the households into seed access group categories. From this process, four out of a possible nine variables could be used to make the

classifications. These were: seed affordability, sex of household head, age of household head and the number of times the farmer was a recipient of seed aid in the previous five years. The other variables were removed from the analysis as they were not useful in distinguishing the clusters.

Seed affordability was assessed in terms of seed prices being affordable, expensive, and very expensive across the different seed sources. A farmer was given a code of '0' (*Expensive*) if one of his/her seed purchases was perceived by them to be expensive. A farmer was given a code of '1' (*Affordable*) if all their seed was affordable. All farmers' varieties from own seed stock were regarded as affordable because they were sourced from own harvest and farmers did not have to purchase the seed. The other variables used in the cluster analysis were demographic variables and the seed aid frequency variable. The cluster analysis based on the selected variables is shown in Table 6.2.

Table 6.2: Results of two-step cluster analysis of Chaseyama and Chikukwa households based on the status of their access to seeds for crops grown in the 2016 - 2017 season

Variable	Cluster 1 (42.2%; n = 94)	Cluster 2 (34.5%; n = 77)	Cluster 3 (23.3%; n = 52)
Seed affordability	Affordable (100%)	Expensive (100%)	Affordable (53.8%)
Sex of household head	All Male	All Male	All Female
Age of household head	Mean = 52.7 years	Mean = 49.4 years	Mean = 58.7 years
Number of times receiving seed aid	Mean = 2.2 times	Mean = 3 times	Mean = 2.6 times

Predictor Importance: Sex = 1; Seed affordability = 0.8; Age = 0.1; Times of receiving seed aid in previous five years = 0.04.

Cluster 1 comprised 42.2% of the farmers sampled across the study area, whose entire seed planted was perceived to be affordable. These households were all male headed, with a mean age of 52.7, and received seed aid approximately 2.2 times over the previous five years (the lowest number of times compared with the other clusters). A one-way analysis between subjects ANOVA was conducted to compare the means across the three seed access clusters. There was a significant effect of the number of times seed aid was received on the cluster groups ($F_{2, 220} = 4.43$, $p = 0.013$). Taken together, these results suggest that a higher number of times of receiving seed aid was associated with households that were seed insecure. The households falling into Cluster 1

were categorised as ‘seed secure’ in terms of seed access since the price of all seed planted was perceived to be affordable by all of them (i.e. 100%) and they received seed aid the least number of times on average. The fact that all households falling under this cluster are males may serve to show that access to seed could to a certain extent be influenced by the sex of the household head.

Cluster 2 comprised 34.5% of the farmers in the study area, who perceived at least one of their seed varieties to be expensive. These households were all male headed, with a mean age of 49.4 (lowest of the three clusters) and received seed aid approximately three times over the previous five years (the highest number of times compared with the other clusters). The households falling into this cluster were in the lowest age group and were categorised as ‘seed insecure’ because the price of some of their seed planted was perceived to be either expensive or very expensive and they received seed aid the largest number of times on average. Compared to cluster 1, the males in this cluster are younger and less seed secure in terms of seed access. Age could be a contributor to seed access especially for seed that is predicated on social relational access.

Cluster 3 consisted of 23.3% of the farmers across the study area, whose seed planted was both ‘affordable’ (54%) and ‘expensive’ (46%). These households were all female headed, with a higher mean age of the household head (58.7) and had received seed aid approximately 2.6 times over the previous five years. The households falling under this cluster were categorised as ‘diverse’ in terms of seed access as the farmers expressed mixed conditions of seed accessibility. The female group thus comprised of households with mixed seed access characteristics.

The households were then divided across the two study areas to determine the site-specific situation of seed access. Figure 6.7 shows the proportion of Chaseyama households categorised in terms of the status of their access to seed. The categorisation was based on the cluster analysis from Table 6.2. The highest proportion of these households was seed secure (58.6%), 18% of the households were seed insecure in terms of seed access and 23.4% of the households indicated mixed access to seed.

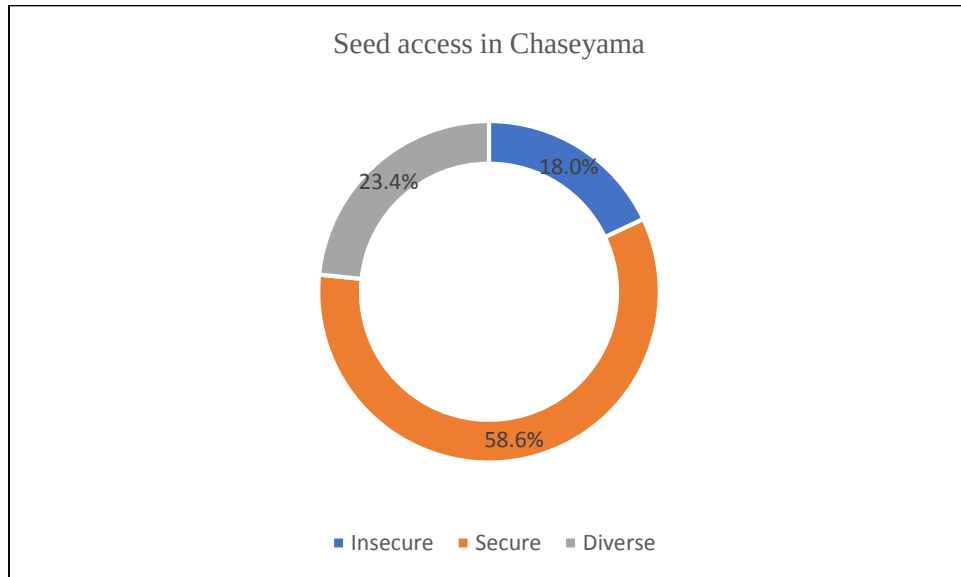


Figure 6.7: Proportion of Chaseyama households with access to seed during 2016 - 2017 season (n=114)

Figure 6.8 shows the proportion of Chikukwa households categorised in terms of the status of their access to seed. The categorisation was based on the cluster analysis from Table 6.2. Over half of the households were seed insecure (50.9%), 23.2% of the households indicated diverse access to seed and 25.9% of the households had secure access to seed.

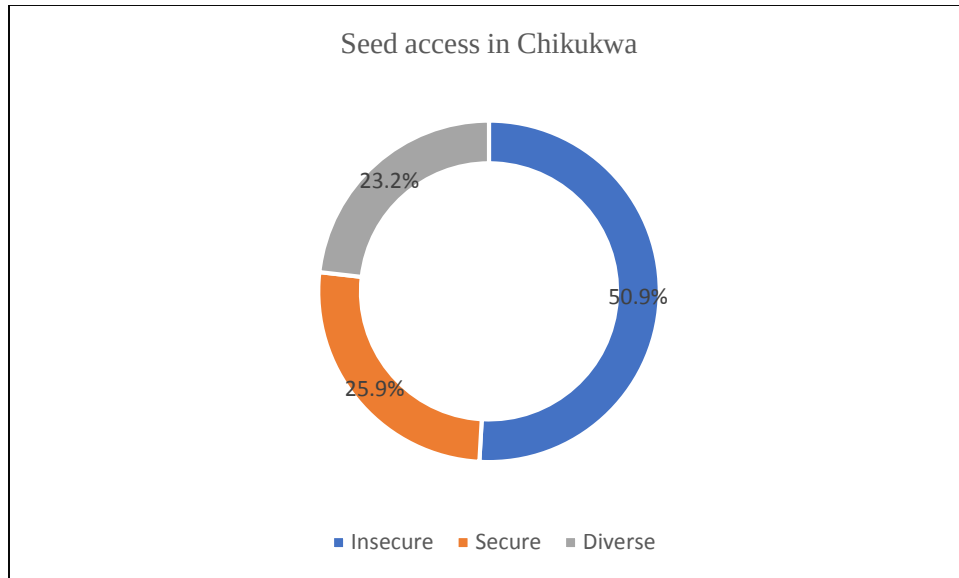


Figure 6.8: Proportion of Chikukwa households with access to seed during 2016 - 2017 season (n=113)

Overall, most Chaseyama households interviewed were seed secure while most of Chikukwa households were seed insecure, based on access to seed during the 2016 - 2017 season. The main determinant of seed access for these households was seed prices that were perceived by households in Chikukwa to be expensive. Data from the agro-dealers interviewed across the two sites revealed that a 10kg bag of maize seed sold in Chaseyama ranged from US\$18 to US\$22, while a 10kg bag of seed sold in Chikukwa shops ranged from US\$30 to US\$35. This could be related to the remoteness of Chikukwa which is further than Chaseyama from Mutare, the nearest city that provides most of the formal seed.

All three clusters showed that there was a wide range of seed accessibility between households that were seed secure, seed insecure and households that indicated mixed results, depending on seed prices and other household characteristics such as sex and age of household head and the number of times they received seed aid. The number of times seed aid is received can be seen as a proxy for vulnerability to seed access on the basis that aid is targeted accurately to the most vulnerable households. Also, repeated seed aid results in 'donor syndrome' dependency.

6.2.2.1 Seed affordability across formal and informal seed sources

Figure 6.9 shows the affordability of seeds sourced during the 2016 - 2017 cropping season. Most of seed accessed (over 75%) for all crops planted was affordable to the households. This implied that most farmers' seed, accessed from various sources, was affordable. The few crops that were considered expensive by many farmers were maize, groundnut and bean seed.

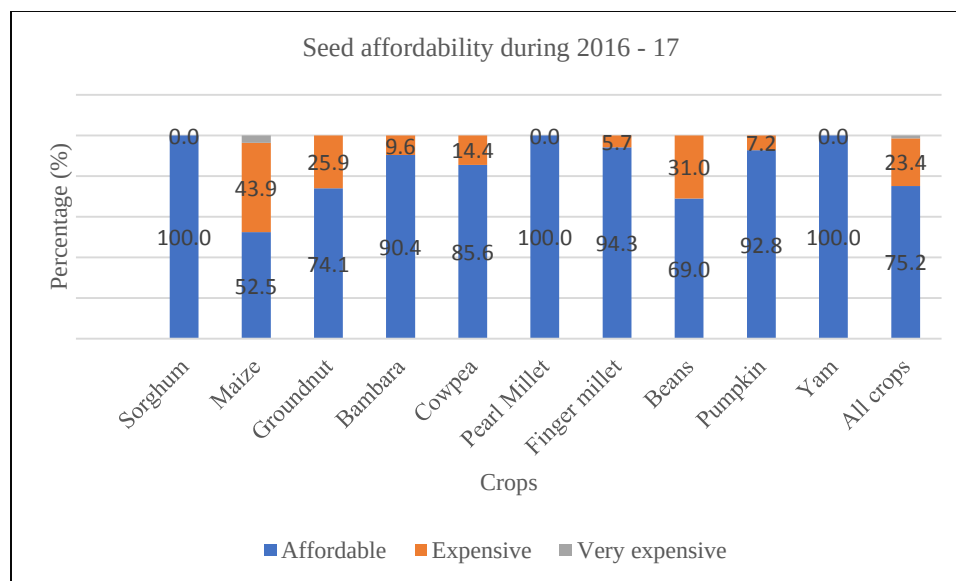


Figure 6.9: Seed affordability for different crops as percentages of kilograms planted

When comparing formal sources (agro-dealers and seed aid) with informal seed sources (local markets and social networks), a higher proportion of seed from informal sources (92.5%) was affordable compared with seed from formal sources (31.7%) as shown in Figure 6.10. The highest proportion of seed accessed from formal seed sources was expensive (63.4%).

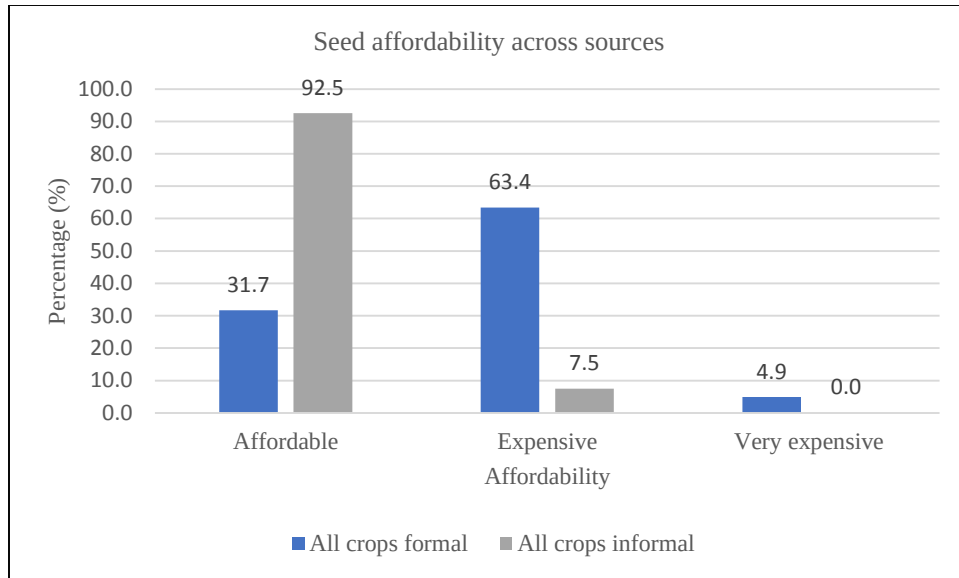


Figure 6.10: Proportion of seed affordability as percentages of kilograms planted

The results showed that the bulk, and higher proportion of seed planted from informal seed sources, was affordable compared with seed from formal sources. The bulk of the seed from formal sources was expensive. These results suggest that there was a higher probability of farmers acquiring affordable seed from informal seed sources for their planting needs compared with seed from formal seed sources.

6.2.3 Seed Quality/Utilisation

Seed quality refers to the technical aspects of the seed such as germination, physical purity, seed health, and varietal quality and purity (Walsh et al., 2014; FAO, 2015b). Households were asked to classify their seed into clean seed (no impurities or damage), fairly clean seed (some impurities, no damage) and unclean seed (some impurities and damage). This classification was adapted from the FAO (2015b) seed security assessment guidance workbook. Seed germination was categorised as ‘good’, ‘fair’ or ‘poor’, based on farmers’ perceptions. Good germination meant that virtually all the planted seed had germinated well in their fields. Fair germination implied that only some of the seed had germinated. Poor germination implied that most of the planted seed had not germinated. Although germination percentage is a measure of the quality of the seed, it is also affected by soil and moisture characteristics.

Both the physical purity (cleanliness) and germination variables were applied to all farmers' seed varieties, regardless of the seed source. The following was the process of developing the binary cleanliness and germination codes of seed quality. A farmer was allocated a code of '0' (not clean) if one of his/her seed varieties (across all sources) was not clean (i.e. had some impurities and damage). A farmer was allocated a code of '1' (clean seed) if all of his/her seed varieties planted were clean (i.e. had no impurities or damage). In the same way as coding for seed quality, a farmer was allocated a code of '0' (poor germination) if one of his/her seed varieties had poor germination (i.e. classified as fair or poor germination). A farmer was allocated a code of '1' (good germination) if all the farmer's seed varieties planted had been classified as good germination.

Cluster analysis was done to determine the number of groups into which the farmers could be divided in terms of seed quality (i.e. seed purity and germination). Two clusters provided the best categorisation of farmers because three clusters resulted in the third cluster having too few households (i.e. nine) in a single cluster. The two clusters produced by using the seed quality indicators are shown in Table 6.3. Appendix six provides the details of the cluster analysis including a measure of the cluster quality²².

Table 6.3: Results of two-step cluster analysis of Chaseyama and Chikukwa households based on the status of their seed utilisation and quality of seed crops grown during 2016 - 2017 season

Seed Quality Characteristic	Cluster 1 (84%; n = 189)	Cluster 2 (16%; n = 36)
Predictor Importance: Germination = 1; Clean seed = 0.83		
Good germination	Yes (100% of farmers)	No (88.9% of farmers)
Clean seed	Yes (100% of farmers)	No (75% of farmers)

Predictor Importance: Germination = 1; Clean seed = 0.83

Eighty four percent of the households were clustered together based on seed with good germination (100% of the households) and clean seed (100% of the households). The 100% shows that all the seed varieties planted by these farmers had good germination and were clean. The households falling under Cluster 1 were classified as 'seed secure' in terms of seed quality.

²² Quality in this context refers to statistical robustness.

Households classified as ‘less seed secure’ (16%) experienced challenges of poor seed germination (88.9%) and unclean seed (75%). The cluster comprised a mixed group of households in terms of their seed quality, although the majority (at least 75% in both cases) experienced challenges with seed germination and clean seed for one of the crop varieties planted.

Given that the majority of the households (84%) were seed secure in terms of both seed germination and clean seed used, quality aspects of seed were not a problem to most of the households interviewed. This concurs with the findings of Kusena et al., (2017) who reported that farmers from Chimanimani showed capacity to supply seeds of good quality.

When comparing seed security across the Chimanimani sites in terms of both seed germination and clean seed, 84.8% from Chaseyama and 83.2% from Chikukwa were located in Cluster 1 depicting good germination and clean seed, i.e. seed secure.

6.2.3.1 *Seed purity across formal and informal seed sources*

Figure 6.11 shows the purity (cleanliness) of seed crops sourced during the 2016 - 2017 cropping season. Most of the seeds planted (over 96%) for all crops were clean, without impurities or any physical damage. This implied that most of the seed used by farmers was of good physical quality. A few seeds planted (2.6%) from different sources were fairly clean. All the pumpkin, yam, pearl millet and almost all the groundnut seeds planted were clean. A few quantities of bean, cowpea and sorghum seed were less clean (i.e. had some impurities and damage). This was not surprising given the susceptibility of legumes to insects and spoilage during storage (Keneni et al., 2011; Srivastava and Subramanian, 2016).

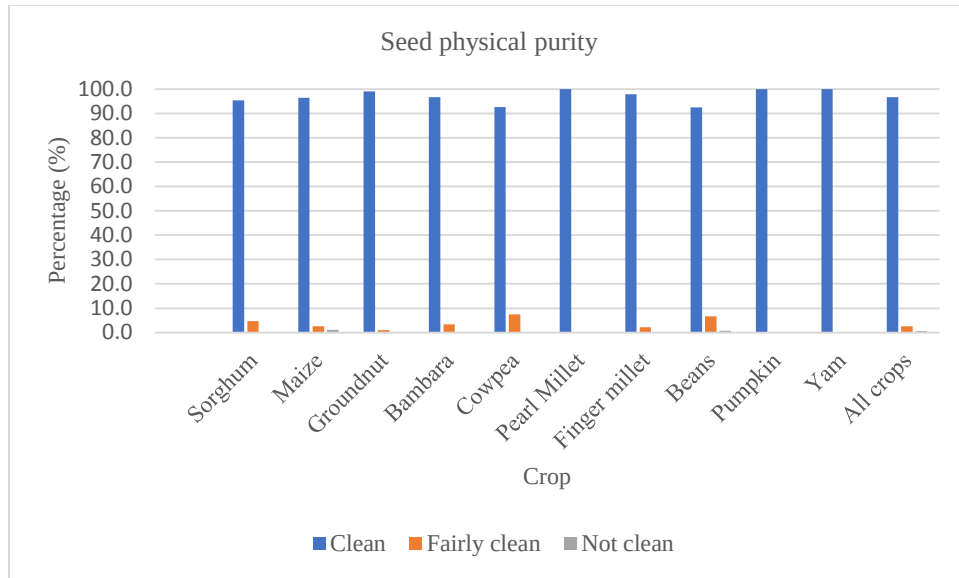


Figure 6.11: Proportion of clean seed for different crops as percentages of kilograms planted

When comparing formal sources (agro-dealers and seed aid) with informal seed sources (own seed, local markets and social networks), high percentages of seed quantities from both formal and informal seed sources (at least 96%) were clean without impurities or any physical damage as shown in Figure 6.12.

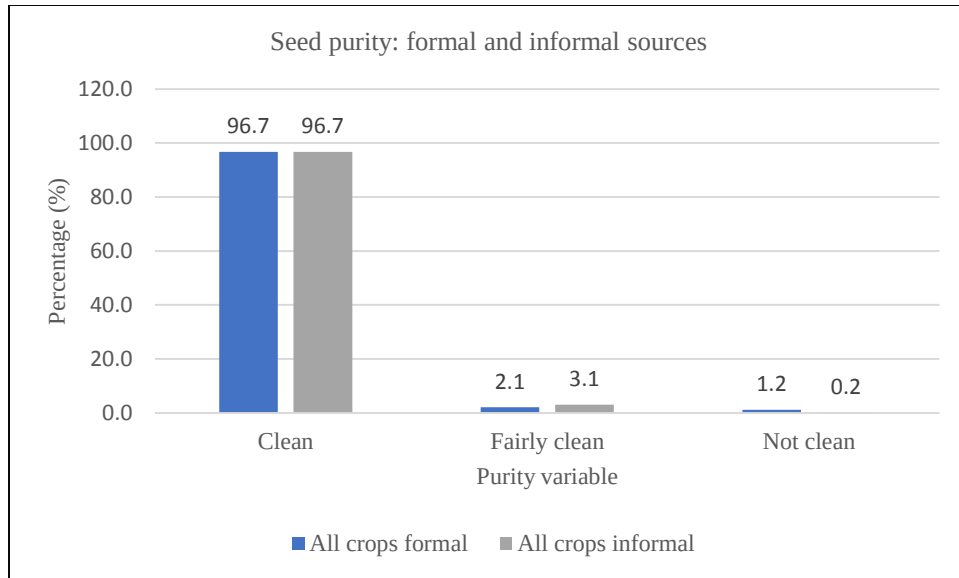


Figure 6.12: Proportion of clean seed as percentages of kilograms planted

These results show that seed from informal sources had relatively good quality characteristics compared with the seed from formal sources.

6.2.3.2 Seed germination across formal and informal seed sources

Figure 6.13 shows the germination characteristics of seed sourced during the 2016 - 2017 cropping season. Over 96% of the seed planted for all crops had good germination. This showed that most seed used by farmers germinated well. A small quantity of seed planted (2.6%) displayed fair germination characteristics. Similar to the quality aspect of clean seed, all the pumpkin, yam and pearl millet seeds that were planted, germinated well. A small quantity of beans, cowpeas and sorghum did not germinate well.

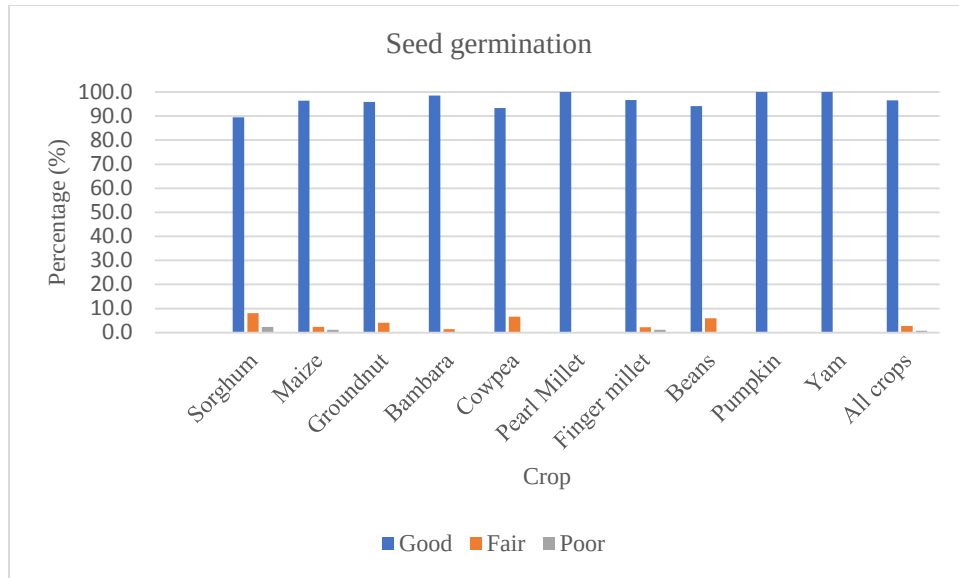


Figure 6.13: Proportion of seed germination as percentages of kilograms planted

When comparing formal sources (agro-dealers and seed aid) with informal seed sources (own seed, local markets and social networks), high percentages of seed quantities from both formal and informal seed sources (at least 96%) had good germination as shown in Figure 6.14.

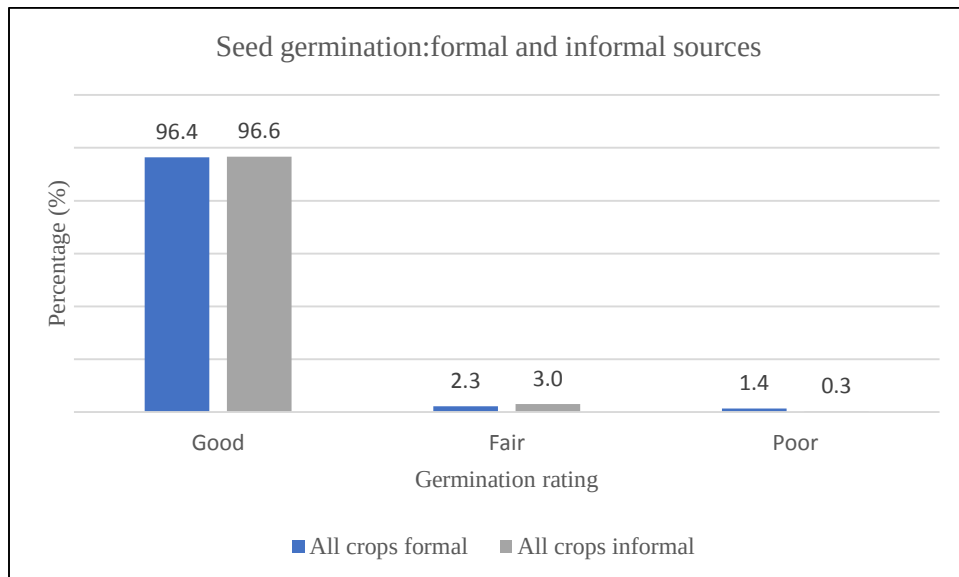


Figure 6.14: Standards of germination of seed obtained from formal and informal sources

These figures showed that the germination performance of seed from informal sources was comparable with that of seed from formal sources. This is similar to other studies that have noted good germination rates for seed from informal sources (Bishaw et al., 2012; Biemond, 2013).

6.3 DETERMINANTS OF HOUSEHOLD SEED SECURITY

Multinomial logistic regression is an extension of binary, logistic regression that allows for the analysis of more than two categories of the dependent or outcome variable with a mixture of continuous and categorical independent variables (Mascie-Taylor and Madsen, 2001; Dragoş and Vereş, 2007). This method was used to determine the characteristics of households categorised in terms of their seed security clusters. Multinomial logistic regression can be used to determine the impact of multiple, independent variables and predict membership of one or other of the dependent variable categories.

6.3.1 Characteristics of Households Categorised in Terms of Seed Availability

A multinomial logistic regression (see Appendix six) was used to compare the households clustered according to their seed availability, classified as seed secure, seed insecure and households from the diverse (mixed) seed security group, based on the clustering done in Section 6.2.1. The output from the multinomial logistic regression based on the significant variables: number of seed sources, total seed quantities of cereals planted during 2016 - 2017 season, and location of the households ('0' for Chaseyama and '1' for Chikukwa), is shown in Table 6.4. The multinomial logistic model shows how determinants (such as socio-economic and demographic indicators) affect the probability that households will exhibit any of the possible outcomes (such as seed security status) with reference to one of the chosen outcomes (Ogundari 2017). The reference category for comparison used in this case was the seed insecure cluster.

The output results showed that for every one-unit increase in the number of seed sources, the probability of farmers belonging to the diverse cluster decreased 0.426 times (ExpB) *versus* the farmers belonging to the seed insecure cluster group. In other words, households that were seed

insecure had significantly more seed sources compared with households from the diverse seed security group.

Similarly, for every one-unit increase in the number of seed sources, the chances of farmers belonging to the *seed secure* cluster decreased 0.281 times (ExpB) *versus* the farmers belonging to the *seed insecure* cluster group. The increase in the number of seed sources decreases the probability that a farmer will be seed secure. This shows that the households classified as seed insecure in terms of seed availability had significantly more ($p < 0.05$) seed sources compared with households classified as either seed secure or diverse seed secure. From Table 6.1, it is noted that households in the seed secure cluster under the seed availability section were characterised by the timeliness, proximity and adequacy of availability of all their seed. The households in the seed insecure category were characterised by some of their seed being received late, supplied far from them and some of the seed varieties planted from the respective sources not being adequate.

These results suggest that the number of seed sources available to farmers does not necessarily result in their being seed secure. A farmer that accessed seed from many sources was more likely to be seed insecure compared with a farmer who used fewer sources. What is critical is that the seed sources available to farmers should be able to provide adequate seed for farmers' planting needs on time and in close proximity to them. The following account from a farmer in Chaseyama shows that, although he accesses his seed from agro-dealers, NGOs and a government-supported scheme, the seeds are not adequate for his needs.

“My family struggles to obtain enough seed from agro-dealers, NGOs and the government seed aid. Due to the high cost of seed from agro-dealers, it is difficult to purchase enough quantities I need, while the government seed aid comes late and is not guaranteed. The seed crops that I could not get include groundnuts, cowpeas, bambara groundnuts and finger millet”. (Leo, Life Case History Interview, Chaseyama, September 2017).

This was in contrast to Tabeth, also from Chaseyama, who relied on one (own-stored seed) seed source but was satisfied with her seed supply. She explained:

For all my seed requirements, I rely on my preserved and stored seed. I do not purchase any seed from the shops. I have enough seed crops of sorghum, Bambara groundnuts, groundnuts, finger millet, sunflower and bean varieties (that include mung beans, Karongoda and sweet beans). (Tabeth, Life Case History Interview, Chaseyama, September 2017).

Table 6.4: Seed availability regression coefficients and their respective significance levels

Seed availability clusters ^a		B	Std. error	Sig.	Exp(B)
Diverse	Intercept	.796	1.261	.528	
	Number of seed sources	-.854	.293	.004	.426
	Cereal seed qty 2016 - 17	.038	.018	.033	1.039
	[Location Area=0]	2.463	.686	.000	11.744
	[Location Area=1]	0	.	.	.
Secure	Intercept	4.157	1.080	.000	
	Number of seed sources	-1.270	.261	.000	.281
	Cereal seed qty 201617	.029	.016	.070	1.029
	[Location Area=0]	.953	.555	.086	2.594
	[Location Area=1]	0	.	.	.

a. The reference category is the *seed insecure* cluster. The significant variables are in bold.

Households characterised as seed secure compared with households characterised as seed insecure were associated with significantly higher, cereal seed quantities planted during the 2016 - 2017 season. This pattern was similar to the households characterised by diverse seed security that had planted significantly higher cereal seed quantities during the 2016 - 2017 season. These two findings are based on the significant probability ratios for the seed secure (Exp = 1.029) and diverse clusters (Exp = 1.039). These results showed that the households classified as seed insecure in terms of seed availability had planted significantly less cereal seed (including maize, sorghum, pearl millet and finger millet) compared with households classified as either seed secure or diverse seed secure (although, for the seed secure cluster, the significance was borderline). The other seed crops did not show any significant differences in the quantities planted.

There were 11.7 times more households characterised by diverse seed security compared with those characterised by seed insecurity in Chaseyama than in Chikukwa. There was a higher proportion of diverse seed secure cluster households from Chaseyama (30%) compared with Chikukwa (8%) and a higher proportion of seed insecure cluster households from Chikukwa (63%) than Chaseyama (9%), as shown in Figures 6.1 and 6.2. These statistics, taken together showed that a higher proportion of Chaseyama households interviewed were more seed secure, while the larger proportion of Chikukwa households interviewed were less seed secure. The farmers' location determined which seed sources were available and also the timeliness of the seed provision and the distance traveled to obtain seed.

To illustrate this point further, the highest proportion of farmers that received seed aid once and twice, were from Chaseyama. In contrast, the highest proportion of farmers that received seed aid every year, was from Chikukwa. Additionally, over five years, Chikukwa farmers benefited 3.6 times from seed aid compared with Chaseyama farmers (1.9 times). Of the 3,894 kg of maize planted by the farmers surveyed in Chaseyama and Chikukwa, about 48% of it was from seed aid. Although seed aid has increased seed availability to farmers in Chikukwa, this is usually provided late (from mid-season and towards the end of the season).

The agro-dealers are not evenly spread across Chaseyama and Chikukwa but tend to be located in accessible, central business centres along the tarred roads. The mountainous terrain and unpaved roads in Chikukwa make the business centres less accessible than in Chaseyama; there are also fewer business centres in Chikukwa compared with Chaseyama as the former is more remote. Depending on their location, farmers who require certified seed, are thus forced to commute to agro-dealers to obtain their seed, even if it means travelling to distant towns such as Mutare or Chipinge.

6.3.2 Characteristics of Households Categorised in Terms of Seed Access

A multinomial logistic regression (see Appendix six) was used to compare households clustered according to seed access, based on Section 6.2.2. The output from the multinomial logistic regression is shown in Table 6.4, using the following significant variables: the number of

household assets owned, the number of crops grown, the number of seed sources and the length of time the household has been farming in the area. The reference category used for comparing the cluster groups was the seed insecure cluster.

Table 6.5: Seed access regression coefficients and their respective significance levels

Seed access clusters ^a		B	Std. Error	Sig.	Exp(B)
Diverse	Intercept	3.177	1.164	.006	
	Total household assets owned	-.212	.071	.003	.809
	#crops grown 16/17	.190	.148	.198	1.210
	Number of seed sources	-.960	.300	.001	.383
	Time you have been farming	.029	.013	.021	1.030
	[Location Area=0]	-.341	.610	.577	.711
	[Location Area=1]	0	.	.	.
Secure	Intercept	3.111	1.075	.004	
	Total household assets owned	-.046	.057	.414	.955
	#crops grown 16/17	.380	.130	.004	1.462
	Number of seed sources	-1.292	.276	.000	.275
	Time you have been farming	.014	.012	.221	1.014
	[Location Area=0]	.109	.544	.842	1.115
	[Location Area=1]	0	.	.	.

a. The reference category is the seed insecure cluster. The significant variables are in bold.

Households in the diverse cluster were associated with a significantly smaller number of assets owned compared with the seed insecure cluster. For every one-unit increase in the total number of household assets owned, the chances of farmers belonging to the diverse cluster decreased 0.809 times *versus* the farmers belonging to the seed insecure cluster. In contrast, households in the secure category of seed access did not have a significantly different number of household assets owned compared with households in the seed insecure category. This was shown by the non-significant p value of 0.414 in the total household assets category of the seed secure cluster. Asset ownership was thus not a determinant of seed access for these households. This could be related to the fact that most of the farmers' seed was sourced through non-monetary means that included local norms and social relationships, as shown in Ethiopia by McGuire (2008). Shiferaw et al.,

(2008) were able to demonstrate that, although asset ownership was a determinant of variety adoption, it did not influence the probability of farmers accessing seed in Tanzania. In contrast, studies elsewhere have revealed that adoption and access to improved seed varieties is correlated with owning more livestock, more land and farm assets (Asfaw et al., 2011; FAO, 2016a; Okello et al., 2017). These seed varieties were procured through commercial transactions requiring income security and thus the importance of asset ownership.

Households whose status of seed access was diverse, did not show a significantly larger number of crops grown during the 2016 - 2017 season ($p = 0.198$) compared with households in the insecure access category. In contrast, for every one-unit increase in the number of crops grown during the 2016 - 2017 season, the probability of the farmers belonging to the secure access cluster increased by 1.462 times *versus* the farmers belonging to the insecure access cluster. This showed that the households having less seed access grew fewer crops compared with households classified as seed secure. Seed insecurity is thus related to households planting fewer crops. This has implications for the seed available for the following season, for food diversity in the household and options for selling. Li et al. (2009) and Njeru (2016) noted that a diverse number of crops grown in a season provides opportunities for farmers to have excess produce, not only to meet needs for household food, but also to have seed for the next harvest and to exchange with other farmers.

A significantly smaller number of seed sources accessed was associated with households from the diverse cluster and seed secure cluster compared with the seed insecure cluster. For every one-unit increase in the number of seed sources, the probability of farmers belonging to the diverse cluster decreased 0.383 times *versus* the farmers belonging to the seed insecure cluster. Similarly, for every one-unit increase in the number of seed sources, the probability of farmers belonging to the seed secure cluster decreased 0.275 times *versus* the farmers belonging to the seed insecure cluster. This showed that households with less seed access had significantly more seed sources compared with households classified as having secure or diverse access. The results shown in Table 6.2 revealed that households with secure seed access were those who both had affordable seed and had received seed aid the least number of times in the previous five years. The households with reduced

seed access were characterised by having to purchase expensive seed and receiving seed aid most frequently.

These results show that the number of seed sources accessed by farmers does not necessarily result in them being seed secure. What was critical was that the seed sources were affordable; this, in turn, was determined by the price of seed, by social relations influencing access, and by economic status. Farmers might use many seed sources but might still continue to be seed insecure, as the quantities received from their sources might be too little for their needs. The use of many seed sources thus might indicate a greater vulnerability to seed insecurity (because seed insecure households try to use many sources of seed in an effort to obtain sufficient seed for their needs).

Significantly more years of farming were associated with households in the diverse cluster compared with households in the seed insecure cluster. For every one-unit increase in the number of years a household had been farming, the probability of the farmers belonging to the diverse cluster increased by 1.03 times *versus* the farmers belonging to the seed insecure cluster. There was no significant difference (i.e. $p = 0.221$) between the seed secure and seed insecure clusters of seed access. These results indicated a mild influence of farming experience on seed security. The location categories did not show any significant differences across seed security clusters in terms of seed access (i.e. in both cases $p > 0.05$).

6.3.3 Characteristics of Households Categorised in Terms of Seed Utilisation/Quality

A logistic regression analysis on seed quality was not performed as most farmers perceived their seed to be of good quality. The key methods for seed preservation and storage used by farmers to ensure good seed quality are shown in Table 6.6

Table 6.6: Seed preservation and storage methods used by Chaseyama and Chikukwa farmers

Seed preservation method	Chaseyama (n = 114)	Chikukwa (n = 113)
Treat with ashes and kept in sacks	23.4%	16%
Smoked in the kitchen	22.5%	50%
Treat with copper shumba and bagged (an agri-chemical)	19.8%	35.8%
Store legumes unshelled	9.9	-
Use of traditional herbs	-	16%
Mix beans with finger millet residues	-	6.6%

Source: Field survey

The methods mentioned by most farmers in Chaseyama were of treating the seeds with ashes and smoking them in the kitchen while, in Chikukwa, farmers noted the importance of smoking seeds in the kitchen and treating them with a storage chemical (copper shumba²³).

A 48-year-old farmer from Jinga village in Chaseyama gave the following account of the seed preservation techniques that he used compared with what was used by his parents:

“In order to preserve my seed for the next planting season, I store my sorghum and millet seed in the kitchen to take advantage of the smoke, while the groundnuts, cowpeas and bean seed are stored in permeable sacks. The seed is first treated with ashes of the mukonde tree (*Euphorbia ingens*) and also musharu leaves (*Colophospermum mopane* tree). These preservation and storage methods are effective in preserving my seed for future planting. My parents during their time even went further to construct a seed storage house (made from *daga*) that was airtight. They used storehouses (*Duras*) to keep the seed. These were air-tight so not infiltrated by pests. I realise that people are beginning to lose this knowledge of seed preservation”. (Edson, Life Case History Interviews, Chaseyama, 2017).

Vivian, a 42-year-old woman residing in Munaka village of Chikukwa recounted:

²³ Grain and Cereal Protectant containing Fenitrothion 1.0% and Deltamethrin 0.13%.

“In order to preserve my maize and finger millet seed, I smoke my personal seed in the kitchen, while the seed intended for sale is mixed with ashes and placed in sacks (that are permeable). I am cautious that the seed mixed with ashes requires the right mixture to prevent discoloration of the seed as this could affect my ability to sell the seed. I am satisfied with these preservation methods as they maintain the quality of my seed”. (Vivian, Life Case History Interviews, Chikukwa, 2017).

These two accounts were corroborated further by a female farmer from Chaseyama who said:

“The seed storage mechanisms that I use and consider effective include use of ash from the mukonde tree, leaves from mopane and gumtree leaves for my legumes, and smoking some of my sorghum seed in the kitchen. I then store the treated seed in sacks or old t-shirt cloth for adequate ventilation. My advice is that these methods are effective if one is able to store the seed immediately after harvest when the seed has dried before being affected by weevils”. (Jill, Life Case History Interviews, Chaseyama 2017).

These three accounts about traditional and indigenous methods of seed preservation and storage corroborate closely with farmers’ perceptions of having quality seeds of their own, stored varieties. Farmers with access to adequate land are able to separate food crops from seed crops and prevent contamination of seed by other seed crops.

6.4 CONCLUSIONS

In this chapter, a framework of seed availability, access, and utilisation was used to present the seed security status of Chaseyama and Chikukwa households. The seed availability indicators that were useful were: timeliness of seed provision, proximity of seed to the farmers, and sufficiency of seed from the various seed sources. The data showed that informal seed sources were more reliable in ensuring that seed was available on time and in close proximity to the households compared with formal seed sources. If farmers use formal seed channels to obtain new germplasm, it is necessary to ensure that seed is made available in time for planting and close to them.

Cluster analysis was useful in determining which variables were important in segregating households into seed security groups. The three clusters show that households cannot be simply segregated into binary groups of seed secure and seed insecure farmers, as there are some households that depict a mixed picture of seed security. The implications of these findings are as follows: households cannot be easily labeled as seed secure or seed insecure based on their cropping profiles; the state of seed security is ever evolving depending of farmers' needs, characteristics, environment and circumstances.

The seed access parameters used to classify households into seed security clusters were: affordability, number of times seed aid was received during the previous five years, and other demographic characteristics such as age and sex of the household head. The farmer cluster that was considered insecure in terms of seed access also had the lowest age-group on average. The cluster of farmers with a diverse status of seed security was made up of all females. Seed from formal sources was perceived to be more expensive than that from informal sources. This was related to the actual seed prices, social relations of access, and economic status of the households. Notably, more farmers from Chikukwa cited concern about expensive seed compared to farmers from Chaseyama. This could be because of the remoteness of Chikukwa and larger number of farmers from Chikukwa that purchased seed from formal sources, which was perceived as expensive.

A majority of households in Chikukwa were seed insecure in terms of both seed availability and seed access. On the other hand, most households in Chaseyama were seed secure in terms of both seed availability and seed access. These findings reveal that there is a possible direct relationship between seed availability and seed access for these households. Seeds that are available on time and in close proximity to the farmers were also more likely to be accessible to them for their planting needs. The implications of these findings are that it is important to link the seed availability parameters to the seed access parameters in order to improve the seed security of smallholder farmers.

When comparing the seed security elements, the data shows that seed quality was not an issue across Chaseyama and Chikukwa compared to seed availability and seed access. Seed germination

and seed purity are aspects that farmers have been able to achieve successfully. The challenge lies with seed timely availability, proximity and affordability. These are the aspects to be considered for improving farmers' seed security.

Farmers' perceived that seed from formal sources and seed from informal sources had comparable quality. This showed that they were confident about their traditional seed quality assurance methods and trusted that informal sources could supply quality seed. Farmers demonstrated a wealth of indigenous knowledge and experience to maintain the quality of their seed through selecting, cleaning, treating, and storing seed.

The analysis identified significant determinants of seed security, which varied across the farmer clusters, such as the number of different crops grown by a household, the number of seed sources, the number of assets owned and the location of the farmers. These determinants suggest the importance of understanding how household characteristics interact to influence the seed security status of farmers. This is important when considering the factors underlying food insecurity, especially given that the same factors might influence both seed security and food security.

CHAPTER SEVEN: FOOD CONSUMPTION AND FOOD SECURITY

7.1 INTRODUCTION

This chapter examines the food consumption and food security status of Chaseyama and Chikukwa farming households. The chapter begins with an overview of the climatic conditions and their impact on household food consumption at a national level. Unlike seed security that does not have standardized, all-encompassing indicators for determining the overall seed security status of households, researchers and practitioners have developed several food security indicators (Jones et al., 2013; Maxwell et al., 2014; FAO, 2016b). This development has not made carrying out food security assessments easy, as these indicators are not applied universally because each indicator captures a certain element of food security. In this section of the research, the proportion of food secure and food insecure households in the study area has been estimated, based on food security indicators that focus on aspects of dietary diversity, food access frequency, and food insecurity experiences that households undergo when they have inadequate food. The characteristics of these households are examined further to explore the determinants of food security at household level in Chaseyama and Chikukwa.

7.2 THE FOOD SECURITY CONTEXT

The study period was focused primarily on the 2015 - 2016 and 2016 - 2017 agricultural seasons. These seasons differed and had contrasting effects on the Zimbabwean population. The 2015 - 2016 agricultural season was an El Niño year that affected several countries in Southern Africa, especially Lesotho, South Africa, Swaziland, Malawi, Zambia and Zimbabwe (SADC, 2016; WFP, 2016). As a result of this phenomenon, the region faced one of the driest rainfall seasons in the previous 35 years and experienced a late start of cropping season, rainfall deficits, and poor rainfall distribution, leading mostly to significant dry spells (SADC, 2016).

The drought experienced during the 2015 - 2016 season affected most parts of Zimbabwe. The country experienced below normal rains. This was critical during the crop planting and

establishment stages leading to marked reductions in cereal production and poor grazing. This was compounded by the below normal rainfall of 2014 – 2015 season (IPC, 2017). The poor rains were the main cause for 42% of households (and 46% in Manicaland Province, which includes Chimanimani District) being food insecure at the third phase of the Integrated Phase Classification (IPC); this season was noted for the highest prevalence of rural food insecurity since 2009 (ZIMVAC, 2016). The ZIMVAC assessment estimated that 4.1 million rural people were food insecure during the peak hunger season from January to March. Manicaland (761 084) and Masvingo (738 291) provinces had the highest number of food insecure people during the peak period. This assessment showed that food insecurity was characterised by a decline in the proportion of households consuming an acceptable diet and an increase in households having poor food consumption. Further, the consumption-based coping strategies²⁴ were highest in 2016 compared with the previous three years, indicating increased vulnerability to food insecurity.

The agricultural season of 2016 - 2017 was characterised by normal to above normal rainfall with good rainfall distribution over space and time during the season that started in November 2016 for most parts of the country (ZIMVAC, 2017). ZIMVAC (2017) noted that the cereal crop performance ranged from good to very good for most areas and was average in the southern part of the country with a few isolated areas that had mediocre maize crop performance. The prevalence of food insecurity nationally was estimated at 11% (approximately 1.1 million rural people) and was lower than that for the previous season during the peak hunger period. Masvingo (176 956), Manicaland (175 285), and Midlands (156 936) had the highest estimated number of food insecure people during the peak period (ZIMVAC, 2017). As a result of a better season and agricultural performance, the household consumption indicators showed improved food access for the majority of households compared with the 2015 - 2016 period. The Coping Strategies Index²⁵, Household Hunger Scale²⁶, and Household Dietary Diversity, as well as consumption of protein, iron and

²⁴ Consumption-based coping strategies are short-term methods used by households to cope with effects of food shortages by changing consumption patterns (Maxwell et al., 2003). These strategies might include restricting consumption for adults, so that small children can eat; borrowing food, relying on less preferred or less expensive food; reducing the number of meals eaten in a day; limiting portion size at mealtimes, etc.

²⁵ This is a food security index derived from a series of behavioral questions about how households manage to cope with shortfalls in food access (Maxwell and Caldwell, 2008).

²⁶ The Household Hunger Scale is an experiential method of collecting household data on a food deprivation scale. The questions were designed to represent varying levels of food insecurity while reflecting three domains perceived as central to the experience of food insecurity cross-culturally: 1) anxiety about household food supply; 2) insufficient quality; 3) insufficient food supply and intake and the physical consequences. (Ballard et al., 2011)

vitamin A rich foods improved from the previous year mainly because of the availability of diverse field crops and food assistance (ZIMVAC, 2017).

7.2.1 Chaseyama Climatic Context

Chaseyama is in Agro-ecological Natural Region IV, characterised by high temperatures and low rainfall of between 300 to 400 mm per annum (Mukute, 2015; Oxfam-UNDP/GEF, 2015). The seasonal performance and outlooks of the area for the previous recent years according to the agricultural extension officers interviewed were as follows:

2014 - 15: Season with low rainfall

2015 - 16: Season with very low rainfall

2016 - 17: Season with a lot of rainfall

2017 - 18: Season expected with average rainfall

(Chaseyama Extension Officers, 2017).

The seasonal assessments closely mirror the food security and vulnerability assessment results for the drier areas of Zimbabwe, conducted by the multi-stakeholder, nationwide, vulnerability assessment committees during those respective seasons (ZIMVAC, 2015; 2016; 2017; 2018). As can be seen from the description, at the local level in Chaseyama, people experienced below normal rainfall and a very poor cropping season in three out of the four agricultural seasons. The two successive seasons with adverse growing conditions, 2014 - 2015 and 2015 - 2016 had a negative impact on the majority of farmers who relied on rainfed crop production. The 2016 - 2017 season (which was a La Niña year for the region overall) had a lot of rainfall and was classified as a season with very good growing conditions. The following year 2017 - 2018 was predicted to have average rainfall and a classification of a fair season. The reality on the ground was characterised by long dry spells in the first half and incessant rains in the second half of the season. The poor distribution of the rains prior to February 2018 affected crop development negatively, resulting in crop wilting and loss of crops for the farmers who planted early (ZIMVAC, 2018).

A woman farmer from Chaseyama gave an account of what her household experienced almost on an annual basis in its effort to access food.

The drought years my household has experienced have been from 2006 to 2015. All these years have had low rainfall, low harvest, and damage from cows and monkeys. The impact of cows on my fields was related to late planting and thus late harvesting. To survive and obtain food during those drought years my family would purchase clothes and exchange for food through barter trade with other farmers from other villages that had obtained better harvests. I have also been receiving food aid assistance. (Jill, Life History Interview, Chaseyama, 2017).

Participants in the Chaseyama focus group discussion made similar comments:

The years 1993 - 2015 have been characterised by frequent droughts with little rainfall, and high temperatures (especially during 2013 - 2014). The impact of this to our community has been incidences of kwashiorkor amongst our children, disease outbreaks such as cholera, coughing, and many cattle deaths. Many households would sell their livestock in order to purchase grain. There were times a bucket of maize would cost \$12 compared to the current cost of \$5. (FGD, Chaseyama, 2017).

These two accounts indicated an unfavourable weather and climate context for farming (especially crop production) amongst Chaseyama households. According to the extension officers in the area, during a good rainy season, some farmers were able to reap a harvest that provided food for the first few months then they relied on purchases for the rest of the year (Chaseyama Extension Officers, 2017). The extension staff confirmed high rates of malnutrition in the ward, which resulted in the feeding of some children in the clinics. The general food distributions were conducted in the area by Care International and feeding of pregnant and lactating women by World Vision (World Vision, 2017).

7.2.2 Chikukwa Climatic Context

The Chikukwa cluster is located in a mountainous and remote location on the eastern side of Chimanimani District and is characterised by very high rainfall of 1,000 mm per annum (Nkomo and Sassi, 2009; Mukute, 2015). The cluster is in Agro-ecological Natural Region 1. Interviews with extension officers from Chikukwa revealed that the area generally experiences high rainfall suitable for crop production. Farmers even plant the late maturing crop varieties (especially hybrid maize) in their rainfed plots. The following were the annual assessments of the area:

2014 - 2015: High crop yields, high rainfall

2015 - 2016: Normal crop yields, average rainfall

2016 - 2017: Average crop yields, high rainfall

2017 - 2018: Expect a good farming season, high yields, high rainfall

(Extension Officers, Chikukwa, 2017).

The seasonal assessments concur with the results of food security and vulnerability assessments for the wetter areas of Zimbabwe, conducted by the multi-stakeholder, nationwide, vulnerability assessment committees in those respective seasons (ZIMVAC, 2015; 2016; 2017; 2018). This description suggested that Chikukwa generally received high rainfall and between average and high crop yields in most years compared with Chaseyama. As noted by one extension officer:

Our area generally receives a lot of rainfall. During 2016 - 2017 season, we had a lot of rains for the crops, which later became too much as rains continued until the harvesting period resulting flooding and crop losses. (Extension Officer 1, Chikukwa, 2017).

This corroborates the statement from the Chikukwa focus group discussion:

Between the years 2010 and 2016, we have been receiving good rainfall for our cropping needs. This resulted in good harvests and more food available in the area. Farmers have been engaging in seed production and seed multiplication. People

from deficient regions have been coming to purchase our grain. (FGD, Chikukwa, 2017).

Chikukwa was affected also by the fall armyworm (*Spodoptera frugiperda*) similar to the other parts of Zimbabwe that grow cereal crops (especially maize). Incorrect identification of the pest as the common stalk borer (*Papaipema nebris*) and subsequent use of the wrong chemicals that were ineffective in killing the worm exacerbated the effect of the fall armyworm (Chikukwa Extension officers, 2017). The local agro-dealers also did not have the right chemical in stock, so farmers who could purchase the chemical had to travel to Mutare or Harare, while farmers and extension officers were not aware of other integrated pest management practices for the fall armyworm. The Food and Agriculture Organisation (FAO) recommends an integrated pest management approach with the use of low-risk pesticides as the last resort (FAO, 2019a).

7.3 FOOD SOURCES FOR CHASEYAMA AND CHIKUKWA HOUSEHOLDS

From the household interviews, farmers were asked about the main food types they were accustomed to eating over the previous 30 years (since the 1980s). Farmers mentioned maize, groundnuts, bambara groundnuts, sorghum, pearl millet, cowpeas and finger millet. Table 7.1 shows the sources of these foods for Chaseyama farmers, based on their responses in the household interviews. The main sources of these foods were farming and wild/forest. Very few of these foods in the past came from purchase and food aid.

Table 7.1: Frequency of food sources used in the 1980s compared with 2017 in Chaseyama

Food sources	Chaseyama during the 1980s	Chaseyama in 2017
Farming (%)	72.0	20.8
Food aid (%)	0.8	20.5
Purchase (%)	2.7	58.3
Piecework (%)	0.2	0.2
Wild/Forest (%)	24.3	-

Source: Field survey. ‘-’ means that the food source was not mentioned.

When comparing food sources during the 1980s with 2017, there is a variation in terms of the proportion mentioning each source. In 2017, most farmers mentioned purchasing food followed by farming and food aid. These figures showed that farming used to be the main food source in the past as well as wild/forest but this has been complemented over the years by ‘external’ food sources such as purchases and food aid. From the focus group discussions in Chaseyama, farmers confirmed that during episodes of drought they would travel to distant locations in search of food to purchase for their households. Although farming continues to be the primary food source for Chaseyama farmers, they appeared to be diversifying their food sources owing to increasing episodes and frequencies of drought amongst other reasons. The food from wild/forest sources has diminished because of the reduction in natural forests owing to overgrazing and as people clear them for arable land and settlement (Leahy, 2013; Gogo, 2018), while indigenous knowledge is lost and eating habits change. Food aid has increased in Chaseyama over the years through NGO interventions (CARE International and World Vision more recently). Owing to low rainfall, the area has been targeted for food aid assistance informed by annual food security assessments carried out in Zimbabwe by the National Vulnerability Assessment Committee (WFP, 2014).

Table 7.2: Frequency of food sources used in the 1980s compared with 2017 in Chikukwa

Food sources	Chikukwa during the 1980s	Chikukwa in 2017
Farming (%)	52.4	61.2
Food aid (%)	-	0.2
Purchase (%)	2.1	35
Piecework (%)	0.2	-
Wild/Forest (%)	45.3	3.4

Source: Field survey. ‘-’ refers to not applicable.

Table 7.2 shows that Chikukwa households in the past used to rely more on farming and wild/forest sources and less on purchases or food aid. Wild forest foods consisted mostly of wild fruits. In 2017, more farmers mentioned farming and purchasing as important food sources. Farming in Chikukwa continued to be an important food source because the area received high rainfall and seed aid from government and NGOs (Mate, 2001; Sunday Mail, 2016). In Chapter five, it was shown that seed aid assistance had a higher reach and consistence in Chikukwa compared with Chaseyama. Food purchases become a complementary food source influenced by changing dietary habits. Food purchases are made through the local grain markets and local shops in the area. Not

surprisingly, owing to the weather conditions in Chikukwa, food aid was not an important food source for these households. One of the extension officers confirmed this phenomenon by saying:

Due to good rainfall that we experience here in Chikukwa, we have cases of farmers from other locations of the country that come every year to purchase grain from this area (Extension Officer 1, Chikukwa, 2017).

7.4 FRUITS AND VEGETABLES

All households interviewed from Chikukwa (100%) and a large proportion from Chaseyama (91%) were growing vegetables. A comparison of vegetable production revealed that Chikukwa farmers grew a larger variety of vegetable types (mean = 4.2) than Chaseyama farmers (mean = 3.2) with a t-test comparison of means that was significantly different at $t_{225} = -5.42$; $p = 0.000$. Chikukwa farmers also grew a significantly higher number of tree types (mean = 48) than Chaseyama farmers (mean = 10) with a t-test $t_{221} = 3.23$; $p = 0.001$. Vegetable production was an important source of food and income for Chaseyama and Chikukwa households. A female farmer from Chaseyama gave the following account of her livelihood strategies:

Due to having inadequate labour and my poor health status, I get cash primarily from gardening, followed by selling chickens, and selling goats. I sometimes get ZWL\$10 per week from the garden. Chickens also provide me cash since they are many and easy to look after. It is not easy to always sell goats when one needs immediate cash. (Roselyn, Life History Interview, Chaseyama, 2017).

Table 7.3 shows the main vegetables grown which include *covo*, *tsunga*, *rape* (all three being types of *kale*, *Brassica oleracea*), pumpkin leaves, tomatoes, cabbages and onions. The leafy green vegetables dominate the other vegetable types. The majority of households grew *covo* with over 90% growing it across the two locations. The other vegetables were grown by between 23% - 66% of farmers. The vegetables grown by households in both areas were used mostly for household consumption and sales. Pumpkin leaves, *okra* and *nyevhe* (spider flower leaves) are traditional vegetables that perform well in drier conditions. Most of the traditional vegetable seed sources

were agro-dealers and farmers' own seed. Agro-dealers formed the bulk of seed sources in Chaseyama, while own farmers' seed dominated in Chikukwa. This could be related to fewer agro-dealers stocking vegetable seeds in Chikukwa and the continued tradition of preserving and storing their own vegetable seed supported by NGOs in the area.

Table 7.3: Proportion of households growing vegetables in Chaseyama and Chikukwa

Vegetable type grown	Chaseyama (n = 104)	Chikukwa (n = 113)
Covo (<i>Brassica oleracea</i>) (%)	94.2	91.2
Tsunga (<i>Brassica juncea</i>) (%)	41.3	58.4
Rape (<i>Brassica napus</i>) (%)	40.4	66.4
Pumpkin leaves (%)	39.4	15.0
Tomatoes (<i>Solanum lycopersicum</i>) (%)	34.6	33.6
Cabbage (<i>Brassica oleracea</i>) (%)	31.7	37.2
Onions (<i>Allium cepa</i>) (%)	23.1	39.8
Okra (<i>Abelmoschus esculentus</i>) (%)	22.1	11.5
Nyevhe (<i>Cleome gynandra</i>) (%)	5.8	-
Carrots (<i>Daucus carota</i>) (%)	2.9	12.4

Source: Field survey. '-' implies that the vegetable was not mentioned.

Of the households interviewed, 98 % from Chikukwa and 79% from Chaseyama grew or possessed fruit trees in their homesteads and fields. The most commonly mentioned fruit trees in Chaseyama included mangoes, bananas, mulberry and *musawu* (*Ziziphus mauritiana*). In Chikukwa, the most commonly mentioned fruit trees were avocados, bananas, mangoes and peaches, as shown in Table 7.4. The *musawu* and *muzhanje* (*Uapaca kirkiana*) are indigenous trees that perform well in drier conditions. Household consumption and sales were the main uses of the fruit trees grown by farmers from Chaseyama and Chikukwa, although a substantial proportion of Chikukwa farmers (28.1%) also exchanged their fruits with others.

Table 7.4: Proportion of farmers either growing or possessing specific trees in Chaseyama and Chikukwa

Tree type	Chaseyama (n = 90)	Chikukwa (n = 111)
Mango (<i>Mangifera indica</i>) (%)	27.1	12.9
Banana (<i>Musa acuminata</i>) (%)	11.6	14.4
Mulberry (<i>Morus</i>) (%)	8.4	0.2
Musawu (<i>Ziziphus mauritiana</i>) (%)	8.4	-
Pawpaw (<i>Carica papaya</i>) (%)	8	0.8
Muzhanje (<i>Uapaca kirkiana</i>) (%)	6.2	3.8

Avocado (<i>Persea Americana</i>) (%)	4	18
Peaches (<i>Prunus persica</i>) (%)	-	11.1

Source: Field survey. ‘-’ indicates that the tree was not mentioned.

7.5 FOOD SECURITY STATUS OF CHIMANIMANI HOUSEHOLDS

Three conventional indices of food security were used during the household survey to determine the food security status of Chimanimani households, namely, the Household Dietary Diversity Score (HDDS), Food Consumption Score (FCS), and the Food Insecurity Experience Scale (FIES). These indicators were selected as the most suitable as they have been shown to be useful in establishing the prevalence of food insecurity, while also monitoring changes in food security at household level (Jones et al., 2013). An additional index – the household Food Security Self-classification Scale (FSSCS) – was developed by the researcher to capture the perspectives and perceptions of the households interviewed.

These indices were collected during the peak hunger season in January and February 2017 because that is usually the best time to assess the food security status of a household. Food security assessment guidelines concur that the optimal time to measure dietary diversity of households or individuals depends on the objective of the survey (Coates et al., 2007; Kennedy et al., 2011), although the peak hunger season is the most useful period as it provides an assessment of the food security situation during the time of greatest food shortage (Swindale and Bilinsky 2005; Kennedy et al., 2011; Maxwell et al., 2013).

7.5.1 Household Dietary Diversity Scores

Household dietary diversity scores are used to measure the number of different food groups consumed over a given reference period (Swindale and Bilinsky, 2005). The foods classified per food group have similar caloric and nutrient content. The number of different food groups consumed is calculated to better reflect a quality diet. Swindale and Bilinsky (2005) collated the following set of 12 food groups used to calculate the household dietary diversity score (HDDS):

A. Cereals	G. Fish and seafood
B. Roots and tubers	H. Pulses/legumes/nuts
C. Vegetables	I. Milk and milk products
D. Fruits	J. Oil/fats
E. Meat, poultry, offal	K. Sugar/honey
F. Eggs	L. Condiments

A household dietary diversity score was developed from the responses of 227 households interviewed in Chaseyama and Chikukwa, based on a 24-hour recall of foods eaten the day previous to the interview. The day of recall was a normal day for most of the households interviewed (>90%) so the information gathered could be used reliably to predict the food type they generally eat during that period (Swindale and Bilinsky, 2005).

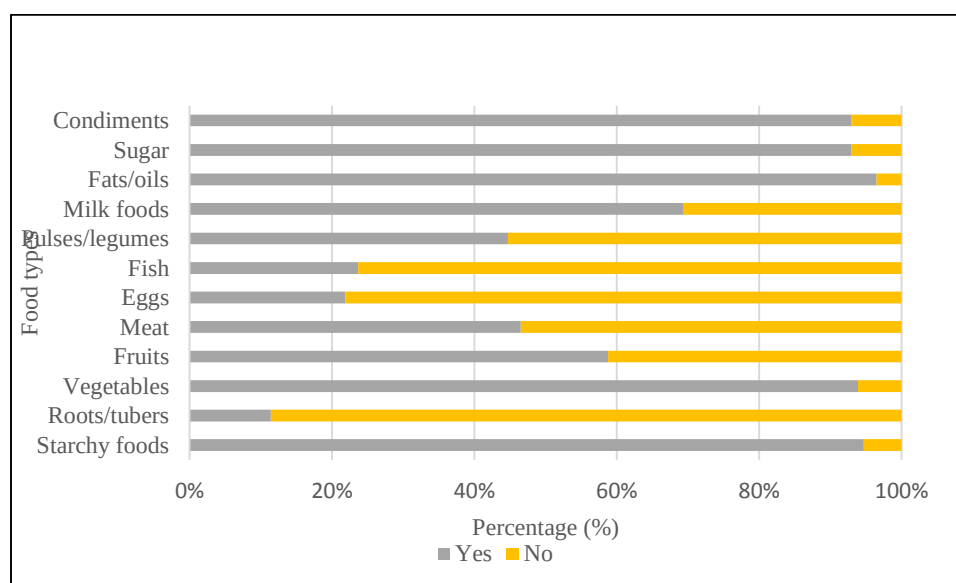


Figure 7.1: Chaseyama dietary diversity (n=114).

Figures 7.1 and 7.2 show the results of the household dietary diversity scores for the households in Chaseyama and Chikukwa. The results showed that the majority of households from Chikukwa were consuming foods with starch/cereals, vegetables, fruits, meat, pulses, milk foods, fats, sugar and condiments. The foods eaten by few people include roots/tubers, eggs and fish. The foods

eaten by the majority of households from Chaseyama during the hunger period included starch/cereals, vegetables, fruits, milk products, fats, sugar, and condiments, while roots/tubers, meat, eggs, fish, while pulses were eaten by only a small proportion.

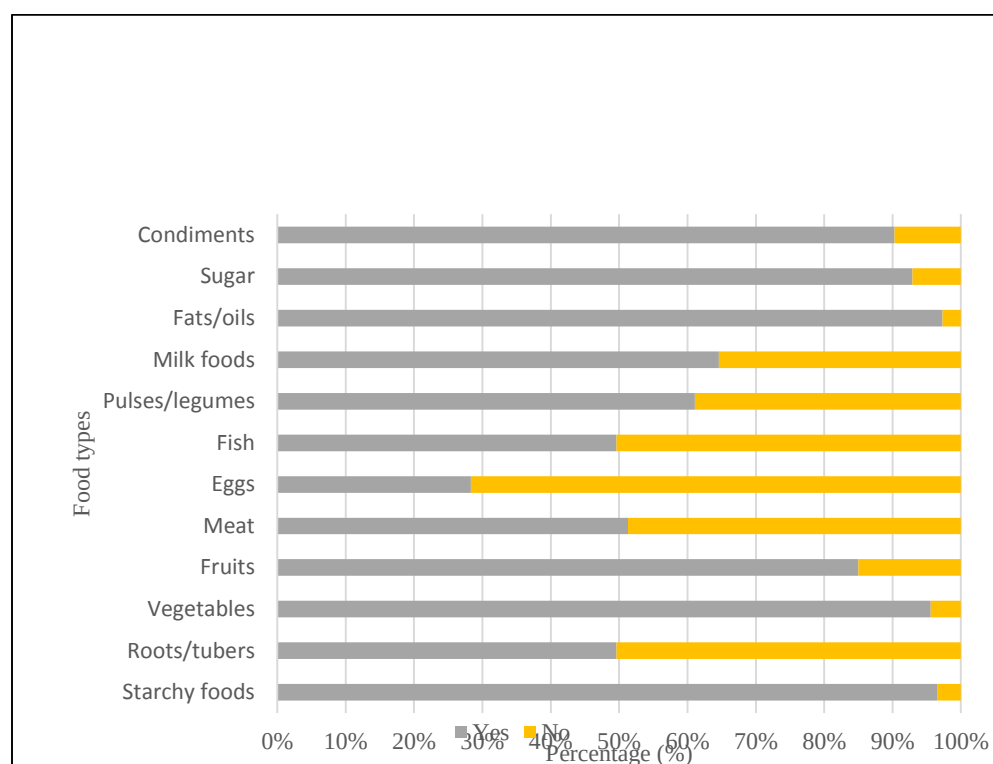


Figure 7.2: Chikukwa dietary diversity (n=113).

Table 7.5 shows that Chikukwa households had a higher dietary diversity score (8.6) than Chaseyama (7.5), although they are both high, showing that on average, households from both locations were consuming a diversified diet. An independent sample T-test of the dietary diversity scores of the two sites produced a t test of $t_{225} = -3.84$; $p = 0.000$. Based on this test, it could be inferred that diet was more diversified and provided wider options for households in Chikukwa than Chaseyama. The foods eaten by the majority of households from Chikukwa, but fewer households from Chaseyama, were fish and pulses that provide protein and iron.

Table 7.5: Dietary diversity scores of households sampled from Chaseyama and Chikukwa

Location	Average Dietary Diversity	Low Dietary Diversity (0-3)	Medium Dietary Diversity (4-6)	High Dietary Diversity (7-12)
	Standard deviations (in parentheses)			
Chaseyama (n = 114)	Mean = 7.5 (2.2)	5%	28%	67%
Chikukwa (n = 113)	Mean = 8.6 (2.4)	3%	15%	82%

Source: Adapted from (Savy et al., 2005; Taruvinga et al., 2013).

Nationally, the HDDS measured during the multi-stakeholder vulnerability assessments in May 2017 was 5.8, a slight improvement from 5.6 in 2016 (ZIMVAC, 2017). All provinces except for Mashonaland Central had improved HDDS compared with 2016. Although the national assessments were conducted just after the lean season, the dietary diversity scores were lower than those for the study areas of Chaseyama and Chikukwa, which showed a higher dietary diversity. The ZIMVAC Report showed further that, on average, households consumed about 6 out of the 12 food groups within the seven-day recall period. Mashonaland East and Manicaland consumed the highest number of food groups (6.3 and 6.1 respectively), while Matabeleland North had the lowest score (5.4). This trend was similar to that of 2016. Nationally, the majority of households consumed mostly cereals, while meat was consumed least. This pattern is consistent with what has been observed in previous ZIMVAC assessments (ZIMVAC, 2014; 2015; 2016).

Although there are no established cut-off points in terms of the number of food groups to indicate adequate or inadequate dietary diversity, researchers have recommended the use of the mean score or distribution of scores for analytical purposes (Ruel, 2002; Kennedy et al., 2011). In this study, low and medium dietary diversity were considered to be inadequate dietary diversity, while high dietary diversity was considered to be adequate dietary diversity. The households with a high dietary diversity (between seven and 12 food groups) were thus classified as being more food secure, while those with low and medium dietary diversity (0-6 food groups) were classified as being less food secure.

Based on the household dietary diversity scores, 67% of households from Chaseyama and 82% from Chikukwa were food secure in terms of having a relatively high, diversified diet. These proportions are significantly different statistically ($X^2 = 34.99$, $df < 1$, $p = 0.001$), implying a strong association between location and food security status. Thus, more households from Chikukwa are eating a diversified diet compared with Chaseyama based on a 24-hour recall of the food groups consumed.

7.5.2 Food Consumption Scores

The Food Consumption Score is a food security assessment tool used for measuring household food access. It is a composite score based on dietary diversity, food frequency and relative nutritional importance of the various food groups consumed by households as shown in Table 7.6 (WFP. 2008; Kennedy et al., 2010). Data were collected according to these parameters for each household, using a seven-day recall period, by means of a household questionnaire during the lean period. The food frequency was measured as the number of days for which a particular food group was consumed during the previous seven days. Table 7.6 shows the nine food groups and weighting applied to each, based on their respective nutritional values. Meat and dairy products were given the highest weight, while sugar, oil and condiments were given the lowest. Wiesmann et al. (2009) argued that the weighting of the food groups makes it possible to capture two dimensions of food security: diet quality and diet quantity.

Table 7.6: Components of Food Consumption Score

	Examples of Food Items	Food Groups	Weight
1	Cereals - maize, sorghum, millets	Main Staples	2
	Potatoes, sweet potatoes, tubers		
2	Beans, bambara groundnuts, groundnuts, cowpeas	Pulses	3
3	Vegetables, leaves	Vegetables	1
4	Fruits	Fruits	1
5	Beef, goat, poultry, pork, eggs and fish	Meat	4
6	Milk, dairy products	Dairy products	4
7	Sugar and sugar products, honey	Sugar	0.5
8	Oils, fats and butter	Fats	0.5
9	Spices, tea, coffee, salt	Condiments	0

Source: Adapted from (Kennedy et al., 2010; Butaumocho and Chitiyo, 2017).

Table 7.7 shows the average number of days per week (over the previous seven days) that households from Chaseyama and Chikukwa ate the different food types. The food groups common to both locations include cereals, vegetables, sugars and fats, while milk foods were more common in Chaseyama and fruits more common in Chikukwa.

Compared with the household dietary diversity score that showed that the majority of Chikukwa households ate meat and pulses, the seven-day recall showed that these rich food groups were eaten fewer times per week across both locations compared with less rich foods. Chaseyama households had a higher frequency of eating dairy products (which have a higher weighting) over a week compared with Chikukwa households.

Table 7.7: Foods eaten over a 7-day period in Chaseyama and Chikukwa

Food group type	Average number of days food type eaten in Chaseyama (n = 114)	Average number of days food type eaten in Chikukwa (n = 113)	Sig. (P value)*
Cereals	6.2 (1.9)	6.1 (2.0)	0.95
Tubers	0.6 (1.7)	1.8 (1.9)	0.001
Pulses	1.7 (1.9)	2.0 (2.0)	0.23
Vegetables	6.3 (1.6)	6.1 (1.6)	0.47
Meat	2.8 (1.9)	2.3 (1.6)	0.04
Fruits	3.1 (2.3)	6.1 (1.8)	0.001
Milk foods	5.4 (2.7)	3.4 (2.7)	0.001
Sugar	6.5 (1.6)	5.8 (2.0)	0.02
Fats	6.9 (0.8)	6.7 (1.0)	0.9

*Bold p values indicate significant differences of means using the t-test of independent samples. Standard deviations in parentheses. Cut-off value for significance is $p < 0.05$.

The t-test of independent samples is used to test the likelihood that differences in means of frequency for samples reflected differences in the populations, and whether the different mean number of times each of the food groups was eaten was statistically significant for Chaseyama and Chikukwa (Mascie-Taylor and Madsen, 2001). The p-values in bold (< 0.05), in Table 7.7, show the food groups in which the means were significantly different. The food groups with significantly different p values were tubers, meat, fruits, milk and sugar. Tubers and fruits are eaten more frequently on average, in Chikukwa compared with Chaseyama. This corresponded with the household survey data, which showed that more farmers were growing more tubers and fruits in

Chikukwa compared with Chaseyama in accordance with the climatic differences. In contrast, the significant p values for meat and milk correspond with the statistically significant, higher means of frequency for Chaseyama compared with Chikukwa. This related to the larger number of farmers who owned livestock in Chaseyama compared with Chikukwa.

Based on the collation of the food consumption scores, households were classified into three profile groups ranging from poor, borderline and acceptable, according to the WFP classification cut-offs (WFP, 2008). As shown in Table 7.8, most households were classified as having an acceptable food consumption score (>90% of households interviewed) across both locations and very few as having borderline or poor food consumption. The households with an acceptable food consumption score were considered to be more food secure, while those with poor and borderline food consumption were considered to be less food secure.

Table 7.8: Food consumption scores of households in Chaseyama and Chikukwa

Food Consumption Score	Profiles	Chaseyama (n = 114)	Chikukwa (n = 113)	Manicaland (2017)
0 - 21	Poor (%)	0.9	-	18
21.1 - 35	Borderline (%)	8.8	7.1	31
>35	Acceptable (%)	90.4	92.9	51

Source: Adapted from WFP (2008: 9). Chaseyama and Chikukwa figures derived from the household survey.

The ZIMVAC national assessments showed a decrease in the proportion of households that were consuming an acceptable diet from 63% in 2015 to 55% in 2017 (ZIMVAC, 2017). The proportion of households nationally consuming a poor diet increased from 8% in 2015 to 16% in 2017 (Poor = 16%, Borderline = 29%, Acceptable = 55%). As shown in Table 7.8, Manicaland in 2017 had the majority of people that were consuming a poor and borderline diet. These results showed that Chaseyama and Chikukwa performed much better than the provincial and national level averages.

Table 7.7 shows that most households ate sugar and oil at least 5.8 times a week on average. WFP (2008: 21) argued that, if one uses the standard Food Consumption Score cut-offs, while the majority of households eat sugar and oil frequently, this tends to distort the food consumption

profiles. A solution proposed by the WFP is to adjust the score profiles by seven as shown in Table 7.9. WFP argued that:

Although both oil and sugar are weighted 0.5, combined, this has the effect of giving all households a base FCS of seven. If this base diet of oil and sugar is combined only with frequent (seven days) consumption of a starch base, the score already amounts to 21. However, this clearly cannot be classified as even a borderline diet. (WFP, 2008: 22).

Table 7.9: Adjusted Food Consumption Scores of households in Chaseyama and Chikukwa

Food Consumption Score*	Adjusted Food Consumption Score	Profiles	Chaseyama (n = 114)	Chikukwa (n = 113)
0 - 21	0 - 28	Poor (%)	5.3	1.8
21.1 - 35	28.1 - 42	Borderline (%)	10.5	15
>35	>42	Acceptable (%)	84.2	83.2

*Source: Adapted from WFP (2008).

After taking into account the adjustments, the household food consumption score showed that 84.2% of households from Chaseyama and 83.2% from Chikukwa were food secure in terms of having a frequent and more diversified diet. This is shown in Figure 7.4. These proportions are not significantly different statistically ($X^2 = 0.044$, $df = 1$, $p = 0.83$), implying that there is no association between location and food security status. An equal proportion of households from Chikukwa and Chaseyama are food secure in terms of frequently eating a diversified diet.

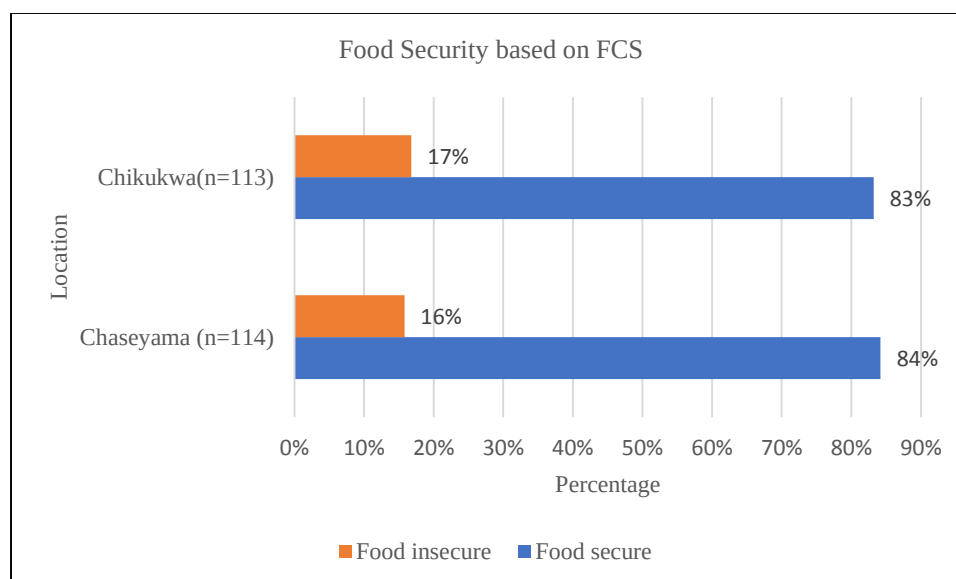


Figure 7.3: Food Consumption Score levels for households in Chaseyama and Chikukwa

7.5.3 Household Food Insecurity Experience Scale

The Household Food Insecurity Experience Scale (FIES) is an experience-based metric of severity of food insecurity that is dependent on people's direct responses to a series of eight questions regarding their access to adequate food (Ballard et al., 2013). The severity of the food insecurity condition is not directly observable but is manifested by certain food-related experiences and behaviours (Ballard et al., 2015). These experiences range from a condition of food security (being certain and having adequate food) to severe food insecurity (experiencing hunger).

Classification ranges from zero (food secure) to eight (severe food insecurity). Households with 0-3 were classified as food secure since they indicated some form of food security and a mild food insecurity status (Ballard et al., 2013). The households rated as having moderate to severe food insecurity were classified as food insecure, as shown in Table 7.10.

Table 7.10: Classification of Food Insecurity Experience Scale

Scale Items		Domain of food insecurity construct	Assumed severity of food insecurity
0	All categories below did not apply	Certainty and Adequate food	Food secure
1	Felt anxiety about having enough food at any time during the previous 3 months	Uncertainty and worry about food	Mild Food insecurity
2	Not able to eat healthy and nutritious food	Inadequate food quality	Mild Food insecurity
3	Consumed a diet based on only few kinds of foods		Mild Food insecurity
4	Did not eat breakfast, lunch or dinner [or skipped a meal]	Insufficient food quantity	Moderate Food insecurity
5	Ate less than they thought they should		Moderate Food insecurity
6	Household ran out of food		Moderate Food insecurity
7	Felt hungry but didn't eat		Severe Food insecurity
8	Went without eating for a whole day		Severe Food insecurity

Source: Adapted from (Ballard et al., 2013)

Food Insecurity Experience was assessed using a recall period of three months of the peak hunger season (November 2016 –January 2017). Figure 5 shows the classification of Chaseyama households. The results showed a decreasing proportion of households along the scale from mild food insecurity to severe food insecurity. The largest percentage of households was those that were worried that they would run out of food (lower mild food insecurity), while the least were those that spent a whole day without eating any food (severe food insecurity).

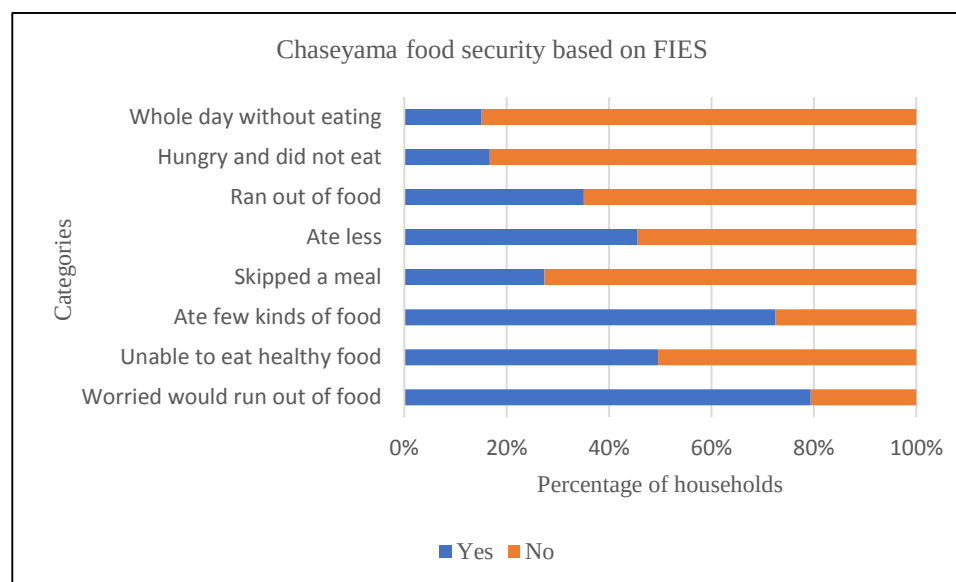


Figure 7.4: Food Insecurity Experience of Chaseyama households

Figure 7.6 shows the Food Insecurity Experience of Chikukwa households. Although there is a similar, decreasing proportion of households along the scale from mild food insecurity to severe food insecurity, this is less evident compared with Chaseyama. There were fewer households from Chikukwa that experienced each of the domains of food insecurity compared with Chaseyama. In Chikukwa, the largest percentage of households was those that were unable to eat healthy food (upper mild food insecurity), while the least were those that spent a whole day without eating any food (severe food insecurity).

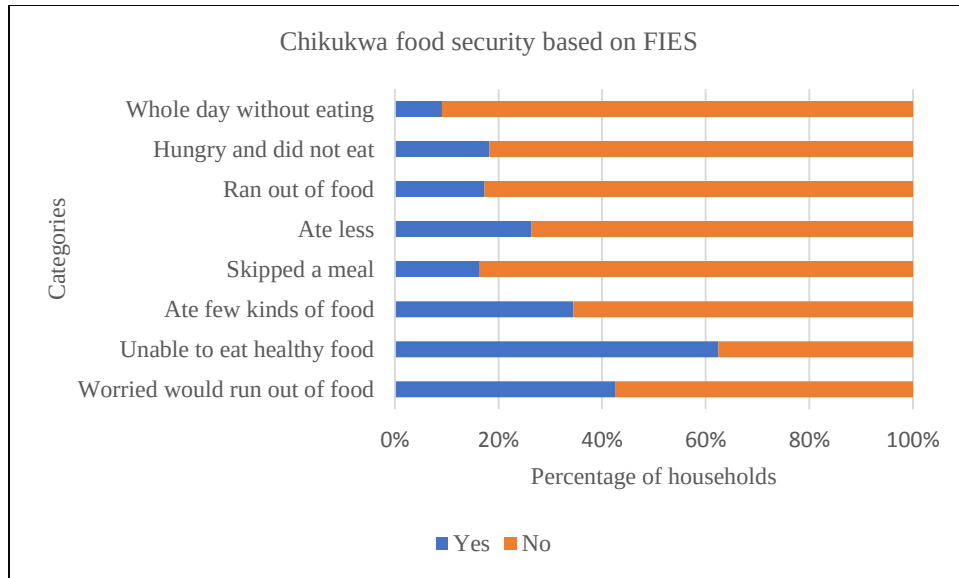


Figure 7.5: Food Insecurity Experience of Chikukwa households

Table 7.11 shows a comparison of the food security status of households across locations. The results showed that most households were food secure across both locations, although more were from Chikukwa.

Table 7.11: Food security status of households in Chaseyama and Chikukwa based on food insecurity experiences

Location	Proportion of food secure	Proportion of food insecure
Chaseyama (n = 114)	54.4%	45.6%
Chikukwa (n = 113)	73.5%	26.5%

A Chi-square test produced a Pearson X^2 value of 8.94, with 1 degree of freedom and p value of 0.003 showing a strong association between the location and food security variable. This confirms that more households from Chikukwa compared to Chaseyama were food secure over the previous three months (peak hunger season) similar to the HDDS results. This is also shown in Figure 7.7.

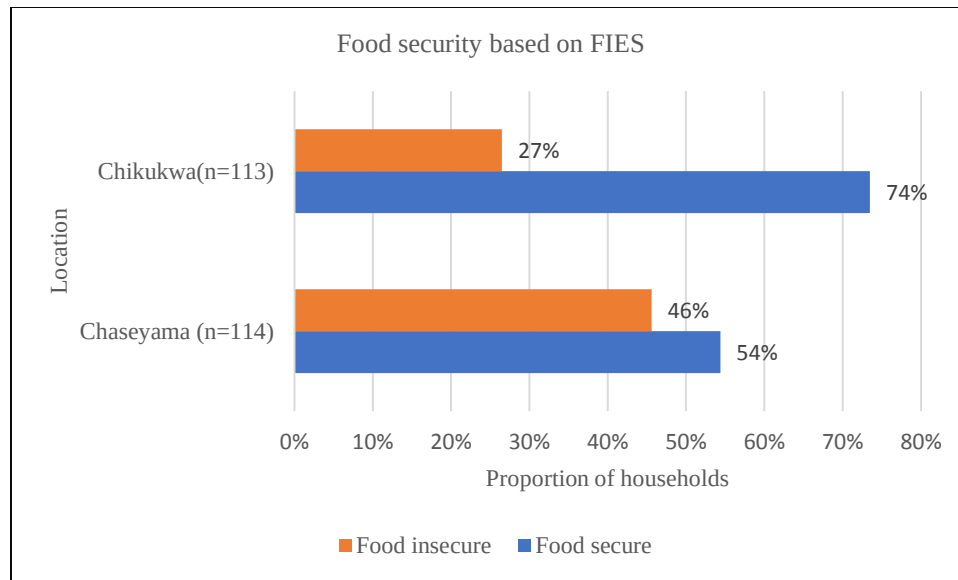


Figure 7.6: Food Insecurity Experience status of households by location

7.5.4 Household Food Security Self-Classification

The Household Food Security Self-Classification Scale (FSSCS) was developed by the researcher as a way in which households self-select the level of their food security status based on their own perception over a longer time horizon (since the previous hunger season over 12 months). Researchers have argued that food security is a multi-dimensional phenomenon that cannot be measured by a single indicator (Migotto et al., 2005; Maxwell et al., 2013; FAO, 2016b). Most food security assessment methods use the information provided by the household (such as type, quantity and frequency of foods eaten) to determine the household food security status. The self-classification method leaves the decision of food security categorisation to the household. Although this approach is subjective, and sometimes leads to over-reporting and under-reporting, it is useful as a complementary measure of food security, based on a household's perception of its food security status. Studies have shown the importance of complementing objective food security assessments with subjective measures because the latter can capture psychological dimensions of food insecurity and are useful for gauging expectations (Migotto et al., 2005; Heady and Ecker, 2012). These studies argue that households might regard themselves as hungry, even if there are no recognisable signs of under-nutrition. Further, even if households are not currently under-nourished, they might have a significant probability, or well-founded fear, of future deprivation.

The categories of food security developed, from which households could choose for self-classification, were: more than enough food all the time; enough food most of the time; enough food a few times; not enough food some of the time; not enough food most of the time. Table 7.12 shows the frequency distribution of categories self-selected by the households from Chaseyama and Chikukwa.

Table 7.12: Status of household food security self-classified by household since the previous hunger season in Chaseyama and Chikukwa

Food security classification	Proportion (%) Chaseyama (n = 113)	Proportion (%) Chikukwa (n = 113)
More than enough all the time	-	6.2
Enough most of the time	32.7	36.3
Enough a few times	38.1	32.7
Not enough some of the time	23	15
Not enough most of the time	6.2	9.7

Source: Field survey

These proportions were reclassified into households that were food secure, comprising the households that perceived themselves as having more than enough food all the time and enough food most of the time. The households re-classified as being food insecure were those that perceived themselves as having enough food a few times, not having enough food some of the time (although these households were borderline, they were classified as food insecure because they have moments when food in the household was inadequate), and not enough food most of the time. This is shown in Figure 7.8.

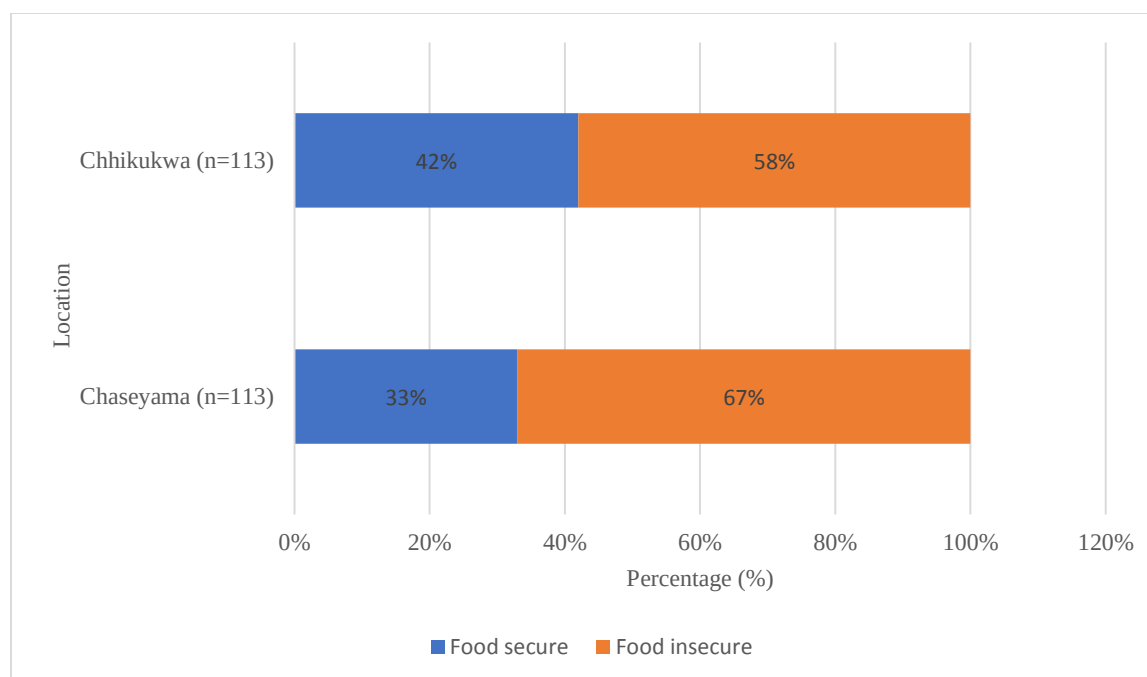


Figure 7.7: Reclassification of food security status of Chaseyama and Chikukwa households.

Figure 7.8 shows that up to two thirds of households from both locations perceived themselves to be food insecure with a larger proportion from Chaseyama (67%) than Chikukwa (58%). Although not significantly different statistically ($X^2 = 2.3$, $df=1$, $p=0.13$) the proportion was similar to the FCS that showed no statistically significant difference between Chikukwa and Chaseyama households.

Using an open-ended question, households were asked to define a ‘*food secure*’ household. Households in Chaseyama defined a food secure household according to the following parameters: employed and farming, enough food all year round, and plenty of livestock. Households in Chikukwa, on the other hand, defined a food secure household as one that has good health, is happy, and has a toilet. The main categories of classification in Chaseyama were related to having adequate food, households’ occupation and assets while, in Chikukwa, categories were related to state of well-being and sanitation. The households from Chaseyama thus defined food security according to the food available to the household and ability to obtain it, while the households from Chikukwa had a broader definition that went beyond having food in the household to include the

household's well-being through other non-food parameters. This showed the importance of how food insecurity is viewed by certain communities, which would have an implication for a household's perceived vulnerability and the form of support required. Food insecurity thus has a social and psychological dimension in addition to the measurement of food eaten. Chitja (2013), for example, has argued that social assets are often overlooked in conceptualising food security assessments. These categories are presented in Table 7.13.

Table 7.13: Self-definition of a food secure household (% cases) in Chaseyama and Chikukwa

Characteristic	Proportion (%) Chaseyama (n = 110)	Proportion (%) Chikukwa (n = 105)
Employed and farming	26.4	1.0
Enough food all year round	23.6	2.9
Plenty of livestock	22.7	2.9
Employed and money for food	13.6	-
Good health	10.9	63.8
Access to irrigation	8.2	-
Good harvest	7.3	10.5
Enough stored food	6.4	14.3
Presence of a toilet	0.9	18.1
Happiness	0.9	46.7
Hardworking	-	8.6

Source: Field survey

7.6 COMPARISON OF FOOD SECURITY INDICATORS

All of the four food security indicators were used to estimate the proportion of food insecure households in Chaseyama and Chikukwa. Although these indicators all measure the food security status of households, they each have their particular emphases. Thus, this led to different estimations of the proportions of households that were food secure or food insecure per location for each food security indicator. Table 7.14 shows the proportion of households categorised by their food security status across the different food security indicators. Although different proportions of food secure households were produced from each of the indicators, the Food Consumption Score (FCS), Household Dietary Diversity Score (HDDS) and the Food Insecurity experience scale (FIES), all estimated that the majority of households were food secure across both locations.

Table 7.14: Proportion of households categorised according to food security status across different food security indicators during the 2016 - 17 lean season

Food Security Indicator	Proportion (%) of food secure households		Pearson Chi-square
	Chaseyama (n = 114)	Chikukwa (n = 113)	
Household Dietary Diversity Score (HDDS)	67	82	X² = 7.29, p = 0.007
Food Consumption Score (FCS)	84.2	83.2	X ² = 0.42, p = 0.52
Food Insecurity Experience Scale (FIES)	54.4	73.5	X² = 8.94, p = 0.003
Food Self-classification (FSSCS)	33	43	X ² = 2.28, p = 0.13

*Chi-squares in bold indicate significant differences in proportions between Chaseyama and Chikukwa

The Food Self-classification (FSSCS) indicator produced a lower proportion of food secure households across both Chaseyama and Chikukwa. One of the reasons for a sharp difference between FSSCS and the other indicators was the time horizon being measured. The FSSCS was analysed over a longer time span, covering 12 months, while the others were used to assess food security status over a shorter period (i.e. 24 hours, seven days and three months). So, when households are assessed over a short time frame, they might show that most are food secure, while more are food insecure over a longer time frame. Another reason is related to households' perceptions of their food security status that was different from the indicator-based assessments. While the standard food security indicators only capture recognisable signs of under-nutrition, these households regarded and perceived themselves as being food insecure.

The results showed that there were more households from Chikukwa than Chaseyama that were food secure in terms of their higher dietary diversity and less experiences of food insecurity. On the other hand, when food security was assessed in terms of frequency of consuming a diversified diet and perceptions of a household's food security status, there were no observed differences between the two locations.

Table 7.15 shows the correlation coefficients between the food security variables using their continuous form. Although the correlations were low (less than 0.5, except for one), they were all statistically significant (i.e. p < 0.05). The HDDS and FCS were correlated positively, while both

of these were correlated negatively with the FIES. Table 7.15 shows that the highest, positive correlation was between HDDS and the FCS for both Chaseyama and Chikukwa since they intersect at the measurement of dietary diversity. The negative correlation with FIES showed that food insecurity experiences tended to reduce with increasing dietary diversity and its frequency (measured by the HDDS and the FCS). This underscored the importance of increasing the dietary diversity of households and its frequency in order to reduce instances of food insecurity experiences.

Table 7.15: Pearson correlations between food security variables

Food Security Indicators	Pearson Correlation (r)	
	Chaseyama (n = 114)	Chikukwa (n = 113)
HDDS and FIES	-0.34	-0.32
HDDS and FCS	0.73	0.42
FIES and FCS	-0.41	-0.31

All correlations significant at 0.01 level.

7.7 DETERMINANTS OF FOOD SECURITY OF CHIMANIMANI HOUSEHOLDS (BASED ON HDDS, FCS AND FIES)

After determining the households that were food secure and food insecure, these two groups were analysed further to determine what characteristics were associated with their food security status. Multiple regression analysis was used to establish which household characteristics were associated with their food security status. Multiple regression makes it possible to determine which of several independent variables are important for predicting a dependent variable (food security status). In addition, the independent variables can be ranked in terms of their order of importance (Mascie-Taylor and Madsen, 2001). Multiple linear regression is useful when the dependent variable is in its metric/continuous form (Mascie-Taylor and Madsen, 2001). In this case, three food security indicators were in their metric form (i.e. HDDS, FCS and FIES). The independent variables that were used included: number of crops planted during 2015 - 2016, quantities harvested and available 2015 - 2016, number and type of livestock owned, number of income sources, size of land used (in hectares), location of households (Chikukwa or Chaseyama), and growing vegetables and fruits.

Before running the multiple regression analysis, its assumptions were tested using the selected variables. These assumptions included: checking the assumptions of normality, homoscedasticity and absence of multi-co-linearity (Hair et al., 1998; Mascie-Taylor and Madsen, 2001). None of the assumptions were violated.

Table 7.16 shows the individual variables that were significant for the HDDS, FCS and FIES indicators (shown in bold). For the household dietary diversity score (HDDS), the significant variables with positive coefficients were: cereal quantity available 2015 - 2016, legume quantity available 2015 - 2016, number of small livestock owned, number of vegetables grown, time household has been farming, and number of tree types grown (showing borderline significance).

The standard multiple regression model is as follows:

$$Y = a + B_1X_1 + B_2X_2 + B_3X_3 + \dots B_nX_n, \text{ (Mascie-Taylor and Madsen 2001), where:}$$

Y is the dependent variable; 'a' is the intercept; the 'Xs' are the various independent variables up to a maximum of n independent variables; 'Bs' are the regression coefficients for each independent variable. The equation model to predict the food security status of households is based on the household dietary diversity score (HDDS) and the important parameters (where $p < 0.05$) taken from Table 7.16 is as follows:

$$\text{HDDS} = 5.32 + 0.002 (\text{cereal available 2015-16}) + 0.022 (\text{legumes available 2015-16}) + 0.026 (\text{number of small livestock owned}) + 0.46 (\text{number of vegetable types grown}) + 0.017 (\text{time you have been farming}).$$

Based on this equation, the households that had large harvests to last them over the peak hunger season (shown by the significant cereal and legume variables) also had higher dietary diversity scores (i.e. were more food secure). The food harvested from own production (especially cereals and legumes) had an effect on the household food security. The tubers quantities remaining at the peak hunger season were not significant as these households had fewer quantities of tubers grown and harvested. This was evident also in the low dietary diversity scores for tubers (Figure 7.1 and

7.2). The number of small livestock owned (chickens, rabbits and goats) was associated with food security shown by the positive coefficient value that implied that every one-unit increase in small livestock owned was related to an increase in the household dietary diversity score. Surprisingly, this is unlike owning large livestock (donkeys and cattle), which was not significant for these households as few households owned large livestock.

The diversity in the types of vegetables grown by the households was associated with a higher household dietary diversity (and, thus, food security). This was not the same as ‘just’ growing vegetables (without an indication of the vegetable diversity) by the household, which was not significant. This was similar to the number of fruit tree types grown that was associated with a higher dietary diversity. The time a household had been farming had a positive relation to the household food security status. This could be related to the household having more experience and knowledge of farming (crop and livestock production) and in food/grain storage and preservation. These six indicators were identified as statistically significant in relation to household dietary diversity. The households depicting these characteristics were also associated with a higher dietary diversity score.

The equation model to predict the food security status of households based on the Food Consumption Score (FCS) and the important parameters (where $p < 0.05$) taken from Table 7.16 is as follows:

$$\text{FCS} = 49.9 - 13.2 (\text{location area}) + 2.75 (\text{number of vegetable types grown}).$$

The variables that had a significant relationship with the food consumption score (FCS) were the number of vegetables grown and the location of the household. Similar to the HDDS, the number of types of vegetables grown by the households were associated with a higher food consumption score, showing the contribution of a wider variety of vegetables grown to a diverse food diet and higher frequency of consumption. Other studies have shown the positive contribution of home gardens and vegetables to increased household dietary diversity and income (Akrofi et al., 2010; Adekunle, 2013; Chazovachii et al., 2013). The location of the household (Chaseyama or Chikukwa) was related to their food security status. This showed that the location of an area by

virtue of its attributes does contribute to a household's access to diversified diet and frequency of food consumption. In this instance the coefficient for location was -13.2 when Chaseyama was coded '0' and Chikukwa was coded '1' (i.e. Chikukwa was the reference location). This implied that, on average, Chikukwa households had a food consumption score of 13.2 less than Chaseyama households. Although the t-test of independent samples gave a lower mean difference of 6.27, this was highly significant at $p = 0.015$ and 225 degrees of freedom, reinforcing that Chikukwa households had a lower food consumption score compared with Chaseyama households.

Table 7.16: Multiple regression coefficients of variables based on HDDS, FCS and FIES in Chaseyama and Chikukwa

Independent variables	HDDS		FCS		FIES	
	Coef.	sig.	Coef.	sig.	Coef.	sig.
(Constant)	5.318	.000	49.883	.000	6.175	.000
Number of crops grown 2015 - 16	.099	.289	.884	.279	.066	.526
Cereal harvested 2015 - 16	.000	.268	.000	.922	.000	.377
Legumes harvested 2015 - 16	.000	.826	.000	.976	-.003	.015
Tubers harvested 2015 - 16	.000	.782	.000	.962	-1.31	.989
Cereal available 2015 - 16	.002	.014	.001	.865	.000	.834
Legumes available 2015 - 16	.022	.034	.005	.958	.000	.980
Tubers available 2015-16	.018	.162	-.114	.322	.004	.815
Number of Cattle and donkeys	-.026	.520	.390	.264	-.002	.972
Number of small livestock owned	.026	.008	.146	.086	-.025	.024
Number of income sources	.335	.149	3.376	.096	-.530	.046
Location Area	.085	.867	-13.157	.003	-.827	.157
Number of vegetable types grown	0.456	.000	2.754	0.014	-.035	.782
Do you have fruit trees?	-.686	.230	1.369	.784	-1.189	.072
Number of tree types grown	.241	.057	1.365	.215	.025	.865
Land size owned (ha)	-.083	.449	-.507	.596	.058	.645
Land size used (ha)	-.046	.799	-1.043	.512	.013	.949
Sex of household head	.321	.355	-.483	.873	-.387	.329
Size of household	.001	.987	-.181	.777	.002	.980
Time you have been farming	.017	.044	.077	.308	-.007	.473

Bold figures indicate significant indicators.

The equation model to predict the food security status of households based on the Food Insecurity Experience Scale (FIES) and the important parameters (where $p < 0.05$) taken from Table 7.16 is as follows:

$$\text{FIES} = 6.2 - 0.003 (\text{legumes harvested 2015-16}) - 0.025 (\text{number of small livestock owned}) - 0.53 (\text{number of income sources}).$$

The variables that showed significant effect on the food insecurity experience scale were the quantity of legumes harvested, the number of small livestock owned, and the number of income sources. All of these variables had negative coefficients, showing that households experiencing more characteristics of food insecurity were more likely to have harvested fewer quantities of legumes, owned fewer small livestock and had fewer income sources. Legumes thus play an important role in ensuring that households are food secure. Studies elsewhere have shown the important role that legumes play in food and nutrition security (Tharanathan and Mahadevamma, 2003; Ojiewo et al., 2015; Sauer et al., 2016).

The importance of ownership of small livestock was observed as well in the HDDS results, where the variable contributed to a more diverse diet. Research has shown that small livestock, such as goats and sheep, contribute substantially to household food security because they provide food and are easy to convert into quick cash required to meet immediate household needs (Van Rooyen et al., 2013; Mango et al., 2014; Msangi, 2014).

Having access to alternative income sources was related to households experiencing fewer instances of food insecurity because income provides options for accessing food for the household. Research has shown that households that have access to better income opportunities are more likely to be food secure than households that had no or little access. (Babatunde and Qaim, 2009; Bogale and Shimelis, 2009; Zerai and Gebreegziabher, 2011). A recent study by FEWSNET in Zimbabwe showed that rural Zimbabweans purchase 65% of their maize from other local households, while food purchases make up 56% of their overall expenses (FEWSNET, 2014). This shows that a significant share of their incomes is spent on food.

7.8 CHARACTERISTICS OF HOUSEHOLDS CATEGORISED AS FOOD SECURE AND FOOD INSECURE (BASED ON THE FSSCS)

Logistic regression analysis was used to establish which household characteristics were associated with food security status in terms of the Food Security Self-Classification Scale (FSSCS). Since this indicator was not continuous in the same way as the other food security indicators, it was converted to a binary form that could be used as the dependent variable of the multiple logistic regression. The independent variables used included: number of crops planted during 2015 - 2016, quantities harvested and available 2015 - 2016, number and type of livestock owned, number of income sources, size of land used (in hectares), location of households (Chikukwa or Chaseyama), number of vegetable types and fruit tree types grown. The assumptions tested included: checking the assumptions of normality, homoscedasticity and absence of multi-co-linearity (Hair et al., 1998; Mascie-Taylor and Madsen, 2001). None of the assumptions were violated.

A test of the full model for the Food Security Self Classification Scale (FSSCS), using all 19 predictors against a constant only model was statistically significant, $X^2(19, N = 224) = 49, p < .05$, indicating that the predictors, as a set, reliably distinguished between food secure and food insecure households. The logistic regression model explains 26.9% of the variation in the outcome variable. The Hosmer and Lemeshow Chi-square Test provided an outcome of $p = 0.76$, which implied that the FSSCS was a good model. A good model produces an insignificant chi-square test ($p \geq 0.05$). Prediction success was good, with 72% of households being classified correctly overall but the model was used more successfully to predict food insecure households (85.7%) than food secure households (50%).

The standard logistic regression model is as follows:

$$\text{Logit}(p) = a + B_1X_1 + B_2X_2 + B_3X_3 + \dots B_nX_n, \text{ (Mascie-Taylor and Madsen 2001),}$$

where:

Logit (p) is the dependent variable; 'a' is the intercept; the 'Xs' are the various independent variables up to a maximum of n independent variables; 'Bs' (the slope values) are the regression

coefficients for each independent variable. The slope can be interpreted as the change in the average value of dependent variable, from one unit change in the independent variable (X). The equation model to predict the food security status of households based on the Food Security Self-Classification Scale (FSSCS) and the important parameters (where $p < 0.05$) taken from Table 7.17 is as follows:

$$\text{FSSCS} = -3.97 + 0.59 (\text{number of income sources}) + 0.28 (\text{number of vegetable types grown}) + 0.026 (\text{time you have been farming}).$$

The significant variables for the FSSCS are shown in Table 7.17, being: the number of income sources ($\text{ExpB} = 1.81$, $p = 0.027$), number of vegetables grown ($\text{ExpB} = 1.33$, $p = 0.027$), and time household had been farming ($\text{ExpB} = 1.03$, $p = 0.008$). For every unit increase in the number of income sources, the likelihood of the households being food secure increased 1.81 times. For every unit increase in the number of vegetable types grown, the likelihood of the households being food secure increased 1.33 times. For every unit increase in the number of years households had been farming, the likelihood of the households being food secure increased 1.03 times.

The number of income sources, number of vegetables grown and period the household had been farming correlated positively with the food security status of households measured over a longer time horizon (12 months), using the households' perceptions of their food security status. This correlation showed the association of income sources and vegetable diversity of a household to its food security, while the period of farming showed the link between length of time in farming and the food that the household eats. The length of farming was also positively related to the household dietary diversity score.

The number of types of vegetables grown by the households was positively related to the level of household food security in terms of FSSCS similar to the HDDS and the FCS. This underscored the importance of vegetable diversity in contributing to the level of household food security over a shorter and longer period. The number of income sources accessed by the households showed positive significance in the results of the FSSCS as well as the FIES. The length of farming had positive relationship with the FSSCS as well as the HDDS.

Table 7.17: Regression coefficients of variables based on FSSCS in Chaseyama and Chikukwa

Independent variables	FSSCSS			
	B	S.E	Exp(B)	Sig.
Number of crops grown 2015 - 16	-.032	.102	.969	.757
Cereals harvested 2015 - 16	.000	.000	1.000	.080
Legumes harvested 2015 - 16	.002	.001	1.002	.134
Tubers harvested 2015 - 16	.000	.001	1.000	.685
Cereal available 2015 - 16	.000	.001	1.000	.538
Legumes available 2015 - 16	-.015	.013	.985	.247
Tubers available 2015 - 16	-.007	.014	.993	.623
Cattle and donkeys	.064	.044	1.066	.146
Small livestock owned	.010	.011	1.010	.350
Number of income sources	.591	.268	1.806	.027
Location Area	-.188	.561	.828	.737
Number of vegetables grown	.283	.128	1.327	.027
Do you have fruit trees?	.184	.728	1.203	.800
Number of tree types grown	.048	.141	1.049	.733
Land size owned (ha)	.038	.154	1.038	.806
Land size used (ha)	.145	.222	1.156	.513
Sex of household head	.141	.400	1.151	.725
Size of household	-.122	.086	.885	.158
Time farming	.026	.010	1.027	.008
Constant	-3.969	.992	.019	.000

Figures in bold refer to significant indicators.

7.9 CONCLUSIONS

In this chapter, the food security status of Chaseyama and Chikukwa households and its determinants were examined. Different measures of household food security were used to determine the status of their food security from different perspectives during the peak hunger season.

Although the food security indicators showed various estimated proportions of food secure households as expected, they showed significant correlations amongst themselves and similar determinants. For each type of food security indicator, there were certain indicators (determinants) that were related to the food security status of the households. These included: the quantity of harvests remaining till the peak hunger season (especially legumes and cereals), diversity of

vegetables grown, ownership of small livestock, number of income sources, and time (in years) the household had been farming. These variables positively correlated with the HDDS, FCS and the FSSCS food security indicators, while legume harvest, number of small livestock owned and number of income sources accessed by the household correlated negatively with the FIES. Taken together, this revealed that households with these attributes were more likely to have a diverse diet, higher frequency of a diverse diet and to perceive themselves to be more food secure, while they were also less likely to experience desperate food insecurity coping strategies.

Food sourced from farm production was critical for farming households as it served as the primary basis of their food supplies. This confirmed the first element of food security, namely, the ability to produce own food in achieving sustainable food security (Mozumdar, 2012). Critically, legumes and cereals harvested should be adequate to enable the households to have sufficient stocks to last through the lean season. This should be complemented by a diverse number of vegetable types grown by the household to cater for their food requirements. A diverse number of vegetables ensures that households have access to a diverse diet from the vegetables as well as income from the surpluses. Furthermore, ownership of small livestock and having access to a diverse number of income streams had significant, positive influence on food security as these factors resulted in food for the household and the ability to purchase additional food needed by the household. Diverse income ensures that households have improved food consumption through food purchases and helps households to manage production risks. These factors reduce the likelihood of households experiencing the negative effects of food insecurity.

CHAPTER EIGHT: RELATIONSHIP BETWEEN SEED SECURITY AND FOOD SECURITY

8.1 INTRODUCTION

The focus of this chapter is on the main theme of this thesis: the relationship between seed security and food security. In Chapter six, the seed security situation of the households was described and, in Chapter seven, information about the status of their food security was presented. The categories used to describe seed security were seed availability, seed access, and seed utilisation. The indicators used to describe food security were the household dietary diversity score (HDDS), food consumption score (FCS) and the food insecurity experience scale (FIES). The food security self-classification scale (FSSCS) was included as an indicator based on self-assessment of food security to complement the findings based on the other indicators. In order to determine the relationship between seed security and food security, their respective indicators were cross-tabulated and analysed using statistical tests of comparisons of means and proportions. The farming household typologies in terms of seed security and food security status was used to clarify the determinants of these dimensions with the aid of the life case histories of farmers.

8.2 SEED AVAILABILITY AND FOOD SECURITY

The seed availability components that were used to compare with food security were: seed adequacy, and temporal and spatial seed availability as presented below.

8.2.1 Seed Adequacy and Food Security

Table 8.1 shows a comparison of food security indicators with the adequacy of seed available to farmers from various sources. The analysis was not segregated by location since this did not yield any significant relationships or useful patterns. This comparison was between the mean food security scores of the farmers that had enough seed and those with inadequate seed. As explained in Chapter six, seed sufficiency was assessed by asking farmers about the quantity of seed they planted for their key crops and whether there was enough seed available from their particular source. To obtain an overall perspective of the seed sufficiency of a household, the variable was

coded '0' (= no) if a farmer claimed that there was not enough seed from at least one seed source, and was coded '1' (= yes) if the farmer claimed that there was enough seed from all his/her sources. The assumption was that any source with enough seed of one crop variety could not compensate for seed that was not enough from other sources. This assumption was justified due to the fact that each variety of a crop has specific and important uses to farmers (Shava et al., 2009; Jarvis et al., 2011).

Table 8.1: Comparison of food security mean scores of groups of farmers that had enough seed with farmers that had insufficient seed from their respective sources

Food Security Indicator	Enough seed from farmers' seed sources	Percentage of farmers	Means (standard deviations in parentheses)	Independent samples test*
Household dietary diversity score	Yes	45.8	8.8 (2.0)	t = -4.9; df = 223; p = 0.000
	No	54.2	7.4 (2.4)	
Food consumption score	Yes	45.8	72.5 (16.5)	t = -6; df = 223; p = 0.000
	No	54.2	58 (19.5)	
Food insecurity experience score	Yes	45.8	2.2 (2.2)	t = 3.5; df = 223; p = 0.001
	No	54.2	3.3 (2.7)	

*Bold indicates significant p values

The farmers who had enough seed from all their sources also had significantly higher dietary diversity scores ($p < 0.05$) and food consumption scores compared with farmers who did not have enough seed. These farmers also tended to experience significantly fewer ($p < 0.05$) food insecurity experiences compared with farmers who did not have enough seed. These findings suggest that farmers with enough seed are also more likely to be food secure.

These results were confirmed further by an analysis of the food security self-classification scale (FSSCS), using the Pearson Chi Square Test, that showed a highly significant relationship ($p = 0.01$) when comparing the two groups of farmers that had enough seed with those without enough seed, as shown in Table 8.2. The Pearson Chi Square Test was used to determine whether the two categorised variables were related. In this case, the farmer group with enough seed also had significantly fewer members that were food insecure (50.5% compared to 72.7%) and significantly more members (49.5% compared to 27.3%) that were food secure.

Table 8.2: Comparison of farmers with sufficient seed with farmers with insufficient seed using the food self-classification scale

Seed security groups	Food self-classification		
	Percentage food insecure	Percentage food secure	Percentage total
Not enough seed from some of farmers' sources	72.7 (n = 88)	27.3 (n = 33)	100
Enough seed from all sources	50.5 (n = 52)	49.5 (n = 51)	100
% of Total	62.5	37.5	100
Chi square test	Pearson Chi-Square = 11.7; df = 1; p = 0.01*		

*Bold indicates significant p values

8.2.2 Temporal Seed Availability and Food Security

A comparison of the household food consumption score with the temporal availability of seed is shown in Table 8.3. There were no significant differences between the household dietary diversity score and food insecurity experiences resulting from the timeliness of seed provision to farmers (not shown in the table). The only significant relationship observed was between the mean food consumption scores of the farmers' groups that obtained their seed on time and those that obtained their seed late.

Table 8.3: Comparison of food consumption mean scores of farmers' groups in Chaseyama and Chikukwa that received their seed on time with those that received their seed late

Food security indicator	Timeliness of seed from farmers' seed sources	Percentage of farmers	Mean (standard deviations in parentheses)	Independent samples test*
Food consumption score	On time	64	67 (19)	t = -6; df = 223; p = 0.05
	Late	36	61 (18)	

*Bold indicates significant p values

Whether or not households received their seed on time or late, farmers had an acceptable food consumption diet score (both greater than 42). However, the households that received their seed on time had a significantly greater food consumption score ($p < 0.05$) compared with those that

received their seed late. This result suggests that the timeliness of seed provision is related to food security and illustrates the importance of making seed available to farmers on time so that their access to food is ensured.

8.2.3 Spatial Seed Availability and Food Security

A comparison of household food security scores with the spatial availability of seed is shown in Table 8.4. The food security mean scores of the farmers were compared between the farmers' groups that received their seed in close proximity to their farms and those that received their seed from further afield. Contrary to expectations, the results showed that farmers that accessed their seed from nearby sources had lower dietary diversity scores and more food insecurity experiences compared with farmers that accessed their seed from sources further away. These findings suggest that, although the proximity of seed sources is important for farmers as it reduces the cost and time of acquiring seed (see Chapter six), households with wider networks are able to access to food from distant locations. This has important implications for food security and confirms findings from Coomes et al. (2015) who show that households with a wider network are able to acquire seed beyond their locality.

Table 8.4: Comparison of food security mean scores between farmers' groups throughout Chaseyama and Chikukwa that obtained their seed in close proximity and those that accessed their seed from far

Food Security Indicator	Proximity of seed from farmers' seed sources	Percentage of farmers	Mean (standard deviations in parentheses)	Independent samples test*
Household dietary diversity score	Near	61	7.6 (2.4)	t = 3.6; df = 203; p =0.000
	Far	39	8.8 (2.1)	
Food consumption score	Near	61	63 (19)	t = 1.4; df = 221; p =0.13
	Far	39	67 (20)	
Food insecurity experience score	Near	61	3.3 (2.7)	t = -3.8; df = 208; p =0.000
	Far	39	2 (2.2)	

*Bold indicates significant p values

These results were confirmed further by an analysis of the food security self-classification scale (FSSCS), using the Pearson Chi Square Test, that showed a highly significant relationship ($p = 0.005$) when comparing the two groups of farmers that accessed their seed from far away and those that accessed their seed nearby, as shown in Table 8.5. The farmer group that accessed their seed from sources that were far away had significantly fewer members that were food insecure (51.1% compared with 69.9%) and significantly more members (48.9% compared with 30.1%) that were food secure. These households were thus more likely to be food secure in comparison with the households that accessed their seed from nearby sources. Depending on the seed source, households that were able to travel longer distances in search of seed were also able to access food from those locations. The sources that sold seed through the formal channels were located usually in business centres that also sold food.

Table 8.5: Comparison of farmers who accessed their seed far away or nearby, using the food self-classification scale in terms of their food security

Seed security groups	Food self-classification		
	Percentage food insecure	Percentage food secure	Percentage total
Seed accessed far	51.1 (n = 45)	48.9 (n = 43)	100
Seed accessed near	69.9 (n = 95)	30.1 (n = 41)	100
% of total	62.5	37.5	100
Chi square test	Pearson Chi-Square = 7.99; df = 1; p = 0.005*		

*Bold indicates significant p values

8.3 SEED ACCESS AND FOOD SECURITY

8.3.1 Perceived Cost of Seed and Food Security

The food security mean scores of farmers were compared between those who perceived their seed to be expensive and those who perceived their seed to be affordable. There was no significant difference in the food security scores of the farmers who claimed that their seed was expensive and those who claimed that their seed was affordable. This could mean that the perception of the cost of seed might not be related to the ability to acquire food.

The relationship between seed access and food security was assessed further by comparing the indicators associated with access, including ownership of livestock, ownership of land, income sources and ownership of other farm assets. Although these variables were not ‘seed access’ indicators specifically, they affected the ability of farmers to acquire seed, since seed access, by definition, referred to the ability of farmers to acquire seed through purchase, exchange, loan, barter or use of influence in social networks (Sperling et al., 2013c; FAO 2016a). With the exception of social networks, these elements were related to economic factors that enabled access to seed.

The correlation co-efficients between the access indicators (income and assets based) and the food security variables are shown in Table 8.6. Although the correlations were low (all less than 0.5), they were all statistically significant at either $p < 0.01$ or $p < 0.05$. The HDDS and FCS indicators had a positive correlation with the access variables, suggesting that there was a strong relationship between food security and the income and asset ownership of households. The strongest relationship observed was between the HDDS and ownership of total assets and access to a larger quantity of cereal seed for planting maize and small grains (i.e. $p < 0.01$). For the FCS, all the asset, livestock and income variables showed a stronger correlation (i.e. $p < 0.01$ significance).

The correlation co-efficients between FIES and access variables were negative, suggesting that food insecurity experiences (measured by FIES) tended to decrease with increasing income sources and asset ownership. This indicated a strong relationship between food security and economic access. The strongest relationship observed was between the FIES and ownership of total assets, access to larger quantities of cereal seed (maize and small grains) for planting and access to more income sources (i.e. $p < 0.01$).

Table 8.6: Pearson correlation tests for relationships between access variables (income and assets) and food security variables

Indicators Compared	Pearson correlation (r)	Significance level (p)
HDDS and total number of household assets owned	0.2	0.01
HDDS and total quantity of cereal seed planted 2016-17	0.3	0.01
HDDS and total livestock owned	0.2	0.05
HDDS and number of small livestock owned	0.2	0.05
HDDS and number of income sources	0.14	0.05
FIES and total number of household assets owned	-0.2	0.01
FIES and total cereal seed quantity planted 2016-17	-0.3	0.01
FIES and number of income sources	-0.2	0.01
FIES and total livestock owned	-0.2	0.05
FIES and number of small livestock owned	-0.2	0.05
FIES and total quantity of legume seed planted 2016-17	-0.14	0.05
FCS and total number of household assets owned	0.2	0.01
FCS and total livestock owned	0.3	0.01
FCS and number of small livestock owned	0.3	0.01
FCS and number of large livestock owned	0.2	0.01
FCS and number of income sources	0.2	0.01

Table 8.7 shows the comparison between the mean scores of the access variables (income and assets) for households classified as food secure and households classified food as insecure based on the food security self-classification scale (FSSCS). The key assumptions that were tested for ANOVA validity include the test of normality and homogeneity of variances. As recommended by Kozak and Piepho (2018), the normality was tested based on residuals, while the homogeneity of variances were checked using diagnostic plots. Both assumptions were met. All the indicators with significant differences, based on the Anova results, are shown.

Table 8.7: Comparison between mean scores for access variables (income and assets) and food security self-classification scale (FSSCS) variable

Proxy access indicators	Mean scores		One-way Anova results
	Food secure	Food insecure	
Total household assets	8.1	6.4	F = 11.1; df=225; p = 0.001
Land size used (ha)	1.7	1.3	F = 5.7; df=224; p = 0.02
Number of small livestock owned	20.6	15.4	F = 5.4; df=225; p = 0.02
Number of income sources	2	1.6	F = 12.5; df=225; p = 0.001
Total quantity of cereal seed planted 2016-17 (kg)	25.8	16.5	F = 20.1; df=225 p =0.000
Total quantity of legume seed planted 2016-17 (kg)	8.7	5.6	F = 7.1; df=225; p = 0.008

It was evident that food secure households (in terms of the self-classification scale) had significantly higher mean scores in terms of asset ownership, income sources and seed quantities grown. These results suggest that households with access to diverse income sources, higher seed quantities to plant and higher asset ownership are likely also to be food secure.

8.3.2 Seed Aid and Food Security

Table 8.8 shows a comparison of the food security status of farmers categorised in terms of the number of times they were recipients of seed aid over the previous five years. This was done by carrying out a One-way Anova analysis that compared the food security scores of farmers grouped according to their frequency of receiving seed aid. The groups receiving seed aid were categorised as ‘never’, ‘few times’ and ‘many times’. The results showed significant differences in the dietary diversity scores and the food insecurity experiences in at least one of the groups. The results suggest that there are differences in food security scores (except for the food consumption scores) amongst farmers receiving seed aid at different times. The findings further indicate that farmers who receive seed more frequently are also more likely to be more food secure and experience fewer instances of food insecurity.

This finding could be the result of a short-term relationship between access to seed aid and access to food. As noted in Chapter five, the suppliers of seed aid were government (for maize seed) and NGOs (for small grains and legumes). When a farmer received these ‘seed aid’ packages for planting purposes, their seed shortage situation might be averted and, assuming they planted the seed and were able to harvest adequate produce, they would have had adequate food for the following season.

Table 8.8 shows that households that received seed aid many times also had significantly higher dietary diversity scores and lower instances of food insecurity. This implies that reinforced access to seed (through seed aid, although these farmers also relied on other seed sources) is related to food access. Findings indicate that seed aid should be provided in exceptional situations of seed stress, such as when farmers are affected by hazards that have wiped out completely their availability and access to seed. Jones et al. (2002) and Sperling et al. (2008) have however shown the negative consequences of repeated seed aid. The findings of the current study make a case for seed aid assistance during times of crisis as a way of ensuring that households are able to produce their own food.

Table 8.8: Comparison of food security mean scores between farmers' groups throughout Chaseyama and Chikukwa according to category of receiving seed aid in the previous five years

Food security indicator	Category of receiving seed aid	Proportion (%) of farmers	Mean (standard deviations in parentheses)	One-way Anova*
HDSS	Never	9.2	7.8 (2.7)	F = 10.1; p = 0.000
	Few times (1-2 times)	48.9	7.4 (2.4)	
	Many times (3-5 times)	41.9	8.2 (2.0)	
FCS	Never	9.2	73 (22.0)	F = 2.8; p = 0.06
	Few times (1-2 times)	48.9	62.4 (17.0)	
	Many times (3-5 times)	41.9	65.4 (17.0)	
FIES	Never	9.2	2.8 (2.4)	F = 10.7; p = 0.000
	Few times (1-2 times)	48.9	3.5 (2.6)	
	Many times (3-5 times)	41.9	2 (2.2)	

*Bold indicates significant p values

8.4 SEED QUALITY/UTILISATION AND FOOD SECURITY

8.4.1 Overall Seed Quality and Food Security

Table 8.9 shows a comparison of the overall seed quality characteristics of households (using the composite indicator of clean seed and germination) with their food security status. A comparison between the mean scores of the food security indicators for the households classified as seed secure and seed insecure was done. The results showed higher and significant differences in dietary diversity and food consumption scores for seed secure households compared with less seed secure households. The results suggest that households that have better quality seed are also likely to be more food secure. This is logically consistent because seed quality is related to good stand establishment, higher crop yields and better crop production (FAO, 2020; Wimalasekera, 2015; Chivasa et al., 2001). However, there were no significant differences in the number of food insecurity experiences for these households.

Table 8.9: Comparison of food security mean scores between farmers' groups throughout Chaseyama and Chikukwa according to seed quality categories

Food security indicator	Category of seed quality	Proportion (%) of farmers	Mean (standard deviations in parentheses)	Independent samples test*
HDDS	Seed secure	84	8.2 (2.3)	t = 2.7; df = 223; p = 0.000
	Less seed secure	16	7.1 (2.2)	
FCS	Seed secure	84	65.8 (19.3)	t = 2; df = 223; p = 0.000
	Less seed secure	16	58.6 (19.8)	
FIES	Seed secure	84	2.8 (2.5)	t = -0.5; df = 223; p = 0.61
	Less seed secure	16	3 (2.6)	

*Bold indicates significant p values

8.4.2 Clean Seed and Food Security

The analysis was taken further to compare the seed quality characteristics of individual households. The food security mean scores were compared between the farmers' groups whose seed was clean (i.e. physical purity) and those whose seed was not clean. The results in Table 8.10 showed higher significant differences in mean dietary diversity and food consumption scores for the farmers who had clean seed. These findings indicate that farmers with clean seed from their seed sources are also likely to be more food secure. However, there were no significant differences in the number of food insecurity experiences for these farmers.

Table 8.10: Comparison of food security mean scores between farmers' groups throughout Chaseyama and Chikukwa according to clean seed category

Food security indicator	Category of whether seed was clean	Proportion (%) of farmers	Mean (standard deviations in parentheses)	Independent samples test*
HDDS	Yes	88	8.2 (2.4)	t = -2.4; df = 223; p =0.000
	No	12	7 (2.0)	
FCS	Yes	88	65.7 (19)	t = -2.2; df = 223; p =0.000
	No	12	56.9 (21)	
FIES	Yes	88	2.5 (0.2)	t = -0.6; df = 223; p =0.54
	No	12	2.6 (0.5)	

*Bold indicates significant p values

8.4.3 Seed Germination and Food Security

The food security mean scores of the farmers' groups were compared between those whose seed germinated well and those whose seed germinated poorly. The results in Table 8.11 showed borderline significant differences in mean dietary diversity scores for the farmers who had good seed germination compared with those who had poor germination. No significant differences were observed in the other food security scores. Thus, the results showed minimal differences in food security scores between the farmers' groups according to the germination characteristics of their seed. This could be related to the finding that most of the farmers' seed (96 % sown, as presented in Chapter six) had good germination characteristics anyway. Since most households interviewed in Chimanimani indicated that the seed they planted had good germination, there were insufficient households with poor seed germination that could be used as a comparison.

Table 8.11: Comparison of food security mean scores between farmers' groups throughout Chaseyama and Chikukwa according to seed germination category

Food Security Indicator	Category of seed germination	Proportion (%) of farmers	Mean (standard deviations in parentheses)	Independent samples test*
HDDS	Yes	85.8	8.2 (2.4)	t = -2; df = 223; p = 0.05
	No	14.2	7.3 (2.2)	
FCS	Yes	85.8	65.3 (19.5)	t = -1.3; df = 223; p = 0.2
	No	14.2	60.6 (19.6)	
FIES	Yes	85.8	2.8 (2.5)	t = 0.3; df = 223; p = 0.79
	No	14.2	2.9 (2.7)	

8.5 ENABLERS AND CONSTRAINERS OF SEED AND FOOD SECURITY

To complement the statistical discussion above, this section focuses on some of the enablers and constrainers to seed and food security of Chimanimani households, based on the life history interviews as well as the 227 household interviews where applicable. The household respondents were asked to give a historical background of their family life and also an assessment of their seed and food security status. Some of the possible drivers and challenges of household seed and food security were identified from the case histories.

8.5.1 Seed Production and Multiplication

Some households had a plot for crop/food production that was separate from seed production. This level of agronomic specialisation was facilitated by local community-based organisations (CELUCT and PORET). These organisations have supported farmers in accessing crop varieties for multiplication and have provided them with training in seed production. Thus, farmers have a diverse number of varieties from different crops. Christy from Chikukwa, for example, had plenty of seed from previous harvests, having cultivated more than 12 different varieties of five crops maize (*madzande*, *chitonga*, *mutsuragudo*), finger millet (*chitende*, *shirishena mutangatsape*), sorghum (*mukadzi usaenda*, *tsweta*, *chikota*, *ruzangawayaya*, *macia*), yams (*madumbe*), and beans (*makamba*), inter-cropped with maize. She had a plot dedicated to seed that was separate from the

food plot. She had a storeroom for storing her seed and grain. She said the following to explain her sufficiency in seed:

In the past my children used to send me money to purchase seed for my planting needs before I was able to keep enough varieties and quantities of my own seed. These days I use the money from my children to hire additional labour for helping in my fields. (Christy, Life case-history interview, Chikukwa, October 2017).

With the additional labour that she hired, Christy was able to utilise all her fields and produce sufficient food and seed. She elaborated that her seed production was providing her with a good source of income by saying:

I get the highest income for my household from selling seed. I sell my seed at shows, to local community-based organisations, neighbours and others coming from outside my village. Just to show you how much I make from seed sales, I sold my maize seed (*madzande* variety) for \$25 per bucket, while for maize grain I got between \$4.50-\$5 per bucket. (Christy, Life case-history interview, Chikukwa, October 2017).

Jackie, a female farmer from Chaseyama, also showed some level of agronomic specialisation by having a plot dedicated to seed and selling some of her seed to relatives and neighbours during seed market days. Jackie and her family obtained most of their maize food requirements from barter exchange with other farmers for cowpeas, groundnuts and bambara groundnuts (mostly landrace varieties) that they grow in abundance. Jackie's household specialised in production of legume seed after realising that maize had not been performing well in her area.

Christy and Jackie's accounts showed that they had been able to preserve, diversify and increase their crop varieties by separating seed production from crop production. As seed producers, they also benefited from the income obtained from seed sales. Food production was an important component of their food source. In the case of these farmers, the ability to specialise in seed production and marketing has been shown to be an enabler of seed security (access to adequate

quality seed) and food security (households' food production). Studies elsewhere have shown the important contribution made by seed production to improved access to quality seed for household food production and income (De Bruijn et al., 1994; Poudel et al., 2003; Setimela et al., 2004).

8.5.2 Seed Preservation and Storage Skills

The farmers that rely on their own crop varieties have mastered the skills of seed preservation and storage. These skills are mostly passed down from one generation to another and from farmer to farmer. Their seed is well selected and preserved using traditional methods for successive planting seasons. The seed is selected and treated differently throughout the stages of crop development (in the field, at harvest and post-harvest). As shown in chapter six, farmers from the larger household sample used various methods to preserve their seed, depending on the crop type, such as traditional herbs, pre-mixed portions, storage agro-chemicals and smoking in the kitchens. The storage facilities ensured adequate drying, while preserving the purity and colour of the seed, and minimal damage from weevils.

The farmers that were satisfied with their seed preservation and storage methods also had access to a wider variety of seed for their planting needs. Terry gave the following account of the process that he implemented:

During harvest, I grade all my seed, separating it from the grain, and storing more quantities of seed than what I need so that I am able to give relatives, other farmers and for selling. The seed preservation methods I use include mixing seed with certain tree ashes (*Ruvengo*, *Hanye* and *Mnyambanje*) that I place in a tin then the seed is covered to prevent entry of air. Weevils do not affect my finger millet at all. (Terry, Life case-history interview, Chikukwa, October 2017).

Vivian from Chikukwa was also satisfied with the seed preservation and storage methods that she used. In order to preserve her seed, Vivian smoked seed (such as maize and finger millet) for her personal use in the kitchen, while the seed intended for sale was mixed with ashes and placed in sacks that were permeable. She was cautious that the seed mixed with ashes was treated with the

right mixture to prevent discolouration of the seed that would make it difficult to sell. Tabeth, from Chaseyama, who claimed that she was able to have adequate and good quality seed for at least two planting seasons, described similar seed preservation and storage procedures.

Jill, a single parent from Chaseyama, was satisfied with the seed that she had. She grew four crops of sorghum, groundnuts, bambara groundnuts and cowpeas from farm-saved seed, barter exchange, and purchases from other farmers. She explained the following with regard to her access to seed:

In the past, I used to run out of adequate seed for planting needs, and also lacked money for purchasing seed. Due to the knowledge I have gained in selecting and preserving my own seed, I am now able to store enough seed for my planting needs. By attending seed fairs, I get a chance to discover varieties that I don't have and buy from other farmers. (Jill, Life case-history interview, Chaseyama, September 2017).

Seed preservation and storage are linked clearly to seed security in terms of access to seed by households and ensuring its quality. In terms of seed availability, the farmers interviewed mentioned their ability to share their seed with relatives and other farmers and to sell the seed. This led to better household food production and, thus, access to food. Researchers have shown that seed selection, treatment, and storage ensure that seed quality and diversity are maintained over time (Kiruba et al., 2006; Mathad et al., 2013 Vernooy et al., 2017). The researchers agreed that the seed treatments used led to good germination, breaking of dormancy, protection against storage pests and diseases, good plant stand and enhanced the longevity of the seeds.

8.5.3 Social Capital

Farmers with strong social ties, kinship and networks had access to seed that had been shared by parents, neighbours and friends. Though some of this seed was commoditised, most of it was shared for free, based on social relations between farmers. The farmers that could not afford to purchase seed from local markets or shops were able to access the seed via social networks.

There were farmers who used to have adequate diverse seed and used to be self-sufficient in their food provision while staying in the household of their parents. This custom was passed down generations to some farmers' current families. The life-history interviews showed that farmers in this situation benefited from the germplasm, as well as the skills and knowledge from their parents. Edson's parents never lacked food and had plenty of food to eat and store. He mentioned that:

My parents in Bocha Marange used to grow plenty of pearl millet and sorghum that was harvested into large granaries. This was able to last my family for three years such that even when drought years followed, we did not lack food. I learnt these farming practices from my parents and so am now using them to ensure that we are also able to harvest enough food most of the years. (Edson, Life case-history interview, Chaseyama, September 2017).

Roselyn, based in Musweshiri under Chaseyama, claimed to have adequate seed for her planting needs. In addition to growing seven crops that included cowpeas, sorghum, watermelons, cucumbers, bambara groundnuts, groundnuts and maize (maize being a minor crop owing to low rainfall) obtained from her own saved seed, NGOs, and grain markets, she was able to source a good finger millet variety from her grandmother. This variety produced a good harvest every time and was not affected by weevils. Even during drought years, she had been able to produce a good harvest from this finger millet variety.

On the other hand, Leo, from Zvekuitirwa Village in the Chaseyama cluster, struggled to purchase and obtain seed from his usual seed sources (agro-dealers and seed aid), and did not retain any seed from previous seasons. He claimed that seed from shops was unaffordable, especially maize and legume seed, and sometimes he received late from other aid sources. His vulnerability was the result of his reliance on formal seed sources which, in his case, he could not afford. Seed aid was also not guaranteed.

Edson from Chaseyama also claimed that the seed from purchases was too expensive for him to obtain adequate quantities. When he settled in Jinga Village in Chaseyama, having moved from

Mutare District, he did not have seed from his parents because, initially, he was not keen on farming and, thus, did not inherit/benefit from their germplasm. He stated that:

As a farmer, I feel that I still lack some of the crop varieties of sorghum (*chimhondo*) and pearl millet (*jiri*). These varieties cannot be found locally though my parents grew them when we were young. I am not sure of where I could get them. The *chimhondo* sorghum variety was not eaten by birds, thrived even during a dry spell and was not affected by weevils when compared to the varieties that we have. (Edson, Life case-history interview, Chaseyama, September 2017).

The cases referred to above showed the influence of kinship, social relations and networks on accessing good crop varieties as well as skills and knowledge passed down from parents on food production during drought years. There were clear links also to food production, as households used the skills they acquired in crop production and benefited from the specific characteristics of the varieties (drought tolerance, culinary features) sourced through social ties. Other studies have shown the crucial role of social relations in mediating seed exchanges and seed flows based on different types of transactions and rules (Sperling and McGuire, 2010b; Stromberg et al., 2010;). Ricciardi (2015: 119) reinforces this point by mentioning that, in most informal seed systems, “common practices among families and communities include seed gifting in marriage ceremonies and other traditional, family-centred, agricultural activities”.

8.5.4. Weather and Climate

The years of national drought in Zimbabwe were 1982, 1992, 2002, 2004, 2008 and 2015 (Kinsey et al., 1998; Nangombe, 2014; Kokera and Ndoma, 2016). Nangombe (2014) argues further that the extreme drought years were 1982, 1992, and 2004, while the other years were mild. Overall, droughts are a frequent phenomenon in Zimbabwe. Although the weather and climate experienced by households within the same community might be similar, its effect on food security is not always the same. This is related mainly to the location of the households: Chikukwa receives high rainfall on most occasions and, sometimes, flooding during cyclones; Chaseyama receives very

low rainfall and is susceptible to drought because it is in a semi-arid location. Furthermore, households in the same location are affected differently by the same weather shocks.

The life-history interviews showed that, although households used to be food secure in the past (in their parents' homesteads), they were food insecure in their own homes because of low harvests and the negative effects of several drought periods. Jill's family from Chaseyama, for example, experienced a period of 10 years of drought (from 2006 to 2015) characterised by low rainfall and resultant low crop harvests that had an adverse effect on the food produced by her household. Although the actual years of national drought were 2008 and 2015, the period of 10 years, mentioned by Jill, during which her household experienced low rainfall and inability to produce adequate food, was related more to the semi-arid nature of Chaseyama. The context of her household also had a bearing on her ability to be productive in a semi-arid region. Jill was a single parent, grew about four crops, the harvest of which had not been good most of the time, and she did not have other livelihood activities or livestock except for a few chickens for household consumption. Jill mentioned the following coping strategies on which she relied during the drought years:

During the years of drought, my family has survived through receiving food aid assistance, buying and selling clothes locally and selling wild honey. This has ensured that my family has enough food to eat. (Jill, Life case-history interview, Chaseyama, September 2017).

Edson also described challenges that he faced in obtaining adequate food for his household. During a drought, his harvests usually lasted up to six months. The previous three drought years (1992, 2002, and 2015) resulted in very low rainfall that affected his harvests such that he had to rely on assistance for his food needs and also seed aid to replenish his seed stock. In some years, some of the seed received did not perform well in the field. In comparison with Jill, Edson was able to produce enough food during the non-drought years and, sometimes, even had some excess to sell. This could be related to the farming practices learned from his parents and the relatively large land area that they used (2ha).

Tabeth, a female farmer from Chaseyama, preserved and stored enough seed for two subsequent seasons at any given time. She relied on her own crop varieties for all her planting needs. Although she acknowledged that drought occurred frequently in Chaseyama and resulted in farmers losing their harvests, her drought-tolerant crop varieties had helped her household to harvest enough food for their requirements. She mentioned that:

My own crop varieties are very tolerant to drought especially sorghum, groundnut (*Zai ratimba*), bambara groundnut (*Zai redawa*) and beans (mung beans and *Karongoda*) while my finger millet variety needs to be planted during the early rainfall in order to develop well. I always need to take care when planting the finger millet. It should be planted before the first rains so that when the rains begin the seed is already in the ground. With that little rainfall it germinates and develops well. (Tabeth, Life case-history interview, Chaseyama, September 2017).

The cases referred to above showed the impact that drought had on households' access to seed and food. Some households were susceptible to drought conditions that resulted in their needing assistance to obtain food and seed for their immediate needs and future planting. Other households showed some resilience to drought conditions as they adopted coping and strategies of growing drought-tolerant crop varieties and complementing this with other livelihoods that were not based on crops (livestock and non-farm income). These alternative strategies were shown in Chapter seven to be strong determinants of access to food by the larger household sample. Other studies have noted the use of farmers' crop varieties that were tolerant to drought conditions and adapted to semi-arid regions (Progressio, 2009; Svodziwa, 2015; Oxfam-CTDT, 2016). These varieties have ensured that farmers are able to produce a good crop harvest under drought conditions.

8.5.5 Livelihood and Asset Options

Findings indicate that personal circumstances and attributes affect the ability of a household to obtain food. Roselyn's parents used to produce enough food for household use and extra for sales. They had high rainfall in Chikukwa and were hardworking in their fields. Her family had relocated to Chaseyama and food had been lacking for the previous two seasons, after being affected by ill

health. Before, they had been able to obtain enough food by using agricultural practices that enabled them to endure the drought conditions of previous seasons. This household's access to food was constrained by human capital (sickness and limited labour available), which affected Roselyn's ability to engage in effective farming activities and prevented her from farming all her land.

The weak asset base of some households (especially land and draught-animal power) constrained their access to food. Roselyn and Jill had small livestock (local chickens and goats) while Kevin did not have any. These households relied on other farmers for access to draught-animal power which put them at a disadvantage as they were given draught livestock when the owners had completed their ploughing and planting activities which was usually late into the season.

Kevin from Chikukwa claimed that his household's harvest usually was not sufficient for food, seed and sales. In addition to not having any livestock, his family had only two livelihood activities that were selling maize grain to the Grain Marketing Board and other farmers and selling yams locally. These sales depended on them harvesting sufficient produce, which was rare. The drought years made it more difficult for his household to produce sufficient food.

Nellie from Chikukwa struggled to sustain a livelihood. She and her husband had a piece of land approximately 0.5ha in size. Their other livelihood activities included rearing chickens and goats, working on other people's fields, and selling firewood. Their few livestock were for household consumption while selling labour was a seasonal activity which also took them away from their own fields. Discussions with her revealed that they struggled to obtain adequate harvests, which resulted in less produce being available for food and seed needs. During the drought of 1992, her family did not have any food at all from their production and relied on handouts. She said:

In my homestead, I have had cycles of adequate food and shortages of food over the years. The worst year was during the drought of 1992/1993 where I completely did not have any food but was assisted by handouts from neighbours. I have noticed that during the few years that I was able to get fertiliser I was also able to get a good harvest compared to the years without applying fertiliser. The main challenge I have

is the small piece of land area of half a hectare. (Nellie, Life case-history interview, Chikukwa, October 2017).

Accessing additional land had not been possible for them. Although they had a relatively small piece of land (0.5ha), Nellie rarely planted all of the field as she claimed that they were not able to keep enough seed for planting and it was expensive to purchase seed.

Leo, who could not access enough seed for his planting needs, relied on rearing small livestock (chickens and goats) and some remittances from children working in town. He also mentioned the effect of drought on his crop production and described his survival strategies as follows:

Though I source my seed from seed aid (sometimes) and purchases (from agro-dealers) this seed is rarely enough for my planting needs especially when I would need to replant due to a drought. To ensure that my household has enough food we rear and sell the local chickens and some goats. (Leo, Life case-history interview, Chaseyama, September 2017).

A comparison of the life histories of Leo and Nellie showed that they both kept small livestock, on which Nellie relied for subsistence needs, while Leo was able to sell some livestock and earn an income to purchase additional food requirements and also to purchase seed from agro-dealers. Some of Nellie's children were still at school and others were unemployed so she did not receive any remittances, while Leo received some remittances from his children who were employed in town.

Other studies have shown the positive benefits of livelihood assets for household food security, such as: livestock (Azzarri et al., 2014; Shively and Sununtnasuk, 2015; Flores-Martinez et al., 2016); social transfers (Bhalla et al., 2016; Burchi et al., 2016; Rohregger, 2017); and sources of income off-farm (Babatunde and Qaim, 2010; Mabuza et al., 2016). These livelihood assets are enablers to accessing seed and food as they tend to cushion households from the impacts of on-going shocks and stresses.

8.6 CONCLUSIONS

The relationship between seed security and household food security was examined in this chapter by placing farmers into seed security groups and categorising them by comparing their food security status. A comparison of mean scores and analysis of the variance of continuous food security indicators (HDDS, FCS and FIES) was carried out for all the farmer groups. The food security self-classification scale variables were used to substantiate findings where relevant.

The tests confirm that a strong and positive relationship exists between food security indicators and key seed security outcomes, such as having access to enough seed and overall seed quality (clean seed with germination of seed). Partial, but strong, positive relationships between some of the indicators of food security and temporal seed availability and seed germination were also observed. Positive correlations were observed between food security indicators and access indicators (based on income, ownership of assets and quantity of seed planted). These results demonstrate the similarity of the determinants of food security and those of seed security.

The only strong, but negative, relationship was observed between food security and spatial seed availability, indicating that households that were able to travel longer distances to access seed were able also to obtain food from those locations.

The household case histories provided evidence of the key enablers and constrainers of seed security and food security. These included seed production, preservation and storage skills, social capital, effects of weather and climatic shocks, and a household's livelihood assets. These factors have a clear bearing on the relationship between the seed security and food security characteristics of households.

CHAPTER NINE: DISCUSSION

9.1. INTRODUCTION

This chapter contains a synthesis and discussion of the findings of this study and relates them to the concept of seed and food security. The focus of the discussion is on the conceptual framework of food and seed security and how household-level determinants and broader contextual factors affect access to seed and food.

The relationship between seed security and food security is complex, yet critical for development practitioners and policymakers in implementing and recommending strategies that are useful for smallholder farmers. McGuire and Sperling (2011: 472) argue that there is a strong link between seed access and food access, although this has received little direct study. However, an increasing number of studies note the contribution of access to certain types of crops and varieties towards accessing food (Padulosi et al, 2009; Okello et al. 2017; Gill et al. 2013). This study adds to the body of knowledge by comparing seed security elements, such as seed availability, access and utilization, to understand the relationship between seed security and food security in the farming systems investigated.

A conceptual framework developed by McGuire and Sperling (2011) was used as the basis of the theoretical discussion of the relationship between the seed and food security of Chimanimani farming households with additional literature used to support the various findings. The conceptual framework of food and seed security is discussed in this section, followed by a comparison of this framework with the researcher's findings from Chimanimani.

9.2. CONCEPTUAL FRAMEWORK OF FOOD AND SEED SECURITY

In support of the food security and seed security framework espoused by McGuire and Sperling (2011), it is argued that the relationship between these concepts is not linear or simplistic, as has been assumed by humanitarian emergency responses. McGuire and Sperling (2011) argue that there are subtle and causal links between seed security and food security, such that insecurity in one does not necessarily reflect insecurity in the other.

Figure 2.4 showed a schematic representation of the relationship between food security and seed security. This is adapted from McGuire and Sperling (2011), who developed the concept to help humanitarian and development agencies appreciate the linkages better, so that they question their prior assumptions (e.g. that after a poor harvest there would be a shortage of seed). This framework is applicable also to acute (transitory) contexts of food price crises and other crises such as drought, flood, pest attack or market shocks (McGuire and Sperling, 2011). The framework does not apply to situations under chronic stress, such as political crises, repeated drought and non-functional institutions, which was a gap this research was intended to fill.

The framework was applied in the research undertaken in Chimanamani to determine whether food security was related to seed security. This was done by determining how the elements of seed security (i.e. availability, access and utilisation) were connected to food security.

9.2.1. Seed availability and food security

In this study, the effects of temporal and spatial seed availability were included to understand the relationship between food and seed security. McGuire and Sperling (2011) argued that, based on their field evidence, there was a weak correlation between acute food unavailability and seed unavailability because a small proportion of the harvest was needed to meet sowing needs for the subsequent season.

The findings of this study confirm that there are no significant associations between scores for temporal seed availability and those for most of the food security scores for farming households

(see Section 8.2.2). In other words, farmers who obtained their seed from different sources, on time or late, did not have observable differences in their food security status. A possible explanation for this is that the temporal difference of accessing seed, between farmers classified as late (from mid-season to the end of the planting season) and early (from before the planting season began to the start of the season), was not wide enough to affect planting time and productivity. The findings from Chimanimani thus confirm that, although temporal seed availability affects seed security, it does not have an impact on food security.

Other studies have shown that planting dates have an effect on plant height, head weight and grain yield of maize and sorghum (Tsimba et al., 2013; Ismail and Ali 1996; Beiragi et al., 2011). However, the time of planting and the intensity of the growth cycle depend on the region, weather and climate. As Mamombe et al. (2016) note, the onset and cessation dates of the rainy season in Zimbabwe are variable in time and space with the highest rainfall being experienced usually between December and February. This was pertinent to Chimanimani where the rainfall season has been erratic over the years.

A key finding from this research was that farmers who obtained their seed from nearby sources also had lower food security scores and more experiences of food insecurity compared with farmers who obtained their seed from sources further away. Although obtaining seed from nearby sources is advantageous for farmers, in terms of lower transaction costs and the timeliness of seed provision (Cromwell and Tripp 1994), there could have been missed opportunities to travel to other areas and thus access food that was not available locally. As noted from the focus group discussions, farmers from Chaseyama coped with drought and unavailability of food by travelling to more distant locations in order to purchase food for their families. This suggests a possible explanation for the correlation between sourcing seed from further away and food security. Those who were able to migrate to look for food or work were, thus, in a better position to obtain seeds from further away and, seemingly, had greater food security, while those who searched locally were less food secure (see Section 8.2.3).

It is possible also that “distant seed sourcing” might correlate with other factors that affect food security, such as having the income and resources to travel and purchase seeds elsewhere. The

ability to travel, itself, might indicate unmeasured aspects of capabilities (cash, health, the available time to go further afield, for example), which have a strong link to well-being and therefore food security. A key conclusion is that, as much as spatial seed availability is critical to reducing the transaction costs of accessing seed, on its own it is not sufficient to ensure access to food.

In combination, these findings suggest that the relationship between seed availability and food security is not straight-forward. The timeliness and proximity of seed should be understood in terms of how these factors affect seed availability on the one hand, and how they might or might not be related to accessing food, on the other. These findings imply that there are weak correlations between a lack of available seed and lack of food, confirming the findings of McGuire and Sperling (2011). Furthermore, the findings suggest that seed availability factors such as proximity and timeliness, while important for ensuring seed availability, do not have a direct relationship with food security.

9.2.2. Seed access and food security

In this section, the relationship between food security and seed access is examined by comparing food security outcomes of Chimanimani households with the farmers' cost of seed and access to assets and income. Studies have shown that access to food in rural settings is affected not only by decreased production, but also by loss of assets, lack of off-farm income, diminished purchasing power, and social marginalisation (McGuire and Sperling 2011; Mutea et al. 2019; Zhou et al. 2019). McGuire and Sperling (2011) argued specifically that poor access to seed of a given crop might not affect overall food security because farmers might switch to different crops or livelihood activities. By contrast, results from this study confirm that access to food and access to seed are not always driven by similar forces (see Table 6.5, Chapter six and Table 8.6, Chapter eight). The ability of farmers to switch to different crops and engage in alternative livelihood strategies is not universal. This was not applicable to the farmers in this study, who relied on a single season in a year (with few alternative crops for food security beyond staple cereals), when they planted their seed and expected a harvest that provided the bulk of their food. If the season were affected by drought or pests, this clearly would affect their produce for consumption and sale. For these

farmers, switching to different crops within a season was not easy, especially given their dependence on rain-fed agriculture, and challenges of access to alternative seed.

The farmers who perceived their seed to be expensive, compared with those who perceived their seed to be affordable, did not show any significant differences in their food security scores (see Section 8.3.1). This underlines the importance of understanding affordability and farmers' perceptions of the cost of seed. Agro-dealer data for Chaseyama and Chikukwa revealed that maize seed was more expensive in Chikukwa compared with Chaseyama (refer to Section 6.2.2), while more farmers from Chikukwa, compared with Chaseyama, mentioned that the seed they purchased was expensive. However, since farmers in Chikukwa were still able to afford to purchase the maize seed, the cost was within affordable limits. Overall, the impact of the relative costs of seed was minimal, since most (between 53% and 90%) of their seed was obtained through social relations (i.e. own seed, exchange with neighbours, relatives, etc.) that are usually free.

Similar results are evident in the literature. For example, a study on access to seed in Uganda revealed that the cost of seed can prevent potential adopters from purchasing and adopting improved crop varieties (Simtowe et al. 2019). In this case, farmers were willing to pay for seed at half the market price. Minot et al. (2007), Sánchez-Toledano et al. (2018) and Kaliba et al. (2018) argue that the price of seed is not the only issue, but rather a shortage of cash, access to information, learning costs, risk considerations, and the perceived advantage of the new variety. Clearly, it is important to consider the cost of seed in ensuring its accessibility to farmers in relation to farmers' economic circumstances and the relative cost of seed from non-commercial sources. The cost of seed alone cannot be linked to access to food by households and should be understood in terms of the actual cost as well as the relative cost in comparison with other seeds preferred and accessed by farmers in the seed system. There are thus many "hidden costs" to adoption, which lead farmers to be hesitant to invest in a "new" variety, regardless of how advantageous it might be to do so assuming adequate assets, insurance, and technical support).

In this research the question of whether indicators such as household assets and income were related to seed and food security was assessed. The findings showed positive correlations between food security indicators, and negative correlations with experience of food insecurity scores (see

Table 8.6). On the other hand, the relationship between these economic indicators and seed security was inconclusive. This was contrary to other research that has observed a strong relationship between access to seeds and ownership of household assets (see, for example, Asfaw et al. 2011; Shiferaw et al. 2008; Mesfin and Zemedu 2018). However, these studies focused on accessing improved seed from formal sources (such as certified seed, improved seed, commercial seed) where access was based on the ability to purchase the seed. In contrast, for Chimanimani farmers, most seed sources included self-provision and social networks, which were predicated on social relations. Also, the influence of non-governmental organisations on farmers' self-provision of seed and self-reliance in Chimanimani, brought about by uncertainties of commercial seed availability, was noted.

While having access to seed is important, utilisation of the seed must be considered also in understanding seed and food security. The link between seed utilisation and food security is discussed in the next section.

9.2.3. Seed utilisation and food security

This study investigated how the elements of seed quality, such as physical purity and seed germination affect food security. McGuire and Sperling (2011) contend that there are fewer linkages between food security and seed security along the utilisation/quality parameter. They argue that, although it is unlikely that problems of use of food would cause problems for seed security, unfamiliar or sub-optimal varieties and poor seed quality might affect food production and ultimately food security.

Results from this study showed higher and significant differences in the food security scores of seed-secure households (in terms of germination and physical purity) compared with those that had reduced seed security (see Table 8.9). Thus, there was a direct relationship between the quality of seed and food security, particularly when considering both physical purity and germination. The results revealed that the quality of farmers' seed was essential to ensure that farmers acquired adequate food from their production. Quality seed would lead to a healthy crop that would ensure better crop yields, provided there is adherence to other, complementary measures of crop

production. This concurs with McGuire and Sperling (2011), who argued that inferior seed quality can depress yields and reduce food production. These findings have been corroborated by other researchers in the region. Shikuku et al. (2019), for example, in their study in Tanzania, showed that households that had increased access to high-quality planting material of orange-flesh, sweet potatoes had a reduced likelihood of having to sell their assets to bridge the food shortage gap, because they were able to produce adequate quantities for consumption and selling. Similar findings were also shown by Roy (2014), Chindi et al. (2017) and Okello et al. (2017) in Kenya, Ethiopia and India, who demonstrated that use of quality and clean planting materials translated into increased productivity and, subsequently, increased income for those participating in the market through sales.

The findings from this study are thus in agreement with those of McGuire and Sperling (2011) and other literature (Shikuku et al 2019; Okello et al 2017) that suggests there is a direct relationship between seed quality and food production and, ultimately, food security. The ability of farmers to access and maintain high-quality seeds is clearly critical to ensure better crop establishment and higher yields for provision of food for farmers' households and income from sales (Madanzi et al., 2007; Ngwenya et al., 2016). The results of this study reveal also that some farmers' practices of seed preservation and storage are adequate to ensure the attainment and maintenance of a comparable seed quality with that of certified seed from commercial channels.

A central conclusion is that, as consideration proceeds from availability, to access and utilisation, the relationship between seed security and food security becomes more evident. This suggests the importance of policy interventions that enable farmers to move beyond wider seed availability, to ensure that they are able not only to access the seed, but also to utilise it to obtain better crop productivity. Having considered the different elements of seed security and how they relate and interact with food security, the effects of household factors on seed and food security are considered in the next section.

9.3. HOUSEHOLD-LEVEL DETERMINANTS OF SEED AND FOOD SECURITY

This in-depth research into the circumstances and practices of farmers in Chimanimani has revealed more complexity in the interactions between seed security and food security than that presented in the framework developed by McGuire and Sperling (2011). As the above discussions have demonstrated, the relationship between seed security and food security is not straightforward, especially when considering the different elements of seed security (availability, access and utilisation). This section explains how household characteristics have a bearing on enabling or constraining seed and food security with the focus on farming practices, households' asset portfolios and the agro-ecological characteristics of the two case studies of Chaseyama and Chikukwa.

9.3.1. Farming practices

Different farming practices were observed between households in terms of the harvested quantities of seed, the number of different crops grown, specialisation in seed production and the length of time spent farming by households.

Households with higher levels of food security harvested significantly higher cereal and legume quantities ($p < 0.05$) compared with less food secure households (see Table 7.16). This emphasises the important contribution of own-crop production to accessing food at household level. A study by Matshe (2009) in sub-Saharan Africa showed that the level of cereal production was a significant factor in addressing food insecurity. Similarly, the FAO (2019b) and the Zimbabwe Vulnerability Assessment and Analysis Report (ZIMVAC, 2019) revealed that sharp drops in cereal production in Zimbabwe were related to the worsening food security status in addition to spikes in staple-food prices. The ZIMVAC (2019) study showed further that own production was the main source of cereal consumed by 51% of rural households in Manicaland, the region that includes the study area. This shows the important contribution of own production to food consumption at household level. For farmers relying mostly on own-seed provision, crop production addresses immediate food needs and also provides seed for future planting.

As expected, households with lower seed access grew fewer crops compared with those with more secure seed access. This has implications for the seed available for the subsequent season, food diversity and options for selling. With less crop diversity, farmers have reduced food diversity, and less seed diversity to keep and grow for the next planting season. Li et al. (2009) and Njeru (2016) note that a diversity of crops grown in a season provides opportunities for farmers to have excess produce for household food needs, seed for the next planting season and for exchange with other farmers. This was equally applicable to Chimanmani farmers who had higher harvests of cereals and legumes as well as reliance on their own seeds compared with purchases.

Recent studies by Ickowitz et al. (2019) and Bellon et al. (2020) substantiate these findings by showing that crop diversity is beneficial for smallholder farmers as it is associated with self-consumption and increased income. Increasing crop diversity at household level thus provides access to greater food diversity and leads to market opportunities. However, based on their studies across Malawi, Niger and Zambia, Asfaw et al. (2019) caution that the impact of crop and income diversification can vary across countries, diversification strategies and individuals' socio-economic status. This finding suggests that crop diversity as a strategy is very context specific and is not always positive for all farmers.

This research revealed that farmers who were able to segregate seed and food plots were able to produce sufficient quantities of high-quality seed for multiple uses. This was made possible by having adequate land and by participating in seed production-based interventions. These households were also likely to produce adequate food for their needs. Previous research has revealed the benefits of having separate seed plots to ensure a constant supply of seed of adequate quality. Almekinders and Louwaars (2002), for example, noted that farmers in the Andes produced seed in separate fields, often with more favourable soil, water or disease conditions. This was also witnessed by Ndjeunga (2002) and Singh et al. (2013), who showed the importance of seed production in ensuring the availability of high-quality seed and enhanced productivity for pearl millet and pulses. Although all farming households cannot be expected to be seed producers, the presence of seed producers in a community does contribute to the availability seed of locally adapted crop varieties than can be shared, exchanged and sold.

The length of time that households had farmed was also found to be related to food security. More food-secure households were associated with more years of farming by the head of the household. Years of farming is connected to the experience gained in farming practices as well as knowledge of biotic and abiotic stresses and how to mitigate them. These findings concur with studies by Kuwornu et al. (2012), Anim et al. (2016) and Onasanya et al. (2016), who reported that experienced farmers have more insight and ability to diversify their production and minimise the risk of food shortage. In contrast, Amaza et al. (2009) and Ngongi and Urassa (2014) warned that the effect of farming experience on productivity and production can be negative later in life, owing to ageing or a reluctance to change from old and familiar farming practices and techniques. In conclusion, farming practices clearly contribute significantly to households' seed and food security, which indicate the importance of linking seed elements (availability, access and utilisation) to farming practices in order to enhance seed and food security.

9.3.2. Household assets portfolio

The evidence from Chimanimani shows that a household's asset portfolio provides a critical base and back-up in ensuring that households that are seed secure can be food secure in a context of stresses and shocks. Some of the household assets that farmers use to ensure their resilience include human (physical health and access to labour), natural (access to, and use of, adequate land), economic (livestock and income sources) and social assets (social relations and networks). Households with ill health and inadequate labour were constrained in terms of their ability to engage in productive farming. These constraints directly affected farmers producing their own seed and food crops and, thus, own-food production. Silvestre et al. (2015) showed that labour availability was an important determinant of household agricultural production and food security, especially in subsistence-oriented households, typically with small farms reliant on unpredictable rainfall. This was applicable to Chimanimani households with small farms (less than 2 ha) that relied on rain-fed agriculture.

The natural assets cited by farmers included access to, and utilisation of, adequate land. Some farmers could not access adequate, arable land for productive farming. This resulted in their maintaining subsistence levels of food production. The ability of farmers to manage seed and food

plots and crop diversification was related to farmers having access to land of adequate size to enable such differentiation. Studies have shown that food-secure households tend to allocate more land to different types of food crops as well as cash crops as they own larger sizes of land (Jayne et al. 2003; Silvestre et al. 2015). Jayne et al. (2003) argue that in Southern and East Africa, growth in agricultural productivity is constrained primarily by farmers' limited access to land, as well as other resources, which was a constraint evident also in this research.

The main economic assets mentioned by households were livestock and alternative income sources. Possessing large livestock ensured that farmers had draught power for conducting their field operations in time for crop production and for farm transportation. Farmers with small livestock such as goats and chickens benefited from consumption of products from these livestock, while others were able to sell, and earn an income, that was used for purchasing additional food and seed. Related to this, farmers with alternative income sources (farm, non-farm and off-farm) tended to be more able to access food for their needs.

The social assets of households had a bearing on sustaining their seed and food security. Social assets, or capital, refer to the resources that are at the disposal of communities and individual farmers through their relations of trust, reciprocity, obligations, kinship and understanding of one another (Gotschi et al., 2008; Adepoju et al. 2011; Rodier and Struik, 2018). Chimanimani farmers with strong social ties and networks had access to good crop varieties, skills and knowledge in food production (see Section 8.5.3). The social ties were with other farmers, neighbours and relatives. Such ties provided an important avenue for farmers to obtain local crop varieties with known quality and characteristics such as drought tolerance, nutrition and culinary advantages. MacGonagle (2007) in her study of Chimanimani and Mozambique, affirmed that social networks were strong amongst the Ndaou people based on historical, cultural and kinship ties. MacGonagle (2007: 69) argues that:

The Ndaou shared common social and cultural traits over several centuries that contributed to the emergence of a sense of “Ndauness”. Social structures and cultural practices related to totems, marriages, births, and deaths served to bind the Ndaou together across southeast Africa.

A large body of literature shows that social relations are essential in mediating seed exchanges and seed flows among kin, for example, through seed gifting during marriage ceremonies and other traditional, family-centred agricultural activities (Stromberg et al., 2010; Sperling and McGuire, 2010b; Ricciardi, 2015; Labeyrie et al., 2016; Thomas and Caillon, 2016).

Inter-generational knowledge transfer has enabled the passing on of knowledge and skills in seed management and food production throughout Chimanimani households. This has benefits of access to seed and food for farmers who have these social connections. Van Niekerk et al. (2015) noted similar phenomena in South Africa, where the knowledge and skills of family farmers were passed from generation to generation, preserving and improving their practices and technologies that supported agricultural sustainability.

In this section, it has been shown that a household's asset portfolio is essential in accessing seed and food. The assets go beyond the traditional, economic assets of livestock and income sources, and also include the physical health of the households, social relations and social networks. These need to be framed as part of the wider determinants of access to seed and food.

9.3.3. Local geographical characteristics

Geographical characteristics were analysed by comparing Chaseyama and Chikukwa households. Half of the food security indicators revealed that Chikukwa households had significantly higher food security scores compared with Chaseyama households (see Section 7.6). In particular, Chikukwa households, on average, had a higher dietary diversity score and fewer food insecurity experiences in comparison with Chaseyama. However, the households from these locations showed similar food security characteristics in terms of frequency of food consumption and perceptions of being food insecure.

These results could be explained partly by the geographical and agro-ecological characteristics of Chikukwa and Chaseyama on the one hand, and by their livelihood strategies on the other hand. Chikukwa is a high-rainfall region (at 1000 mm per annum) with cooler temperatures (mean annual

temperature ranges of 15-18 °C) (Mugandani et al., 2012; Oxfam-UNDP/GEF, 2015). These households owned 1.8 ha of land, on average. Chaseyama on the other hand, is characterised by a semi-arid environment with higher temperatures (mean annual temperature range of 18-24°C), low rainfall (300-450 mm per annum) and shallow, infertile and rocky soils (Mugandani et al., 2012; Mashapa et al., 2013). The households sampled from Chaseyama had access to 2.3 ha of land, on average.

Another key difference is the terrain. Chikukwa is hilly and undulating which makes it difficult, if not impossible, to use an ox-drawn plough to till the land. Moreover, the grass and type of vegetation (sour veld) in Chikukwa is not suitable for keeping goats and cattle. This explains why fewer numbers of livestock were owned in Chikukwa. Chaseyama, on the other hand, has a sweet veld conducive to farming with livestock, while its terrain is flat. These agro-ecological differences result in nuanced differences in terms of the sources of food available to the farmers in the two locations. The sources of food for Chikukwa households were mainly field crops, vegetables and fruit production, related to the agro-ecological conditions and farming practices prevalent in this area. Although Chaseyama households (21% of farmers) mentioned similar food sources, the percentages of farmers were less in comparison with Chikukwa (72%), while most from Chaseyama (58%) relied on food purchases compared with those in Chikukwa (35%). Crop farming in Chaseyama was less productive compared with Chikukwa. These findings showed the importance of agro-ecological factors in influencing the types of crops grown (which was related to the seeds available) and the ways in which households acquired their food types from different sources.

The above differences manifested in different seed-security and food-security outcomes. Chaseyama households utilise drought-tolerant crop varieties (mostly from their traditional crop varieties and farmers' varieties) that are resilient to moisture and heat stress, such as small grains. The benefits for farmers of diversifying towards more drought-tolerant alternatives, such as local small grains and drought-tolerant maize, have been noted in the region (Mavhura et al., 2015; Oxfam-CTDT, 2016; Lunduka et al., 2019). The semi-arid location of Chaseyama households, and the resultant low crop yields under rain-fed conditions, meant that these households have adapted

various strategies with regard to their production of food and access to food. They have also engaged in livestock farming, sales, and food purchases in order to meet their food needs.

For Chikukwa households, their agro-ecological context provides a suitable environment for diversified crop production of large quantities and diverse food for their needs. This results in a higher dietary diversity and lower instances of food insecurity. Studies have noted the benefits of diversified crop production, such as diverse diet and/or improvement in household income and nutrition at household level, and climate resilience and ecological sustainability on a broader level (Njeru, 2013; Mango et al., 2018). Mango et al., (2018), in particular, showed from their study in Malawi that households with higher levels of crop diversification also had more diversity in terms of the food crops that were consumed within the households, and had lower levels of food insecurity in comparison with those that had relatively lower levels of crop diversification.

In this section, the emphasis was on the importance of considering the geographical and agro-ecological characteristics of farming households, which affected the types of crops grown and food sources available, which, ultimately, characterised the relationship between seed security and food security.

9.4. BROADER ASPECTS OF SEED AND FOOD SECURITY

The findings of this research reveal that it was not only the seed security elements (of availability, access and utilisation) and household-based determinants that affected the relationship between seed and food, but also the wider contexts in which households found themselves. The households in Chimanimani do not exist in a vacuum. They constantly interact with, and are molded by, a broader context that is shaped by their historical roots on the one hand, and the present and evolving environment to which they are exposed. The historical issues relate to how households have experienced and been affected by government action and agricultural policies in the past and present. The critical factors that were identified as having had a bearing on the seed and food security of Chimanimani households were the socio-economic and political context, and the effects of the weather and climate.

9.4.1. Socio-economic and political factors

The ability of smallholder farmers to meet their seed and food requirements must be understood in the context of the broader historical trajectory of Zimbabwe's agricultural development. Within this broader framework, the political and socio-economic environment has played a key role and continues to be highly influential. The critical elements include the political environment, socio-economic factors, policy-related interventions, and the relationship between commercial and farmers' seed systems. Although these factors are all inter-related, they have been discussed individually to show the influence that each have on the ability of smallholder farmers to access seed for their planting needs and, ultimately, food.

Political instability in Zimbabwe has been a constant factor since the ruling party, Zimbabwe African National Union Patriotic Front (ZANU PF), took office and sought to maintain power at all costs (Lupahla, 2018). ZANU PF control has been intensified over the years, with the international community responding by imposing economic sanctions that have plunged the nation even further into economic collapse (Hove, 2012). The period between 1999 and 2008 has been called the "lost decade of development" because it was characterised by Zimbabwe's economy losing approximately 52% of its Gross Domestic Product (Kanyenze et al., 2017). Although this historical course of events might not be related directly to seed and food, its impact on the economy and nation of Zimbabwe influenced the agricultural economy and, ultimately, seed and food security. Below, the influence of the politics on the economy, agriculture and access to seed and food is further explicated.

The World Bank initiated an Economic Structural Adjustment Programme in the 1990s, which compounded the situation by restructuring government activities and reducing expenditure. This resulted in reduced, short-term credit as well as reduced budgets for agricultural research and development, which stifled support for smallholder farmers (Marquette 1997; Leiman and Behar 2011). Rural households in Zimbabwe were affected by reduced remittances from urban areas as people were retrenched and lost their incomes (Potts and Mutambirwa, 1998). This led to the adoption of subsistence forms of agricultural production and resultant food insecurity. FEWSNET

(2007) and CIAT et al., (2009) have noted the negative impact of the socio-economic melt-down, market failures and political chaos on accessing commercial seed in Zimbabwe.

Related to the political and economic distress in the country, the nation experienced an increased and protracted period of food and seed aid through the government, multi-lateral organisations and non-governmental organisations (NGOs) (Munyanyi, 2005; Rohrbach et al., 2005; Mutonodzo-Davies, 2010; Government of Zimbabwe, 2013b; Mudzingiri and Chidoko, 2014; Chinyoka, 2017). This assistance was related also to the incidence of drought experienced in the country. The food- and seed-aid interventions manifested at local levels through annual food aid in Chaseyama and annual seed aid in Chikukwa. Seed aid in Zimbabwe increased access to seed of hybrid varieties, which benefited well-resourced households in high-rainfall areas compared with under-resourced households in semi-arid locations (Chiduza et al., 1994; Pixley and Banziger, 2001).

Agricultural policies in Zimbabwe have contributed to shaping access to specific crops and seed types over the years. Before national independence, the former, minority government promoted the selling and growing of hybrid maize and banned the use of farmers' own varieties (in Chimanimani, and nationally). This was a strategy to increase agricultural production and food for the growing urban population. This enforcement continued after independence until the 1990s, leading to the widespread use of hybrid varieties (Cromwell, 1992; Zerbe, 2001). Overall, this policy framework reduced the crop and seed diversity that was possible through farmers' provision of own seed and affected overall seed security because most households had to purchase expensive seed, sometimes not suited to their farming environment. Other studies have noted the negative effects of agricultural policies that did not support the exchange of farmers' crop varieties (Cromwell, 1992; Zerbe, 2001; Leiman and Behar, 2011). Zerbe (2001), specifically showed that the agricultural policies in Zimbabwe since the 1990s led to the saturation of the maize seed market with hybrid varieties by banning the sale of open-pollinated varieties.

The seed industry in Zimbabwe is well developed with 24 seed companies supplying mostly hybrid maize, soya and cotton seed, with intermittent production of small quantities of seed for legumes and small grains (Mwashaireni, 2019). The industry produces between 30 000 tons and 40 000 tons of certified maize seed per year that met the nation's formal demand for maize seed (Mujaju

and Jonga, 2014; Mwashaireni, 2019). Since the 1990s, Zimbabwe has been a significant seed producer and a key exporter of seed to the region, owing to its strong seed sector, through the Seed Services, the Crop Breeding Institute (CBI) and private-sector seed companies (Fintrac, 2016). However, over the past 20 years, the seed industry has experienced a series of challenges and almost shut down, resulting in shortages of certified commercial seed. These challenges included the unfavourable policy/regulatory environment during the period between 2005 and 2008 and the period during 2000 after the fast-tracked land resettlement programme, when the industry was a net importer of certified seed, mostly from South Africa, Zambia, Malawi and Netherlands (CIAT et al., 2009; Muto nodzo-Davies, 2010; Leiman and Behar, 2011; ACB, 2016). Given the cyclical nature of political and economic instability in Zimbabwe, it is likely that the commercial seed system will continue to be vulnerable and face challenges in meeting national seed requirements.

With the exception of maize, the commercial seed system has played a peripheral role in the supply of seed to the majority of smallholder farmers in Zimbabwe. A limited number of crops are sold via the seed companies and agro-dealers. As found in this research (Section 5.3.4) all agro-dealers who were interviewed stocked maize, while only two out of 12 stocked cowpeas, sorghum and groundnuts in limited quantities. Moreover, their outlets were located far away from farmers. With the exception of South Africa, this situation was similar in other countries in the region such as Zambia, Malawi and Tanzania (Chinsinga, 2010; ACB, 2016; Sisay et al., 2017; ACB, 2018; Westengen et al., 2019).

Farmers' seed systems, on the other hand, have shown temporal resilience in their ability to ensure seed access to smallholder farmers, contributing to outcomes of dietary diversity, food security and access to income (Nathaniels and Mwijage, 2000; Mayes et al., 2012; Gill et al., 2013; Chindi et al., 2017). Other studies have shown the resilience and capacity of farmers' seed systems to continue to provide diverse and adapted varieties despite national seed laws that were biased towards the commercial seed system and the growth and expansion of certified seed (Eicher, 1995; Almekinders, 2000; Visser, 2015; Herpers et al., 2017).

In this section, the wider influence of factors in the broader contextual environment has been shown in the form of political and socio-economic policy in the relationship between the

commercial and farmers' seed system. These factors have been shown to have a historical and on-going impact on access to seed and food security. Although these factors typically were beyond the control of smallholder farmers, it is important to analyse and understand them in order to determine what policy interventions might be useful in attaining sustained seed and food security.

9.4.2. Effects of weather and climate

The influence of weather and climate, and the adaptation by households, has had a clear bearing on the outcomes of seed and food security. The location of farmers in Chaseyama and Chikukwa has exposed them to different weather and climate-related hazards, and farmers within the same location have been affected differently by the same atmospheric conditions. Chaseyama is a semi-arid area with a long history of drought periods. As a result, NGO food aid assistance has been common, and households often cope by travelling to other locations to purchase food. Such households have preferred to use small grains and varieties that are drought tolerant. The in-depth life histories (Section 8.5.4) have confirmed that most farmers in Chaseyama have experienced droughts several times in the past.

Chikukwa, on the other hand, is rarely affected by drought, receiving an average 1000 mm of rainfall annually, but severe cyclones and flooding have had a severe impact on farmers' crop production. Government seed aid has frequently targeted this area with hybrid maize varieties and fertilisers. Although some households are seed-secure, hazards and natural disasters such as cyclones have had a negative impact on their ability to produce food, especially during the cyclones of 2000 and 2019.

Given the impact of climate change, weather and climatic shocks are likely to increase in frequency, intensity and magnitude (Vizcayno et al 2014; Westengen et al, 2019) and this will have an impact on the seed and food systems of smallholder farmers on an ongoing basis. Climate change affects agriculture through an increased likelihood of erratic rainfall, altered seasonal weather patterns and a more frequent occurrence of adverse weather events, floods and droughts (Mijatovic et al., 2013). The farmers who have adapted their seed strategies to the effects of these shocks are more likely to be seed-secure and to produce sufficient food from their own production.

Research is showing increasingly that practices that strengthen resilience to climate change include crop diversification, adjustment in agricultural practices and use of species that are resistant to abiotic stress (Progressio 2009; Mijatovic et al., 2013; Vizcayno et al., 2014; Svodziwa, 2015; Vernooy et al., 2017). Farmers interviewed attested that possession of certain drought-tolerant, local varieties of maize and finger millet ensured that they had some yield even during drought years. The agronomic practices that enhanced their production during periods of weather-related shocks included water harvesting and soil management (minimum tillage, use of organic matter and erosion control), which improved the productive potential of the land and optimised water use.

9.5. THEORETICAL CLASSIFICATION OF SEED SECURITY IN RELATION TO FOOD SECURITY USING QUADRANT TYPOLOGIES

The discussions in the previous sections brought to the fore that households are not necessarily in the same situation in terms of access to seed and food. They are affected differently by seed-security elements (availability, access and utilisation), household characteristics and broader contextual factors. As a way of illustrating the different, and evolving, circumstances of households in terms of seed security and food security, a diagrammatic quadrant has been used to compare seed security with food security (Figure 9.2). As these conditions are not static and allocating any particular household to a specific quadrant is not always straightforward, the quadrants serve to provide a pictorial view of the possibilities of seed- and food-security situations. The arrows serve to illustrate that the classifications are in constant motion because farmers might be in transition or oscillating between classifications, depending on their circumstances at any given time.

Drawing on the findings in Chapters six and seven, households that are **secure in their seed and food requirements** (Quadrant 1) represent the optimal level of interaction between seed and food security as they meet household food requirements all the time and have adequate seed and planting materials for their needs. Their seeds (from all seed sources) meet requirements for food, socio-cultural and economic needs. These households show a strong relationship between their seed and cropping patterns and their food provision (i.e. a strong, own-crop, production-food-provision pathway). For these households, their specific household determinants of seed and food

security and wider contextual factors, such as weather and climate, geographical position and the socio-economic and political environment, enable them to access seed and food for their needs. The households in Chimanimani with such a description were seed secure in terms of accessing quality and affordable seed on time in proximity to them. In terms of seed security these constitute the households in cluster one under seed availability (Table 6.1), cluster one under seed access (Table 6.2), and cluster one under seed quality (Table 6.3). In terms of food security, these households had higher scores in their dietary diversity, food consumption scores and had less instances of experiencing food insecurity.

Households that are **seed-insecure but food-secure** (Quadrant 2) have adequate food for their needs but are constrained in terms of their needs for seed. Their sufficiency in food might not be through on-farm crop production, which would require that they be seed-secure. Households positioned in this category are not strongly reliant on the own-crop, production-food-provision pathway as they have other, alternative sources for food security (such as livestock, social transfers and non-crop-based income sources). Seed insecurity for farmers in this category includes seed that is poorly adapted to their environment, inferior-quality seed, seed that is too expensive (low score on seed access) and seed that either is received too late or is too far (low score on seed availability). The household determinants and contextual factors thus support access to food but not access to seed.

	Food secure	Food insecure
Seed secure	1: Secure in food and seed requirements - Strong relationship between seeds/cropping patterns and food provision. - Strong assets base, adapted to the weather and climate, geographical and agro-ecological environment, in tandem with their farming system.	3: Secure in seed, constrained by food - Weak relationship between seed access and food access. Constraints to crop production beyond seed (e.g. lack of other inputs such as land and labour). - Impacted by drought, lack of alternative livelihoods, weak assets base.
Seed insecure	2: Adequate food, constrained by seed - Weak relationship between seed access and food access. Constraints mostly crop-production (seed) based. - Contributors to food security are non-crop based such as remittances, off-farm income and livestock production.	4: Inadequate seed and food - Weakest relationship between seed and food security - Impacted by shocks such as drought, lack of alternative livelihoods, weak assets base, and unfavourable socio-economic and political environment.

Figure 9.1: Household typologies of seed- and food-security status

A third category of households is those that are **seed secure but food insecure** (Quadrant 3). They have what they need for crop production (seed inputs in particular), but this does not translate into household food security. Such households have many non-seed-related constraints that affect their crop production. These might include insufficient inputs, drought or a lack of alternative livelihood sources. Some households have inadequate arable land, or large family sizes to feed with limited income sources. For these households, in contrast to Quadrant 2, their household determinants and contextual factors favour access to seed and not access to food. Quadrant 2 and 3 are represented by Chimanimani households that were classified as the ‘diverse’ cluster in terms of seed availability (Table 6.1) and seed access (Table 6.2). Quadrant two households would have adequate food while quadrant three would be food insecure.

Quadrant 4 contains households that can be classified as **insecure in terms of both their seed and food requirements**. They lack secure access to adequate-quality seed which is the basis of useful

crop production and are also food insecure. Seed insecurity can manifest in terms of low seed availability (timeliness or proximity), low access (affordability) and low utilisation (low seed quality). Seed insecurity can cause food insecurity if the households are highly dependent on own-crop production for their food needs, because seed is a vital input. This is more prevalent if the household does not have other assets and means of livelihood to access adequate food. These farmers' household determinants and contextual factors contribute to constraining their access to seed and food. With respect to Chimanimani households, these were characterised by low access to affordable seed (due to the perceived expense of the seed) that was accessed far away and accessed late. These households were represented by cluster 2 under seed availability (Table 6.1), cluster 2 under seed access (Table 6.2) and cluster 2 under seed quality (Table 6.3). In terms of food security, these households had lower scores in their dietary diversity, food consumption scores and had more instances of experiencing food insecurity.

The implications of these findings are significant. Farmers do not become seed secure and food secure through simple provision of seed and food assistance. One needs to consider their seed sources ensures seed access and how they obtain adequate food. The relationship between access to seed and access to food is not always evident or strong. An important conclusion is that household and contextual factors need to be analysed and understood based on the individual farmers as these factors impact on the ability of attaining seed and food security.

9.6. DIAGRAMMATIC PRESENTATION OF THE RELATIONSHIP BETWEEN SEED SECURITY AND FOOD SECURITY

Figure 9.3, below, shows a graphic summary of the relationships between seed-security and food-security components. The figure is composed of the seed- and food-security quadrants, from Figure 9.2, overlaid by the determinants and factors of seed and food security. The inner circle contains the dimensions of availability, access and utilization, which are the elements of seed and food security. Borrowing from the framework of McGuire and Sperling (2011), these elements are the primary building blocks in understanding the interaction between food and seed security. Using the indicators of seed security (such as proximity, timeliness, seed adequacy, affordability, seed physical purity and germination) and food security (household dietary diversity score, food

consumption score, and food insecurity experience scale), makes it possible to classify households into those that are either secure or constrained in terms of seed and food security at a particular time. The four quadrants represent these. While this illustration represents a starting point in understanding and categorising households as a basis for unraveling the constraints in accessing seed and food, it is important to note that it is limited in helping to understand the underlying factors involved and the determinants of seed and food security.

To address this limitation, it is necessary to identify household-level factors and broader determinants influencing seed security and food security. The connecting lines in the diagram serve to cluster the household-level factors together, while the broader determinants are located outside these lines, showing that they are macro-level factors. The household-level indicators (designated by the oval shapes) include the asset portfolio (such as human, natural, economic and social capital), farming practices (such as level of crop production, crop diversity, differentiated seed and food plots, and length of time spent farming) and geographical characteristics (such as agro-ecology, natural hazards and differential attributes). These household-level indicators comprise the immediate local environment of farming households that impact their access to seed and food.

The two outer triangles represent broader contextual factors such as the weather, climate and the socio-economic and political context (which influences and is impacted by policy and regulatory aspects). These broader contextual factors are not snapshots, but rather are a culmination of a historical trajectory that has shaped and continues to affect households over time and space.

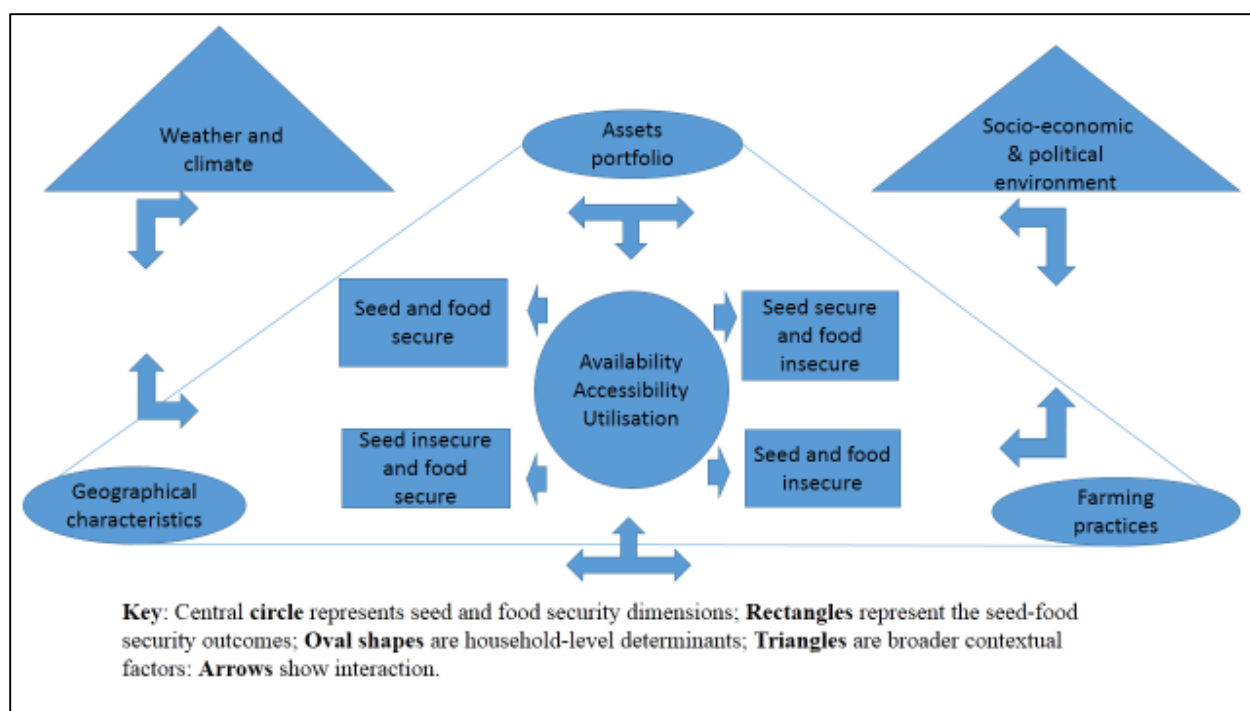


Figure 9.2: Determinants and factors of seed and food security

The arrows across the household factors and broader determinants serve to illustrate that these enablers and constrainers of seed and food security are not static, but also interact with each other in complex ways to determine seed- and food-security outcomes.

It is argued that the dimensions of seed and food security (i.e. availability, access and utilisation) are grounded in the determinants and factors of seed and food security. The extent to which a farming household is secure in terms of availability, access and utilisation, depends on how the household factors and broader determinants interact with each other and the household, either as enablers or constrainers. While farming households are to a limited extent in control of the household-level determinants, broader contextual factors are beyond their control.

It could be argued that farmers who have household-level factors working in their favour are more likely to be able to adapt to a harsh contextual environment compared with farmers whose household-level factors are constraining. For example, a household with an asset portfolio characterised by access to adequate labour (human capital), land (natural capital), livestock (economic capital), and good farming practices (such as crop diversity and longevity in farming)

increases the likelihood of them being able to attain seed and food security, even in a context of drought and national economic challenges. On the other hand, households could experience these same factors as constrainers. For example, households located in marginal and semi-arid locations, susceptible to frequent droughts or flooding, are more likely to struggle in crop production which will have an impact on their self-provision of food. Weak access to household assets, social marginalisation, and a socio-economic melt-down, coupled with market failures would further compound their vulnerability to food and seed insecurity.

Thus, the overall model does not contradict the framework of McGuire and Sperling (2011) *per se* but builds upon it by highlighting the household and contextual factors that are critical in enabling or constraining attainment of seed and food security. While the development of this model was based on case-study research in Chimanimani, Zimbabwe, it has wider implications for countries that share similar contexts, as well as for assessment methodologies. In this regard, it is proposed that assessments of seed and food security should move beyond considering availability, access and utilisation indicators, which are a good starting point, to consider also household-level determinants and the broader contextual factors that either constrain or enable households to attain seed and food security. This would ensure a deeper understanding of the constraints that farmers face and assist in designing appropriate interventions that would contribute to meeting their seed- and food-security needs.

9.7. CONCLUSIONS

In this chapter the key findings from this research were discussed and related to the broader literature about seed systems and food security. The findings were organised into themes and interpreted with reference to the seed and food security conceptual framework of McGuire and Sperling (2011).

A conceptual framework was developed to interpret these findings. Seed and food security have similar dimensions of availability, access and utilisation, which are the main indicators for classifying households in terms of their seed and food security status. However, they do not explain how and why households differ in their access to seed and food. The quadrants of seed security-

food security typologies serve to differentiate the households into four, broad, seed security and food security categories, at a particular time, based on their household characteristics and how they interact with, and are influenced by, broader contextual factors such as the weather and climate, and the wider socio-economic and political environment.

Scholarly research about the relationship between seed security and food security is still emerging and is essential in understanding the interactions of households' seed systems and their ability to obtain adequate food. This study contributes to this evolving body of knowledge by using empirical evidence to test research findings within the context of household-level determinants and broader factors that have an impact on seed and food security. This context provides the reasons for how and why households differ in their access to seed and food. While a few researchers have attempted to understand the interaction between seed and food security, most studies have been more narrowly confined to the seed- and food-security elements of availability, access and utilisation.

The findings of this study reveal that the relationship between seed security and food security is complex, multi-dimensional, and not always linear. Seed security does not necessarily equate to food security, nor does seed insecurity necessarily equate to food insecurity. These findings are contrary to the assumptions of humanitarian and development actors who promote interventions based on seed provision as a linear path to ensuring better food access. Thus, the use of existing food-security assessments to extrapolate seed insecurity of households has some critical flaws.

It is necessary for planners and implementers of development programmes that use seed-related interventions to address food-security constraints to understand that seed provision will not result directly in the attainment of food security, and also might be counterproductive by disrupting farmers' seed systems. Farmers' seed systems are located beyond the seed itself and are affected also by household and contextual factors that interact constantly either to strengthen or to weaken farmers' access to seed and food. This research is intended to help in designing specific, support policy initiatives that enable farmer-led seed systems to work for their well-being in the long term.

CHAPTER TEN: CONCLUSIONS

10.1. INTRODUCTION

The purpose of this study was to understand the links between seed security and food security in order to determine policy interventions, as well as the implications of smallholders' seed security strategies for improved food security. The areas of Chaseyama and Chikukwa in the Chimanimani District, used as case studies, were selected according to contrasting weather, soil, agro-ecological conditions and infrastructural characteristics. These study sites provided a wide range of ecological and climatic characteristics that were representative of the two extremes of agro-ecological zones found in Zimbabwe.

Using a case study methodology, empirical research was conducted with qualitative and quantitative data collected to: a) examine the seed-security status of smallholder farming households; b) characterise their household food-security status; c) assess the relationship between household-level seed security and household-level food security and the extent to which seed security contributed to food security; d) contribute towards a conceptual framework that links seed security and food security; e) determine implications of policy for smallholders' seed strategies for improved food security in the Zimbabwean context and beyond.

10.2. SEED SYSTEMS AND SEED SECURITY

The findings of the study showed that Chaseyama farmers used fewer seed sources (most using three or less) compared with Chikukwa farmers (most using at least four sources) and also had lower cropping diversity (three crops, on average, compared with five) during the 2016 - 2017 cropping season. The results of the household survey showed the dominant role played by informal seed sources (own seed, local market and social network) for both case-study sites over three agricultural seasons (2015 - 2016, 2016 - 2017 and 2017 - 2018). This underscores the importance of informal seed systems for access to seed among smallholder farmers. The informal seed system has shown resilience over time in the face of an unpredictable policy framework, harsh socio-political environment, and in the midst of natural hazards such as drought and cyclones.

Although of lesser importance to small-scale farmers in comparison with the farmers' seed system in the study sites, the formal seed system should not be under-estimated in terms of its influence on farmers' accessing certain seed varieties through seed aid and agro-dealers, specifically improved, early-maturing maize-seed varieties. In this study it was found that 80.3% of maize planted during the 2016-2017 season was acquired from formal seed sources (agro-dealers and seed aid).

The framework of seed availability, access, and utilisation, as championed by the FAO (2016a) and Remington et al. (2002), was used to determine the seed-security status of smallholder households in Chimanimani. The seed availability components that were used were timeliness of seed provision, proximity of seed to the farmers and sufficiency of seed from the various seed sources. The data showed that informal seed sources were more reliable in ensuring that seed was available on time and in closer proximity to households compared with formal seed sources. Interventions that provide seed to farmers should be informed by the type of crop required, and the necessary varietal attributes, whilst ensuring that the seed is made available in close proximity and in time for planting. This would ensure that farmers are able to plant in time in response to the weather patterns and would reduce their transaction costs of acquiring seed.

The seed access parameters that were used to place households into seed-security clusters for analysis were: affordability, the number of times farmers received seed aid during the previous five years, and other demographic characteristics such as the age and sex of the head of the household. The "seed secure" farmer group consisted of households that were all headed by males, who perceived the price of all the seed they planted to be affordable. This may imply that access to seed could be influenced by the sex of the household head. They also had received seed aid the least number of times, on average. The "insecure" farmer group, in terms of seed access, had the lowest average age-group, accessed their seed late, and more than half (57%) sourced their seed from far away, with 78% claiming that the seed was inadequate for their planting needs. The group of farmers with a "diverse" seed-security status (i.e. some seed secure while others seed insecure) were all females. The three clusters served to show that there was a wide range of seed accessibility including households that were seed secure, households with mixed results and households that

were seed insecure. This depended on farmers' characteristics, crop varieties and seed sources that they accessed.

Seed from formal sources was perceived to be more expensive than that from informal sources. This was related to the actual seed prices, social relations involved in access, and economic status of the households. It was noted that more farmers from Chikukwa were concerned with the high cost of seed than those from Chaseyama. This might have been because of the remoteness of Chikukwa, and more farmers from Chikukwa purchasing seed from formal sources which were perceived to be expensive. Another possible reason was explained by the different wealth profiles of the two sites. There was a higher proportion of Chaseyama households that owned livestock, especially poultry, goats and cattle (and, therefore, possibly wealthier) compared with Chikukwa households.

It was found that seed from formal and informal sources had comparable quality, based on physical purity and acceptable germination standards. This served to show that farmers were confident about their traditional seed quality assurance methods and trusted informal sources to supply quality seed. The evidence provided showed that farmers possessed a wealth of indigenous knowledge and experience to maintain the quality of their seed through selection, cleaning, treating, preserving and storage.

Significant determinants of seed security varied across the farmer groups. These included the number of different crops grown by a household, number of seed sources, number of assets owned and location of the farmers. These determinants indicated the importance of understanding how household and agronomic characteristics interacted to influence the seed-security status of farmers. This interaction was important when relating seed-security determinants to the factors underlying food security.

10.3. FOOD CONSUMPTION AND FOOD SECURITY

Different measures of food security were used to identify the diverse dimensions of food insecurity of households in Chimanamani during the peak hunger season. The Households Dietary Diversity

Score (HDDS) and the Food Consumption Score (FCS) were both used to measure the food-security status of households, based on the quality and diversity of the food they ate, while the FCS also included a consumption frequency dimension, measured over a seven-day recall period. The Food Insecurity Experience Scale (FIES) was used to capture the food-security status of households on a longer time scale (three months) based on their lived experiences of hunger, such as worrying about inadequate food and compromising the quality and quantity of food eaten. The Household Food Security Self-Classification (FSSCS) was developed to capture an individual households' perception of their food-security status over a longer time horizon (12 months).

Although the food security indicators estimated varied proportions of food-secure households, they were found also to have significant correlations amongst themselves and had similar determinants. Based on all the indicators (except for the Household Food Security Self-Classification) it was estimated that the majority of households were food secure across both locations during the peak hunger season. The Food Self-classification (FSSCS) indicator produced a lower proportion of food-secure households across Chaseyama and Chikukwa. This could be related to the fact that the households' perceptions of their food-security status were different from the indicator-based assessments. While the standard food security indicators captured only recognisable signs of poor food consumption and under-nutrition, these households perceived themselves as being food insecure. This underscores the importance of complementing standard food security assessments with subjective measures, as the latter can capture psychological dimensions of food insecurity and are useful for gauging expectations of food. Households might regard themselves as hungry, even if there are no recognisable signs of under-nutrition. Furthermore, even if households are not currently under-nourished, they might perceive a significant probability, or well-founded fear of future deprivation, which manifests as a perception of food insecurity.

When comparing the two sites, the results showed that there were more households from Chikukwa than from Chaseyama that were food secure in terms of higher dietary diversity and fewer experiences of food insecurity. However, when food security was assessed in terms of the frequency of consuming a diversified diet and households' perceptions of food-security status, there were no observed differences between the two locations.

The study served to decipher the determinants of household food security in Chimanimani. These included: the quantity of harvest stocks remaining through the peak hunger season (especially legumes and cereals - being the bulk of the type of food grown and eaten by households), the diversity of vegetables grown, ownership of small livestock, number of income sources, and time (in years) that the household had been farming. These variables correlated positively with the HDDS, FCS and the FSSCS food security indicators, while legume harvest, number of small livestock owned, and number of income sources accessed by the household correlated negatively with the FIES. Taken together, these findings revealed that households with larger crop production to take them throughout the year, growing diverse vegetables and owning productive asset are more likely to have a diverse diet, higher frequency of a diverse diet and to perceive themselves as being more food secure and are also less likely to have to develop food-insecurity coping strategies.

10.4. RELATIONSHIP BETWEEN SEED SECURITY AND FOOD SECURITY

The relationship between seed security and food security was analysed by classifying farmers into seed-security groups and then comparing their food-security status. The tests confirmed that, although timeliness and proximity of seed affected seed availability, their effect on accessing food was not direct. When comparing access to seed and food security, the relationship was complex and non-linear. For example, although the cost and affordability of seed had an effect on accessing certain types of seed, the relationship to accessing food was not obvious. Similarly, having household assets and income correlated with having a better food-security status, but did not always ensure access to seed. This is because farmers' seed sources included self-provision and social networks, which were predicated on non-financial factors such as social relations.

In terms of seed utilisation, the results revealed that the quality of farmers' seed was essential in ensuring that farmers acquired adequate food from their production. Quality seed was assessed in terms of physical purity and acceptable germination. Quality seed led to a healthy crop that would ensure better crop yields, if other complementary measures of crop production were available. Taking all the seed security elements together, this suggests that the relationship between seed

security and food security is not direct, but rather complex and contextual. It was noted that, as consideration proceeded from availability, to access and utilisation, the relationship between seed security and food security became more evident and much clearer. This suggests that it is important for seed not only to be more widely available and accessible but also to be utilised (i.e. of good quality) to obtain better crop productivity.

The household survey and case histories provided evidence of the key enablers and constraints of seed security and food security. These were categorised into household-level determinants of seed and food security as well as broader contextual dimensions. The household-level determinants included farming practices (such as level of crop production, crop diversity, differentiated seed and food plots, and farming longevity), households' asset portfolio (such as the human, natural, economic and social assets), and geographic differences (such as physical and agro-ecological characteristics and assets endowments) across locations.

The broader dimensions that had an impact on seed and food security included social, economic and political factors and the effects of weather and climate. These dimensions had a historical and on-going impact on access to seed and food security. While farming households are to a limited extent in control of the household-level determinants, broader contextual factors are beyond their control. It is critical to understand how these determinants interact, influence and contribute to household seed and food security.

10.5. CONTRIBUTION TOWARDS THE CONCEPTUAL FRAMEWORK THAT LINKS SEED SECURITY AND FOOD SECURITY

The framework of links between food security and seed security espoused by McGuire and Sperling (2011) was based on the argument that there were subtle and causal links between seed security and food security, such that insecurity in one did not necessarily reflect insecurity in the other. McGuire and Sperling (2011) argued that seed security elements were, in most cases, the cause of food security rather than the other way. They further contended that there was no evidence of causal links from food security to seed security. Their framework was applied to acute (transitory) contexts of food-price crises and other acute crises such as drought, flood, pest attack

or market shocks that affect security (McGuire and Sperling, 2011). However, the framework did not take into account situations of chronic stress such as political crises, economic instability, repeated drought and non-functional institutions. Thus, the aim of this thesis was to determine the interaction between seed and food security in a chronic context. This was done by extricating the household determinants and broader factors that were constrainers and enablers of the interactions between seed and food security. The findings concurred with McGuire and Sperling (2011) that the relation between seed and food security is not straight forward. Additionally, it argues that there are underlying causal determinants and factors that are critical in contributing to the seed and food security of households. It is necessary to consider these household-level and broader determinants in terms of how they affect the seed-security elements of availability, access and utilisation in contributing to food security.

The **seed security and food security quadrants** described served to show the various dimensions within which farmers experience different situations of seed and food security. There were households that were secure in their food and seed requirements because of a strong relationship between seed/cropping patterns and food provision. For these households, their specific household determinants of seed and food security and wider contextual factors, such as weather and climate, geographical position and the impact of the socio-economic and political environment, enabled them to access seed and food for their needs.

Other households **adequately accessed food, but not seed**. Households falling into this classification were not strongly reliant on the crop production-food provision pathway as they had other, alternative contributors to their food security (such as livestock, social transfers and non-crop-based income sources). Seed insecurity for farmers in this group included seed that was poorly adapted to their environment, inferior quality seed, seed that was too expensive or was either too far from them or was received too late.

A third classification of households was those that were **seed secure but food insecure**. They had what was needed for crop production (seed inputs in particular), but this did not translate into household food security. Such households have many, non-seed related constraints that affected their crop production. These include insufficient inputs, drought or a lack of alternative livelihood

sources. Some households had inadequate arable land, or large family sizes to feed with limited income sources.

Lastly, some households had a double burden of **insecurity in both seed and food requirements**. The factors affecting access to seed for these households also affected access to food. Shocks such as drought, a lack of alternative livelihoods, and weak assets affected them. Seed insecurity might cause food insecurity if the households were highly dependent on own household crop production for their food needs, as seed is a vital input. This was more prevalent if the household did not have other means of livelihood and assets to access adequate food.

10.6. STUDY RECOMMENDATIONS

The implications of these findings are profound. Households that are food insecure are not necessarily seed insecure. This is contrary to the assumption of humanitarian actors and governments that providing seed assistance to households will alleviate seed insecurity and ultimately improve self-provision of food. Typically, seed aid is combined with food assistance on the assumption that food insecure households are also seed insecure. Clearly, this is not a linear path and seed aid can also be counter-productive in cases of repeated provision that could undermine farmers' seed systems and longer-term seed recovery of the seed sector.

A key recommendation is that government and organisations involved in seed-related interventions should be informed by seed-security assessments rather than relying on food-security assessments as proxy measures of seed security. These assessments should not be used simply to analyse the immediate elements of seed security (such as availability, access and seed quality) which is the current practice but should also be informed by the underlying factors that interact to influence the seed-security status of farmers. These include the household-level determinants (such as farming practices, households' asset portfolio and geographic differences) and broader contextual determinants (including social, economic and political factors, and the effects of weather and climate). Seed security assessments that incorporate household level determinants as well as broader contextual determinants will be better able to identify seed security constraints faced by smallholder farmers and inform appropriate responses.

Second, the effect of seed interventions by governments and development actors has been to promote and support the formal seed system in the belief that this system is superior in ensuring better access to improved quality seed for farmers. Indeed, many studies have recommended linking smallholder farmers to the formal seed system as a way of addressing constraints to seed access (Remington et al., 2002; Rubyogo et al., 2010; Okello et al., 2017). This study has shown that farmers' seed systems (informal systems) are comparable in terms of quality achieved and, sometimes, even out-perform the formal seed system, especially with regards to ensuring that farmers have timely access to affordable and diverse crop varieties in closer proximity. Farmers' seed systems should receive equal or more attention to that given to formal seed systems and should obtain increased investment efforts if farmers are to attain resilience in seed security.

Understanding the complementarity of formal and informal seed systems is important in ensuring access to adequate seed for smallholder farmers. It is critical to understand the seed systems farmers interact with, to determine the constraints they face and to resolve ways of addressing these in order to ensure that farmers can benefit from both systems. Farmers interact with both the formal and informal seed systems in order to address their diverse needs such as cultural, food, nutrition, and income. This is in line with studies that have shown the complementary roles of the formal and informal seed systems for smallholder farmers (Louwaars and de Boef 2012; Westengen et al., 2014; Croft et al., 2017; Ferrari et al., 2017). Westengen et al. (2014) through their study of farmers in semi-arid Tanzania revealed that those who had access to drought tolerant, open-pollinated maize varieties through the formal seed system mixed these varieties with local varieties. Dilbone (2015:63) argued that “practices of combining improved and local varieties were seen to enhance seed security and the adaptive capacity of farmers in the face of climate change”. These broader approaches could address the disparities that manifest via different agro-ecologies, types of farmers, the diversities of organisations that operate in seed supply, and the range of objectives for agriculture, and the type of crops grown.

Third, the study revealed that, although there are similarities in the determinants of food security and seed security, these are not consistent across all farmers or timeframes. Seed security does not necessarily equate to food security, nor does seed insecurity necessarily lead to food insecurity.

The development of seed and food security policies and strategies for smallholder farmers should be informed by the causal factors and determinants that could be potential enablers and/or constrainers in attaining seed and food security. These factors should be analysed according to different scales and time frames, including household level (farming practices, households' asset portfolios and geographic differences) and should include broader contextual determinants (social, economic, political factors, and the effects of weather and climate) that have both a historical trajectory and a continuously evolving influence on farmers' seed and food security.

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APPENDICES

APPENDIX ONE – Household Survey

Household Survey Questionnaire

Enumerator Name _____ Date _____ Name of respondent _____

Cell number (respondent) _____ Household head name _____

Marital Status (HHH) _____ HHH Age _____

HHH Sex: M _____ F _____ (Tick) HH size _____; Number Adults _____ Number Children _____

Total land area Owned: _____ Ha/Acre (Tick one).

Total Land Area actually cultivated Nov 2016-Feb 2017: _____ Ha/Acres (Tick one)

Area: Chukka / Chaseyama (Tick one) Village name _____

PART 1. HOUSEHOLD BACKGROUND

1. How did your family come to live in this area?

2. When was that? _____

3. How long have you been farming in this area _____ (Years/since when?)

PART II. SEED SOURCES FOR CROPS GROWN LAST SEASON: (NOV 2015 to Feb/March 2016)

Crop	Variety name	Source (codes 1-8)	How acquired (codes 1-9)	Are you still sowing it? (Yes/No)	If No, why not?

Sources of seed: CODES		How acquired :CODES	
1= friends/neighbors/relatives	5= government	1=exchange/barter	5=direct seed distribution
2= local market	6= NGO /FAO	2= gift (friend/neighbor/relatives)	6= seed loan
3= agro-dealer	7= contract growers	3= purchase/buy	7= food aid
4= community-based seed groups	8= other (specify)	4= vouchers/coupons (sometimes w/fairs)	8= money credit
			9=other (specify)

4. In the last 10 years, which varieties have you been growing? Specify source, crop, variety name, and if you are still sowing the variety.

5. Which seed crops did you plant the previous season **(NOV 2015 to Feb/March 2016)**?

6. From the above list, what were your most important crops²⁷ for which you used seed or planting material? (**Top three**)

Crop A:	Crop B:	Crop C:

7. For each crop, in Question 6, from where did you obtain your seed, how was it acquired, which variety was used, (see table below).

Crop A: _____ (fill in crop name)

Sources of Seed planted list ALL sources <u>See codes 1-10</u>	How acquired <u>see codes A-J</u>	Quantity local units		Seed /Variety Quality: G=good A=average P= Poor	Use of Fertilizer/ manure? Yes/No	Use of pesticides? Yes/No
		#	Unit (kg/Lt)			
Total seed quantity planted for Crop A _____					Name of fertilizer/manure used:	

Sources of seed: CODES		How acquired :CODES	
1= home-saved/own stocks	6= community-based seed groups	A= save/own stocks	F=direct seed distribution
2= carryover-maize hybrids	7= government	B=exchange/barter	G= seed loan
3= friends/neighbors/relatives	8= NGO /FAO	C= gift (friend/neighbor/relatives)	H= food aid
4= local market	9= contract growers	D= purchase/buy	I= money credit
5= agro-dealer	10= other (specify)	E= vouchers/coupons (sometimes w/fairs)	J=other (specify)

²⁷. Please note for legumes (groundnuts, cowpeas, bambara groundnut, beans) ask for shelled state.

Follow-up questions Crop A

In most years, how much seed do you plant of this crop?	Total quantity actually planted the previous season (see above)	This season, did you plant M=more; S=same; or L=less than usual?	If different (M or L) explain

For Crop A: Amount Harvested _____ Kg/Lt (**Tick unit**); Amount Sold _____ Kg/Lt (**Tick unit**);

Amount eaten _____ Kg/Lt (**Tick unit**); Amount given to others? _____ kg/Lt (**Tick unit**);

Amount still available _____ Kg/ Lt (**Tick unit**)

How much quantity of this crop does your family require for eating per month? Kg/Lt (Tick Unit).

If sold some of crop A, what did you use the money for?

Crop B _____ (fill in crop name)

Sources of Seed planted list ALL sources <u>See codes 1-10</u>	How acquired <u>see codes A-J</u>	Quantity local units		Seed /Variety Quality: G=good A=average P= Poor	Use of Fertilizer/ manure? Yes/No	Use of Pesticides Yes/No
		#	Unit (Kg/lt)			
Total seed quantity planted for Crop B _____					Name of fertilizer/manure used:	

Follow-up questions Crop B

In most years, how much seed do you plant of this crop?	Total quantity actually planted the previous season (see above)	This season, did you plant M=more; S=same; or L=less than usual?	If different (M or L) explain

Sources of seed: CODES		How acquired :CODES	
1= home-saved/own stocks	6= community-based seed groups	A= save/own stocks	F=direct seed distribution
2= carryover-maize hybrids	7= government	B=exchange/barter	G= seed loan
	8= NGO /FAO		H= food aid

3= friends/neighbors/relatives 4= local market 5= agro-dealer	9= contract growers 10= other (specify)	C= gift (friend/neighbor/relatives) D= purchase/buy E= vouchers/coupons (sometimes w/fairs)	I= money credit J=other (specify)

For Crop B: Amount Harvested _____ Kg/Lt (**Tick unit**); Amount Sold _____ Kg/Lt (**Tick unit**)

Amount eaten _____ Kg/Lt (**Tick unit**); Amount given to others? _____ kg/Lt (**Tick unit**);

Amount still available _____ Kg/ Lt (**Tick unit**)

How much quantity of this crop does your family require for eating per month?..... kg/Lt (Tick Unit).

If sold some of crop A, what did you use the money for?.....

Crop C _____ (fill in crop name)

Sources of Seed planted list ALL sources <u>See codes 1-10</u>	How acquired <u>see codes A-J</u>	Quantity local units		Seed /Variety Quality: G=good A=average P= Poor	Use of Fertilizer/ manure? Yes/No	Use of Pesticides ? Yes/No
		#	Unit (Kg/Lt)			
Total seed quantity planted for Crop C _____					Name of fertilizer/manure used:	

Follow-up questions Crop C

In most years, how much seed do you plant of this crop?	Total quantity actually planted the previous season (see above)	This season, did you plant M=more; S=same; or L=less than usual?	If different (M or L) explain (see separate code list: 1-34)

For Crop C: Amount Harvested _____ Kg/Lt (**Tick unit**); Amount Sold _____ Kg/Lt (**Tick unit**)

Amount eaten _____ Kg/Lt (**Tick unit**); Amount given to others? _____ kg/Lt (**Tick unit**);

Amount still available _____ Kg/ Lt (**Tick unit**)

How much quantity of this crop does your family require for eating per month?..... kg/Lt (Tick Unit).

If sold some of crop A, what did you use the money for?.....

PART III: SEED SOURCES THIS SEASON (NOVEMBER 2016- FEBRUARY 2017)

8. Which seed crops did you plant this season?

9.0 From this list, which are your most important crops for which you used seed or planting material: (**Top three**)

Crop A:	Crop B:	Crop C:

Crop A _____	Own seed	Local market	Social network	Agro-input dealer	Seed Aid ²⁸
Name of major variety					
Was there enough seed from this source? Yes=1; No=0					
What quantity of seed (kg/Lt) did you plant from this source? State unit used					
At what time was the seed available? 1 = before the planting season; 2 = at start of the season; 3 = mid-season; 4 = towards the end of season					
Where did you collect the seed? 1 = in this village; 2 = neighboring village; 3 = neighboring district; 4 = far away district					
How did you acquire the seed? 1 = cash; 2 = on credit; 3 = bartered; 4 = free (gift)					
How was the price or terms of trade? 1 = affordable; 2 = expensive; 3 = very expensive (ask those that acquired by cash, credit or barter only)					
How clean was the seed? 1 =clean, no impurities or damage; 2 = fairly clean, some impurities, no damage; 3 = not clean, some impurities and damage					
How was the germination of the seed? 1 =Good; 2 =Fair; 3 =Poor					
Indicate name of organisation who provided seed aid :					

9.1 Assess varietal suitability, availability, accessibility and quality of crop from various sources

9.2 Overall, if you consider all the above seed sources, was there enough seed available for Crop A during this season (**NOVEMBER 2016- FEBRUARY 2017**)? Yes () No () (tick one).

9.3 In the upcoming season (**NOVEMBER 2017- FEBRUARY 2018**), where will you source seed of crop A

() from? () Own seed () Local market () Social network

²⁸ Please note that seed aid includes government, NGOs and FAO.

() Agro-dealer () Seed aid (select all that apply)

9.4 Assess varietal suitability, availability, accessibility and quality of crop from various sources

Crop B _____	Own seed	Local market	Social network	Agro-dealer	Seed Aid
Name of major variety					
Was there enough seed from this source? Yes=1; No=0					
What quantity of seed (kg/Lt) did you plant from this source? State unit used.					
At what time was the seed available? 1 = before the planting season; 2 = at start of the season; 3 = mid-season; 4= towards the end of season					
Where did you collect the seed? 1= in this village; 2= neighboring village; 3= neighboring district; 4= far away district					
How did you acquire the seed? 1= cash; 2= on credit; 3= bartered; 4= free (gift)					
How was the price or terms of trade? 1= affordable; 2= expensive; 3= very expensive (ask those that acquired by cash, credit or barter only)					
How clean was the seed? 1=clean, no impurities or damage; 2= fairly clean, some impurities, no damage; 3= not clean, some impurities and damage					
How was the germination of the seed? 1=Good; 2=Fair; 3=Poor					
Indicate name of organisation who provided seed aid					

9.5 Overall, if you consider all the above seed sources, was there enough seed available for Crop B during this season (**NOVEMBER 2016- FEBRUARY 2017**)? Yes () No () (tick one).

9.6 In the upcoming season (**NOVEMBER 2017- FEBRUARY 2018**), where will you source seed of crop B

() _____ from? () Own seed () Local market () Social network

() Agro-input dealer () Seed aid (select all that apply)

9.7 Assess varietal suitability, availability, accessibility and quality of crop from various sources

Crop C _____	Own seed	Local market	Social network	Agro-dealer	Seed Aid
Name of major variety					
Was there enough seed from this source? Yes=1; NO=0					
What quantity of seed (kg/Lt) did you plant from this source? State unit used.					
At what time was the seed available? 1 = before the planting season; 2 = at start of the season; 3 = mid-season; 4= towards the end of season					
Where did you collect the seed? 1= in this village; 2= neighboring village; 3= neighboring district; 4= far away district					
How did you acquire the seed? 1= cash; 2= on credit; 3= bartered; 4= free (gift)					
How was the price or terms of trade? 1= affordable; 2= expensive; 3= very expensive (ask those that acquired by cash, credit or barter only)					
How clean was the seed? 1=clean, no impurities or damage; 2= fairly clean, some impurities, no damage; 3= not clean, some impurities and damage					

How was the germination of the seed? 1=Good; 2=Fair; 3=Poor					
Indicate name of organisation who provided seed aid					

9.8 Overall, if you consider all the above seed sources, was there enough seed available for Crop A during this season (**NOVEMBER 2016- FEBRUARY 2017**)? Yes () No () (tick one).

9.9 In the upcoming season (**NOVEMBER 2017- FEBRUARY 2018**), where will you source seed of crop C

() from? () Own seed () Local market () Social network

() Agro-input dealer () Seed aid (select **all that apply**)

VEGETABLES AND FRUIT TREES

10.0 Are you currently growing any vegetables? Yes () No () (tick one)

10.1 If Yes, which vegetables are you growing and for what purpose?

Name of Vegetables grown (e.g. Kale, Spinach, Tomatoes, Okra, amaranth, pumpkin leaves, etc)	Source of seeds (multiple responses possible-see below)	Use of the Vegetables grown (multiple responses possible-see below)

Sources of vegetable seed: CODES 1= home-saved/own stocks 2 = friends/neighbors/relatives 3= local market 4= agro-dealer	5= community-based seed groups 6= government 7= NGO /FAO 8= contract growers 9 = other (specify)	Uses of the vegetables: CODES 1= Household consumption 2= sales 3= gift (friend/neighbor/relatives) 4=Exchange 5= other (specify)

11.0 Do you have fruit trees? Yes () No () (tick one)

11.1 If Yes, which fruit trees are you growing and for what purpose?

Fruit tree type	Number of trees owned	Year Planted	Use of the harvested fruits

PART IV: SEED STORAGE AND ACCESS TO VARIETIES

12. In practice how do you differentiate seed from grain?

13. What ways do you use to store and preserve your seed?

Seed storage losses this season?	Yes/ No	If yes, on which priority crops? (3 maximum)	About what quantity of the stock was lost?
13.1 For the last season, (between May and Nov 2016) did you have any losses of seed that was stored?			

PART V. SEED AID

14. In the last 5 years, have you received seed aid? **Yes** () **No** () (tick one)

15. If yes, how many times: total_____. If yes, specify the organization, means of delivery, crop, variety

Organization (codes 1,2,3)	Means of delivery (codes A,B,C,D)	Crops
CODES : Organizations involved in seed aid 1= Government 2=NGO/FAO 3= Other - specify		CODES: means of delivery A= Vouchers (and fairs) B= free – direct distribution C= seed loan D= other (specify)

name and year received (table directly below)

16. In what ways can farmers without adequate seed be supported to have access to adequate seed for your
needs at all times?

PART VI. OTHER LIVELIHOOD CHARACTERISTICS

17. Do you rear livestock? **No** **Yes** (circle one)

18. If yes which livestock types do you keep?

Livestock Type	Number kept	Livestock Type	Number kept
Cattle		Donkey	
Goats		Poultry (Birds)	
Sheep		Other	
Pigs		Other	

19. What were your main sources of income for your household during the last year (2016)?

Income source	Ranking (in terms of contributor to household needs)

20. Do you own any of the below assets:

Asset type	Ownership Yes=1; No=0	Number Owned
Plough		
Wheel barrow		
Knapsack sprayer		
Ox Cart		
Hoe		
Bicycle		
Motor cycle		
Vehicle		

PART VII: FOOD AVAILABILITY AND ACCESS AT HOUSEHOLD LEVEL

21. How would you classify the food security status of your household? (*Tick the applicable*)

- (a) Have more than enough food all of the time ()
(b) Have enough food most of the time ()

- (c) Have enough food some of the time ()
 (d) Don't have enough food some of the time; ()
 (e) Don't have enough food most of the time ()

22. What are the reasons for this?

23. From your perspective, how would you define a household that is food secure?

24. What have been your household **food sources** in the past and currently?

Food types and sources more than 10 to 30 years ago?		Food types and sources currently?	
Food Type	Source of the food	Food Type	Source of the food

25. Now I would like to ask you about the types of foods that you or anyone else in your household ate **yesterday** during the day and at night. First, was yesterday a normal day in terms of eating habits or different from the usual?

Normal () Different () (tick one)

Food Type	Yes	No	Source of food 1=Farming; 2=Purchase
1. Any bread, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice, wheat,			
2. Any potatoes, yams, cassava or any other foods made from roots or tubers?			
3. Any vegetables?			
4. Any fruits?			
5. Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?			
6. Any eggs?			
7. Any fresh or dried fish?			
8. Any foods made from beans, peas, or nuts?			
9. Any cheese, yogurt, milk or other milk products?			
10. Any foods made with oil, fat, or butter?			
11. Any sugar or honey?			
12. Any other foods, such as condiments, coffee, tea?			

26. For how many days (0-7) of the **last 7 days** have you eaten the following food groups?

Food group	Days (0-7)	Food group	Days (0-7)
1. Cereals		6. Fruits (including wild fruits)	

2. Roots and tubers		7. Milk/Milk products	
3. Pulses/legumes/Nuts		8. Sugar/Honey	
4. Vegetables		9. Oil/fat/ butter	
5. Meat/fish/eggs			

27. Food Insecurity Experience Scale: During the last three months (**November 2016 - January 2017-Peak hunger period**), was there a time when:

Food Insecurity Experiences	Yes (1)	No (0)
1.You were worried you would run out of food because of a lack of money or other resources?		
2.You were unable to eat healthy and nutritious food because of a lack of money or other resources?		
3.You ate only a few kinds of foods because of a lack of money or other resources?		
4.You had to skip a meal because there was not enough money or other resources to get food?		
5.You ate less than you thought you should because of a lack of money or other resources?		
6>Your household ran out of food because of a lack of money or other resources?		
7.You were hungry but did not eat because there was not enough money or other resources for food?		
8.You went without eating for a whole day because of a lack of money or other resources?		

28. In what ways can households without adequate food be supported to have access to adequate food at all times?

29. What is the main water source for your drinking and cooking needs?

Water source (see options below)	Distance from household (km/meters)	Reliability
Codes: 1=Tap 2=Borehole 3=Protected well 4=unprotected well 5=River/dam		Codes: 1=Reliable most of the time 2=Reliable some of the time 3=Not reliable

THANK YOU SO MUCH FOR YOUR TIME

APPENDIX TWO: Agro-Dealer Survey

Agro-Dealer Questionnaire

Objectives:

- To identify varieties of crops being sold by the agro input dealers.
- To determine availability, access and quality related issues from agro-input business.
- To understand the demand and supply of (certified) seed.

Section 1: Background information

- 1.1 Name of Enumerator: _____
- 1.2 Date: _____
- 1.3 Location (Chaseyama / Chikukwa) 1.4 Village: _____

Section 2: Agro-Input Business Information

- 2.1 Name of the Business: _____
- 2.2 Name of sales agent (respondent): _____
- 2.3 Age: _____ 2.4 Sex: Male _____ Female _____
- 2.5 Education: No formal _____ Primary school _____ Secondary _____ Tertiary _____
- 2.6 Mobile #: _____
- 2.7 For how many years have you been in the agro-input business (selling inputs)? _____
- 2.8 Are you part of a network of agrodealers? _____
- 2.9 If yes, which and where? _____
- 2.10 Which agro inputs do you deal in? (Multiple responses, tick all that apply)

Inputs	Inputs
Crop Seed	Sprayers
Vegetable Seed	Animal drugs
Tree seed	Planters
Agro-chemicals	
Fertilizers	
Hand tools	
Animal ploughs	

- 2.11 What are the seed types that you sell? (State all the crops and vegetables)

- 2.12 What proportion of the seed you stock are hybrids compared to OPVs? Hybrids _____ OPVs _____

Section 3: Crop Seed Demand and Supply

- 3.1 Which are the three top most selling crop/vegetable seed?

	Crop A	Crop B	Crop C
Crop Name			
Rank (1, 2....5)			

- 3.2. Of the above crops, which are three varieties that you sell most? (For each of the varieties mentioned, ask the questions in the table)

Crop A (Name.....)

	Variety (i)	Variety (ii)	Variety (iii)
a) Variety (name)			
b) Packaging size units stocked			
c) Current Price per unit			
d) Price at planting			
e) Volume sold this past season (2016/17)			
h) Month of highest sales			
i) Ranking of varieties as per demand (1-3). (Two varieties can have the same rank)			
J) Name and location of the Main supplier			

Crop B (Name.....)

	Variety (i)	Variety (ii)	Variety (iii)
a) Variety (name)			
b) Packaging size units stocked			
c) Current Price per unit			
d) Price at planting			
e) Volume sold this past season (2016/17)			
h) Month of highest sales			
i) Ranking of varieties as per demand (1-3). (Two varieties can have the same rank)			
J) Name and Location of the main supplier			

Crop C (Name.....)

	Variety (i)	Variety (ii)	Variety (iii)
a) Variety (name)			
b) Packaging size units stocked			
c) Current Price per unit			
d) Price at planting			
e) Volume sold this past season (2016/17)			
h) Month of highest sales			
i) Ranking of varieties as per demand (1-3). (Two varieties can have the same rank)			
J) Name and Location of the main supplier			

3.3 What has been the trend of demand of the different crops you are selling for the past 5 years?

3.4 Who are your customer groups, please rank them in terms of those that purchase the most (1) and those that purchase the least (6). (**Multiple response-Tick all that apply**)

Group	Rank	Group	Rank
Individual farmers		Government	
Farmer groups		Other Agro-dealers	
NGOs/UN		Traders	

3.5 Do you sometimes provide seed on credit to farmers who want seed during planting season? Yes () No ()

3.6 Of the farmers who buy seed, what proportion (%) are getting it on credit? (**You may ask out of 10 of those who buy seed, how many get credit?**) _____

3.7 How do the credit farmers pay you back (terms and whether cash or kind?)

3.8 Do you sometimes exchange seed with other goods from the farmers during planting time? Yes () No ()
Please elaborate _____

Section 4: Seed Storage and Fertiliser

4.1 Do you also sell fertilizers? Yes (___) No (___)

4.2 Of the farmers who buy crop and vegetable seed, what proportion (%) also buy fertilizers at the same time? (you may ask out of 10 of those who buy seed, how many buy fertilizers?) _____

4.3 Which fertilizers do you stock?

Section 5: After sale services and feedback

5.1 How do buyers know that you sell/supply seeds?

5.2 What kind of after sales services do you normally offer your customers in relation to seed?

5.3 Which seed types were asked by farmers this season, but you did not stock them?

5.4 What are the reasons for failing to stock these?

5.5 What determines the kinds of seed that you stock and distribute?

Section 6: Challenges and Way forwards

6.1 What are the top three challenges in your seed business?

APPENDIX THREE: Extension Officer Interview Guide

Extension Officers Interview

Aim: With these questions, we are trying to understand your role in supporting farmers' access to seed and its contribution to household food security in this area.

Note:

- The date of the meeting, the name of the officer and contact number
- The Area covered by officer

All information will be kept confidential, and personal identity will not be revealed. Participants are free not to answer any questions they feel uncomfortable with. Written consent should be sought.

1. Tell me about the work that you do". "Where do you work?" With how many farmers? How long have you worked with farmers in this area?
2. Tell me a bit about yourself and where/when you got your training. What on-the-job training have you received? On what aspects? Have you ever received training on seed production? Agroecology?
3. What knowledge/training do you impart to smallholder farmers? Also, interesting to know how you decide what knowledge and training to share. Is it farmer driven? How are training needs established?
4. What knowledge/training do you impart to smallholder farmers? How frequently is this provided? What methods do you use to impart this knowledge? How confident are you with regard to meeting extension needs of farmers in this area?
5. What types of crops do smallholder farmers grow in this area? Where do farmers get seeds for these crops? How would you rate these sources in terms of number of farmers involved, reliability and meeting the diverse needs of smallholder farmers?
6. Which seed crops are available and which ones are difficult to access during time of planting? How has this evolved over time (last 5-10 years or more depending on extension officer's length of service)?
7. What seed initiatives/ strategies have been promoted in this area over the years? By whom and for what purpose? What role has your office played in the various seed initiatives in Chimanimani? What other organisations have worked with farmers in this area in implementing which seed initiatives?
8. For the last 3 seasons, how would you rate each season overall in terms of farmers' key crops: Good, Average, Poor (starting from current season). Why rating and impact on crop production of key crops.
9. What hazards have impacted farmers' access to seed in this location? El Niño?
10. What do you think are the Key constraints that farmers face in terms of seed availability, seed access and quality?
11. Are there specific actions needed in relation to promoting seed availability and access?
12. In your view what is the food security situation in this area? What could be the contributing factors to food (in) security? Are there cases of malnutrition in this area?
13. Do you think there could be a relationship between seed security and food security in this community? If so, how so, if not why not?
14. What support do you think needs to be provided to smallholder farmers to improve their household food security?
15. What constraints do you face in your work?
16. What supporting or enabling policies are present for your work? What works and what doesn't? What needs urgent attention to improve seed and food security?
17. What is your take on specific seed types such as hybrids, OPVs and local seed varieties? Which seed types have you been promoting? Why? Which seed types do you think contribute to improved food availability? Why?

18. Does your job have specific incentives / targets? Whether your work involves focusing on ‘progressive farmers’ because they have a quota for getting farmers to sign up to a package / attend a training?

Then closure-- and ask if they have any questions—or additions to make

APPENDIX FOUR: Community Group Interview Guide

Community Group Trend Analysis

How has the community changed its practices in terms of the seed crops grown and food situation in your lifetimes?
Let us construct a timeline to see this evolution

Year	Seed and Food situation	Cause of the situation	Strategies implemented

Year	Food situation	Cause of the situation	Strategies implemented

APPENDIX FIVE: Life History Interview Guide

Life history interviews: semi-structured interview guide

Aim: With these questions, we are trying to understand the impact of farmers' seed system to household food security in this area. A life history interview provides a rich historical and current perspective of the situation, context, and personal circumstances that have interacted to contribute to a households' seed and food security status.

Note:

- The date of the meeting
- The place
- A specific name and contact number

All information will be kept confidential, and personal identity will not be revealed. Participants are free not to answer any questions they feel uncomfortable with.

Family history

1. Where did you grow up? Whose home was it (e.g. your father's, your mother's, another relative)?
2. How many brothers and sisters do you have? Where do they live now? How often do you see them? How do they support themselves – Jobs? Farming? Businesses?
3. Thinking back to your childhood, was life different then from now in terms of farming? How it is now? In what way? Was it better or worse?
4. What agricultural technologies did you receive from your parents (such as seed, knowledge, equipment, livestock, etc.)? How has this benefited your current farming?

Children

5. How many children have you had in total? How many boys, how many girls? Are they all still alive?
6. How many of your children are at school (or are pre-school)? How many are 18 years old or older? Those over 18 what are they doing now?
7. Do any of your children send money to you? Do they help out in any other way (e.g. by bringing home food, seed or other goods)?
8. Are any of your children interested in farming? What farming skills and knowledge are you transferring/have transferred to your children? Have you transferred any seeds? Which? Why? How has this process been? Why, please explain.

History of food access and farming (under your parents/guarding care)

9. What types of food did you use to eat when you were growing up? Where did that food come from? How adequate was the food that your family got in meeting your household needs? Were there times when the food was not sufficient? What were the reasons? How was this resolved?
10. What crops did your parents grow when you were growing up? Which crops were grown for food? Which were grown for income?
11. What were the sources for different seed crops that you had. How reliable were the different seed sources?
12. What methods did your parents use to store the seed for your next planting season? How effective were these?

Current food access and farming (For your household)

13. What types of food is your family eating now? Where does that food come from? Comparing the different food sources, how adequate is the food that your family gets in meeting your household needs? Are there times when the food is not sufficient? What are the reasons? How is this resolved?
14. If eating different foods now compared to the past why is that?
15. What crops are you growing at present? Which crops are grown for food? Which are grown for income?
16. What are the sources for different seed crops that you have. What is your assessment of reliability of these seed sources?

17. If growing different seed crops now compared to the past why is that? Do you remember any milestone events that changed the way – food was obtained or farming was done?
18. What methods are you using to store your seeds for your next planting season? How effective are these?
19. Which seed crops do you lack but need? What are the constraints to getting them?

Food Security and Seed security

1. In which years in the past 10 years have you felt that your household had adequate food for its needs? Please describe these years and the circumstances. Why was your household food secure in those years?
2. Have you ever felt that your household did not have adequate food for its needs? In which years have you felt that your household did not have adequate food for its needs? Why was your household food insecure in those years? What coping strategies were adopted by your household? How effective were these?
3. In the past 10 years, in which years have you felt that your household was able to get the type of seed you needed? Please describe these years and the circumstances. Why did your household have the type and quantity of seed needed in those years?
4. In these 10 past years, have you ever felt that your household was not able to get the type of seed needed for planting? In which years have you felt this way? Why was your household seed insecure in those years? What coping strategies were adopted by your household? How effective were these?

Sources of income/other livelihoods

1. What other activities are your household members involved besides farming? Which members of your household are involved in these?
2. What are the different sources of income in your household at the moment? What are the most important income sources, and why are they important to you?
3. What was the most important source of your income 10 years ago? 5 years ago?
4. What will be the most important source of income for you in 5 years' time, do you think?

THANK YOU FOR YOUR TIME.

APPENDIX SIX: Variables selection; Cluster analysis and Multinomial logistic regression

Seed Security of Chaseyama and Chikukwa Farming Households

1. Selection of variables that contribute to household Seed Availability

The following variables in Table 1 extracted from the household survey were initially selected as relevant in determining household seed availability of Chaseyama and Chikukwa households.

Table 1: Seed availability variables allocated across the 2015 - 2016 season and the 2016 -2017 season

Seed Security Aspect	Variable name identified	Description of each variable
Availability 2015 - 2016 Season	1. Crops1516 2. Cereal201516; Legumes201516; Tuber201516 3.Cereal201516Hav; Legume201516Hav; Tuber201516Hav 4.Cereal201516Avail; Legumes201516Avail; Tuber201516Avail	1. Number of crops grown previous season (Nov 2015-March 2016) 2. Total seed quantity planted of each major crop group 3. Amount harvested of each major crop group 4. Amount still available of each major crop group (as at Feb 2017-peak hunger season)
Availability 2016 - 2017 season	1. Crops1617 2.Numbseedsources1617 3. Cerealseedqty1617; Legumeseedqty1617; Tuberseedqty1617 4. SEEDTIME3 5. SEEDTAKE3 6. SEEDENOU3	1. Number of seed crops planted this season (Nov 2016-Feb 2017) 2. Number of seed sources for 2016-17 3. Total seed quantity planted of each major crop group 4. Timeliness of seed availability ranging from '0= LATE' to '1= ON TIME' (Binary form) - of all sources of the top 3 important farmers' crops. 5. Proximity of seed source ranging from '0=FAR" to '1=NEAR' (Binary form). 6. Enough seed from all sources: '0'=No and '1'=Yes

In order to determine which farmers were seed secure and which were less seed secure, Cluster Analysis was done using the variables in Table 1. A Two-step cluster analysis was conducted using the Statistical Package for Social Sciences (SPSS, version 25) to determine which variables were good segregators of the households in terms of seed availability. The model showed that of all the variables in Table 1, timelines of seed availability (SEEDTIME3), proximity of seed (SEEDTAKE3) and seed adequacy (SEEDENOU3) were strong indicators in segregating households on seed availability, while the others were weak. It was thus inferred that these three variables were able to segregate amongst the farmers in terms of seed availability.

A further Two-step cluster analysis was conducted limiting the analysis to the strong indicators (timelines of seed availability, proximity of seed and seed adequacy). From the cluster analysis, three clusters were produced that

segregated households in terms of the seed availability variables. The model based on these three variables was classified as good model (see Figure 11 cluster quality) showing that the three variables were good segregators of the households into three clusters.

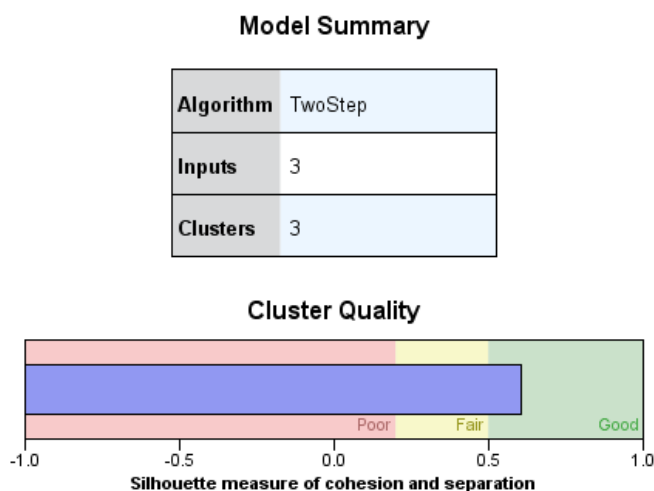


Figure 11: Chimanimani Cluster analysis model based on key seed availability indicators (timelines, proximity and seed adequacy).

2. Selection of variables that contribute to household Seed Access

The seed access variables initially selected included seed price (affordable or expensive), access to seed aid, and number of times a farmer accessed seed aid. Other variables that were classified under the access category did not have a straightforward relationship to access and were not strictly speaking ‘seed’ variables but had a bearing on the ability of farmers to acquire seed. This included income, asset variables (livestock, homestead assets and land), and demographic variables (sex of household head and age of household head). All these initial variables are shown in Table 2.

Table 2: Seed access variables selected from the household survey

Seed Security Aspect	Variable name identified	Description of each variable
Seed Access	1. SEEDPRICE3 2. Largestock; Smallstock; 3. Incomesources 4. TOTHHASSETS: Carnum Plownum; Wbarnum; Spraynum; Oxcartnum; Hoenum; Bicynum; Mcyclnum. 5. Landused; Landowned 6. HHHsex 7. HAGE 8. SeedAid	1. Price /terms of trade of purchased seed across crops between ‘1=affordable’ and ‘0=expensive’. 2. Number of livestock owed –large stock (cattle and donkeys) and small stock (goats, chicken) 3. Number income sources of households 4. Asset indicators (Total number of different assets owned) 5. Size of land owned and used in ha

	9. AidTimes	6. Sex of household head 7. Age of household head 8. Whether household has received seed aid 9. Number of times receiving seed aid

A Two-step cluster analysis was used to determine which variables in Table 2 were good segregators of the households in terms of seed access. The model showed that price of seed (SEEDPRICE3), sex of the household head, age of household head, and times receiving seed aid were strong indicators in segregating households on seed access, while the others were weak. Based on these variables the households were categorized into three clusters. The cluster model summary is shown in Figure 12 below.

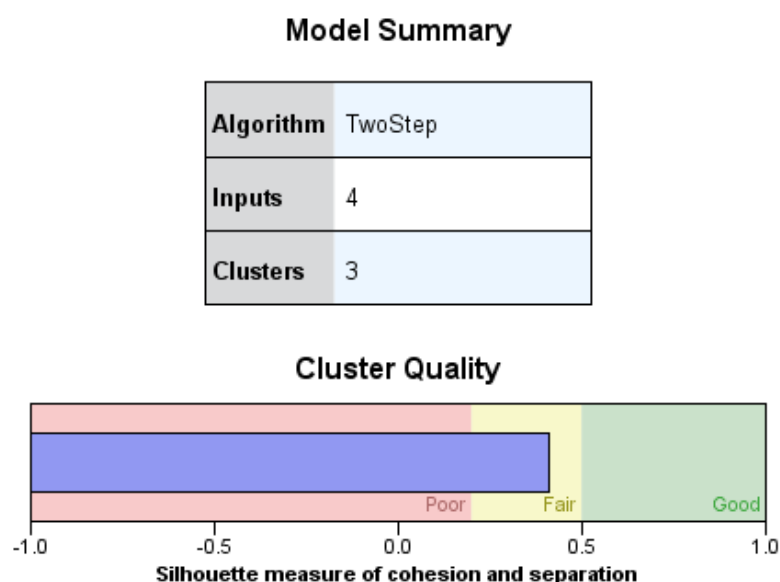


Figure 12: Cluster analysis model quality for Chimanimani households based on key seed access variables.

3. Selection of variables that contribute to household Seed Quality

For simplicity, the seed quality variables were reclassified into binary form as shown in Table 3.

Table 3: Seed Utilisation (Quality) during the 2016-17 season

Seed Security Aspect	Variable Identified	Description of Variable
Utilisation/Quality	1. CLEANSEEDS 2. GERMSEEDS	1. How clean is the seed across major crops coded as '1=clean' and '0=not clean'

		2. Germination of seed across crops coded as '1=good' and '0=not good'.

A Two-step cluster analysis was conducted to determine whether the two variables were good segregators of the households in terms of seed utilisation/quality. The models produced showed that these variables were strong indicators in segregating households on seed utilisation. It was thus inferred that clean seed and germination of seed were important in segregating households in terms of their seed quality status in Chimanimani.

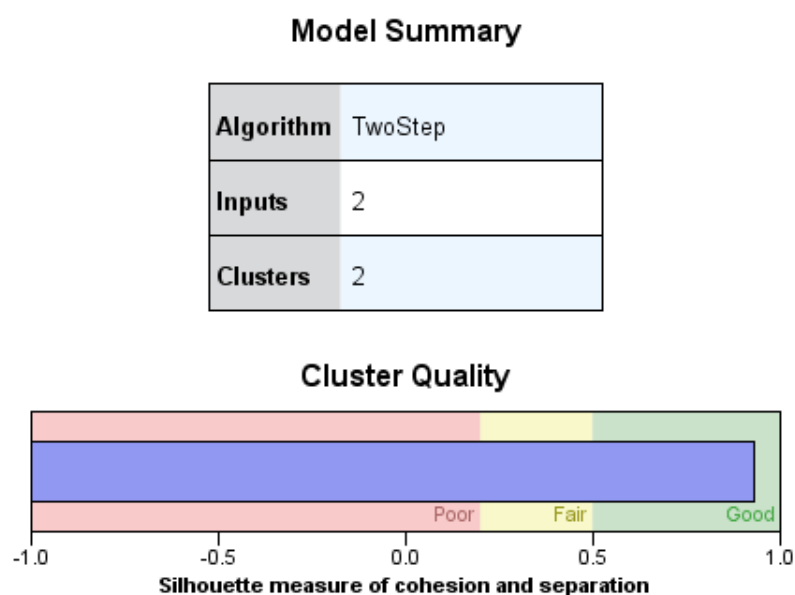


Figure 13: Cluster analysis model quality for Chimanimani households based on key seed utilisation variables (germination and clean seed).

4. Multinomial logistics regression of *Seed Availability* household characteristics

A multinomial logistic regression compared the households clustered according to their seed availability clusters in terms of their household characteristics. The three seed availability clusters (seed secure, seed insecure and diverse cluster) were developed from timelines of seed availability, proximity of seed and seed adequacy variables served as the dependent variables. The predictors used were : quantities of crops planted during 2015-2016, 2016-2017, quantities harvested and available 2015-2016, number of crops grown, number of seed sources, times receiving seed aid in the last five years, number and type of assets owned, number and type of livestock owned, size of land used (in ha), length of farming (years), location (Chikukwa or Chaseyama). After removing three cases that the analysis identified as outliers, the regression was run several times until the model remained with significant variables.

Table 6.4 in chapter six provides the final output from the multinomial logistic regression showing the significant variables as number of seed sources, total seed quantities of cereals planted during 2016-2017 season and location of the households (0 for Chaseyama and 1 for Chikukwa). The reference category used was the seed insecure cluster.

5. Logistics regression of *Seed Access* household characteristics

A multinomial logistic regression compared the households clustered according to their seed access clusters in terms of their household characteristics. The three seed access clusters (seed secure, seed insecure and diverse cluster) were developed from four seed access variables (seed affordability, sex of household head, age of household head and times of being a recipient of seed aid in the last five years). These seed access clusters served as the dependent variables. The predictors used were: total number of assets owned, number crops grown 2016-2017, number of seed sources, number and type of livestock owned, size of land used (in ha), length of farming (years), location (Chikukwa or Chaseyama).

Table 6.5 in chapter six provides the final output from the multinomial logistic regression showing the significant variables as the number of household assets owned, number of crops grown, number of seed sources and time the household has been farming in the area. The reference category used was the seed insecure cluster.