EXPECTATION MEETS REALITY: A CASE STUDY OF THE CONVSERVATION AGRICULTURE INTERVENTION PROGRAMME IN NKHOMA MISSION, MALAWI

by

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Conservation Agriculture (a three-practice intervention programme emphasising minimal tillage, crop rotation, and mulching) has been promoted as a sustainable, successful agricultural intervention programme in numerous countries. Yet, existing literature has only found Conservation Agriculture to have long-term success in tropical-environment countries. This thesis focuses on agricultural intervention programmes in the semi-arid country of Malawi, looking at smallholder farmers' likelihood in adopting Conservation Agriculture, rates of success if Conservation Agriculture is adopted, and sustainability of the programme. Building off of literature in a global and national context, 115 smallholder farmers in Nkhoma Mission, Malawi answered semi-inductive interview and focus group questions.

Results show that when Conservation Agriculture is adopted, it is usually abandoned within five years because farmers felt progress was taking too long or they did not feel they had support from local experts to continue with the technique. Rather, the data concludes that farmers favour a programme known as Sasakawa, which encourages the incorporation of traditional farming practice with a slight reduction in the number of seeds used. Sasakawa saw more immediate success than Conservation Agriculture.

An adaptation of Conservation Agriculture called Farming God's Way associates the three principles with being a good and Godly Christian. This adaptation saw the same results as Conservation Agriculture, but has a longer adoption rate before being abandoned. Farmers who

try Conservation Agriculture saw success, but felt they were doing something wrong and were unable to ask questions to local experts.

Given the results of the data, recommendations for further research include creating universal definitions and an evaluative framework for cross-environment and cross-country comparisons of intervention programmes, establishing a sample farm in central Malawi for a better long-term study on the success potential of Conservation Agriculture, Sasakawa, and Farming God's Way, and increased collaboration between the various organisations and actors teaching agricultural practices to smallholder farmers in the Nkhoma Mission area.

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LIST OF ACRONYMS

CA: Conservation Agriculture

CF: Conservation Farming

CGIAR: Consultative Group for International Agricultural Resources

CWFS: Committee on World Food Security

EU: European Union

FAO: Food and Agriculture Organization of the United Nations

FASR: Field Action Science Reports

FGW: Farming God's Way

FISP: Farm Input Subsidy Programme

HA: Hectare

ICARDA: International Centre for Agricultural Research in the Dry Areas

ICRAF: International Council for Research in Agroforestry; also called World Agroforestry Centre

ICRISAT: International Crops Research Institute for the Semi-Arid Tropics

IFAD: International Fund for Agricultural Development

IGOs: Inter-governmental Organizations

MDGs: Millennium Development Goals

MK: Malawian Kwacha

MoAFS: Ministry of Agriculture and Food Security

NCATF: National Conservation Agriculture Task Force in Malawi

NGOs: Non-governmental Organizations

OECD: Organisation for Economic Co-operation and Development

OPV: Open-pollinated Variety

PCA: Precision Conservation Agriculture

SDGs: Sustainable Development Goals

RT: Ridge Tillage

TA: Traditional Authority; refers to both geographic region and a high-level Chief

TF: Traditional Farming; refers to both practices and techniques used

WFP: World Food Programme

PREFACE

I would like to thank Mr. Patrick McGunagle and the University of Pittsburgh Nationality Room Scholarship Selection Committee, Ms. Belkys Torres and the UCIS International Travel Grant Selection Committee, and the GSPIA Professional Development Fund Selection Committee for providing generous financial support for this project.

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1.0 INTRODUCTION

"Give a man a fish, he eats for a meal. Teach a man to fish, he eats for a lifetime."

~African Proverb

Today, 10.7% of the world's population are under the global poverty line, indicating 1.1 billion people have moved out of poverty in the 5-year period from 2012-2017 (World Bank, 2017). However, for millions of people in the developing world, access to sustainable food sources prohibits their progress out of poverty. Access to sustainable food sources has been a top priority for inter-governmental organizations like the United Nations, the European Union, and non-governmental organizations like World Hunger for decades. Despite the billions of dollars spent on agricultural research, experts remain conflicted over how to achieve sustainable food security.

Over 90% of global food sources are smallholder-owned farms tasked with providing food for one or two families (USAID 2011). Most of these farms are in the developing world. In response to food security crisis, organizations and country governments have implemented various agricultural intervention programmes aimed at increasing crop production for farmers for better standards of living while also increasing disposable income available to the household.

Some of these programmes have seen great success, while others have been controversial or have failed.

The research questions posed in this thesis developed from inquiries into the status of sustainable food security achievement rates of semi-arid countries, and focus on agricultural intervention rates in Malawi. To obtain data regarding agricultural intervention programmes and practices, interviews and focus group discussions were conducted in Nkhoma Mission, Malawi over a six-week period.

A two-pronged literature review provides insight into the focus of agriculture interventions by the international development community and then in Malawi. The global focus of the first section highlights international focus on agriculture, especially as it pertains to the Millennium Development and later the Sustainable Development Goals. This focus, and the numerous international government organizations tasked with resolving food security deficits, has been forced to adapt to new challenges as the effects of climate change increase. Smallholder farmers in particular are vulnerable to climatic change, dealing with issues such as changing growing periods, unpredictable access to rain waters, and changes in soil nutrient levels. The global community has established and tried a large number of agricultural interventions in the developing world. This paper limits these interventions to Agroforestry, Ridge-Tillage, Conservation Agriculture, Sasakawa, Traditional Farming practices, and Government subsidy programmes. Conservation Agriculture is described as a three-pronged intervention system consisting of minimal soil disturbance, mulching, and crop rotation. Its related adaptations are then presented and analysed for successes and failures in the developing world. From this, a gap in the literature emerges: Conservation Agriculture has not been tested as a sustainable, long-term solution in semi-arid environments.

The second portion of the literature review focuses on Malawi as a semi-arid environment, providing a history Malawi's agriculture practices. The second section follows a similar pattern of discussion as the first focusing on climate change, agricultural interventions tried in country with Conservation Agriculture highlighted for longer analysis. Farming God's Way, a Malawi-based adaptation of Conservation Agriculture, is also presented. This portion reiterates the lack of literature supporting Conservation Agriculture as a sustainable, long-term solution is missing. This thesis thus focuses on data collection responding to research questions supported by the literature: identification of agricultural techniques adopted by smallholder farmers in Malawi, related factors in the decision of adoption, and evidence of Conservation Agriculture's success in a semi-arid environment.

The third chapter gives the methodology, identified as a case study in Nkhoma Mission, Malawi. This chapter provides the rationale for the decision to use case study methodology, along with the semi-inductive creation of questions for interviews and focus groups. The chapter concludes with an identification and analysis of potential limitations associated with the research and the formal research design. The fourth chapter identifies definitions of potentially complicated terms and is where the hypotheses are developed.

The fifth chapter describes and analyses the field data collected by the researcher. A total of 115 participants answered questions and provided basic demographic data. As such, the fifth chapter is divided into three sections: demographic analysis, open-ended question responses and analysis, and a series of summary statements on the overall dataset. In particular, demographic analysis is conducted along age, sex, educational level, farm size, current farming practices, and farming technique response lines. Open-ended question responses are analysed in 11 categories based on participant responses.

The sixth chapter provides recommendations and next steps in a five-section format. Recommendations are made for the local Nkhoma Mission community, the international research community, and the researcher. Finally, the seventh chapter concludes the thesis, linking the findings to the overall literature review provided in chapter two and reiterating the main findings of the work.

1.1 RESEARCH QUESTIONS

The primary research question that this thesis focuses on is: What factors influence smallholder Malawian farmers' adoption of new agricultural techniques?

Secondary questions include: What agricultural techniques have Malawian smallholder farmers adopted? What agricultural intervention programmes are in operating in Nkhoma Mission? These questions are secondary in nature because variation in the adoption of different programmes can be used to parse out different reasons for adoption and understanding what types of interventions are available to smallholder farmers aids a more inclusive analysis.

1.2 THESIS

The thesis discusses the various agricultural techniques and related intervention programmes in Nkhoma Mission, with particular focus on Conservation Agriculture and its capacity amongst smallholder farmers. Adoption rates of Conservation Agriculture are low among smallholder farmers in Nkhoma Mission because of misunderstandings of the concept

and related terms (e.g., definition disparities, differences in specific measurements used, assumptions on time between implementation of programme and improvements in crop production), availability of competing intervention programmes with varying levels of support, and preconceived notions of required farming inputs for crop production success. When offered opportunities to learn new techniques, Conservation Agriculture is seen as difficult or more labour-intensive compared to traditional farming methods. Thus, Conservation Agriculture is dismissed in favour of small, incremental adaptations to currently used farming techniques, such as the Sasakawa method. Differing definitions regarding agricultural intervention programmes in the Nkhoma Mission area blur the lines of comprehension for farmers and researchers alike. The lack of universal definitions creates confusion and mistakes among farmers. Until common definitions are established, farmers continue to differ in understanding of technique implementations, and experience frustration at the lack of progress seen in their own crop production. Farming God's Way and Conservation Agriculture are essentially the same intervention programme with the main difference being the incorporation of prayer in the former. This overlapping understanding of the interventions creates difficulties in distinguishing between the two programmes and dilemmas in evaluating success in terms of adoption rates and crop production yield.

2.0 LITERATURE REVIEW

This section is divided into two major parts and examines the current scholarship and organisational discussions surrounding agricultural intervention methods and their conditions for success. The first part begins with a brief discussion on the role of agricultural intervention in international development, where the contextual importance of the research questions are analysed. The impact of climate change on agricultural production follows, noting the importance of government support and a revitalized debate on seed type for smallholder farmers. Specific agricultural interventions are then examined, with relevant strengths and weaknesses analysed in a global context.

The second part focuses on Malawi-specific literature and presents scholarship relevant to the conditions of and opportunities available to smallholder farmers. First, the discussion focuses on the diverse history of Malawi-based agricultural interventions and their relevant successes or failures. A country profile on Malawi is presented, and is inclusive of relevant demographic information. This part then focuses on the impact of climate change on Malawian smallholder farmers. The chapter concludes with considerations of the modern debates of agricultural intervention programmes in Malawi. Overall, the literature review focuses particular attention to on two intervention programmes (Conservation Agriculture and Farming God's Way) in Malawi, and ends with a discussion on the knowledge gaps this paper aims to address.

2.1 INTERNATIONAL DEVELOPMENT AND AGRICULTURE: MDGS, SDGS, AND NGOS

In September 2000, 189 world leaders signed the Millennium Development Goals (MDG), a set of eight universal objectives for all countries to achieve by 2015 aimed towards improving the human condition (FAO, 2001). Established by the United Nations (UN), the first of these international goals—known as MDG 1—was to eradicate extreme poverty and hunger. The goal aimed to accomplish three specific targets during the period from 1990-2015: halve the proportion of people whose income is less than $1.25USD a day, achieve full and productive employment and decent work for all, and halve the proportion of people who suffer from hunger (Ibid). The MDGs were interconnected in scope and focus which led to overlap among the eight goals. Related MDGs include MDG 7: ensuring environmental sustainability; MDG 3: promoting gender equality and empowering women; and MDG 8: Global partnership for development. Food security was indirectly linked to the remaining goals dealing with primary education (MDG 2), child mortality (MDG 4), maternal health (MDG 5), and combatting diseases (MDG 6). Following the adoption of UN resolution A/RES/55/2, international and intergovernmental organisations such as the Food and Agricultural Organization (FAO) convened food summits, created policy statements, and worked with country governments on progress towards MDG 1 as related to food security.

A midpoint evaluation of global goal progress was scheduled for 7 July 2007 and, while Asia was found to have made great stride in agricultural productivity, there was, “essentially little to no progress on overall poverty rates since 1990” in Sub-Saharan Africa (Prowse et al., 2007). The United Kingdom Department for International Development released an Agricultural

Policy Paper in preparation for the midterm report, highlighting the critical role of small farms and the need to place smallholder farmers first in agricultural development (Ibid).

With not all of the MDGs met and 815 million people still malnourished, the Sustainable Development Goals (SDGs) were signed by nearly all country governments in 2014. The SDGs effectively replaced the MDGs and launched 17 new objectives for global achievement by 2030. SDG 2 was to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture (UN, 2017). This goal expanded the former MDG 1 from three targets to five in the new SDG:

- 2.1 by 2030 end hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round;
- 2.2 by 2030 end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons;
- 2.3 by 2030 double the agricultural productivity and the incomes of small-scale food producers, particularly women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment;
- 2.4 by 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme

weather, drought, flooding and other disasters, and that progressively improve land and soil quality;

- 2.5 by 2020 maintain genetic diversity of seeds, cultivated plants, farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at national, regional and international levels, and ensure access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge as internationally agreed.

(UN, 2017)

As with the MDGs, the SDGs focused on food security overlaps with several other goals including no poverty (SDG 1); good health and well-being (SDG 3); quality education (SDG 4); gender equality (SDG 5); decent work and economic growth (SDG 8); reduced inequality (SDG 10); sustainable cities and communities (SDG 11); climate action (SDG 13); life on land (SDG 15); and partnerships for the goals (SDG 17) (UN, 2017).

Prior to the MDGs and the SDGs, the Committee on World Food Security (CWFS) (1974) was established as an intergovernmental body for the UN. It was tasked with reviewing food security issues such as increased global food prices, famine concerns, and child malnutrition. With funding provided by the FAO, IFAD, and WFP, the Committee on World Food Security is charged with generating policies to assist country governments, non-governmental organizations (NGOs), intergovernmental organizations (IGOs), and other stakeholder actors in achieving global and universal food security (FAO 2015b) CWFS also tries

to formulate pre-emptive measures to combat the impact of climate change on agriculture and global food distribution, some of which are discussed below. (Ibid).

2.1.1 The Impact of Climate Change on Global Food Production

Climatic change is most frequently viewed as a gradual, non-linear process which may have large impacts on crops, notably on the utilization aspects of seed security and crop suitability as environments change (Nordhagen & Pascual, 2013).

At the Future Forum on World Food Affairs in October 2014, Dr. Rwelamira of the Sasakawa Africa Association presented research estimating that globally, three to four billion people will suffer chronic malnutrition and severe starvation by the end of the 21st century. Of those people, approximately 65% of the most impacted will be smallholder farmers (Rwelamira, 2014). Some of that number is attributed to climate change and its increasing impact on smallholder farmers and their crops. Drs. Nordhagen & Pascual at the University of Cambridge (2013) note that the, "vast majority of small-scale farmers in Sub-Saharan Africa will suffer agricultural losses due to higher frequency [of climate change-related events], greater intensity, and growing magnitude of extreme events." A 2015 article by Springmann et al. estimates that agriculturally-mediated changes from climate change will be the cause of death for, "155 world regions by the year 2050, resulting in approximately 529,000 deaths." Beyond linking climate change to deaths from food insecurity, Springmann and colleagues determined that by 2050 climate change will have caused a three percent reduction in all global food availability (Ibid).

There have been attempts to mitigate the effects of climate change on food availability, most notably through initiatives on diversification of crops grown and inputs utilized (seeds,

fertiliser, manure, etc.). These coping mechanisms are not limited to agriculture itself, but also including movements away from reliance on agriculture for families, family labour, and inherent resiliency of smallholder farmers to respond to climate change impacts (Nordhagen and Pascual, 2013).

To address climate change and its impact for smallholder farmers in various global and national case studies, the following paragraphs present discussions of seed security concerns, a primary focus of contemporary researchers. Nordhagen and Pascual (2013) discuss the importance of variegation of seed sources, especially for smallholder farmers. Climate shocks often push farmers to purchase seeds from local markets but the quality of these seeds and uniformity of them can result in an overabundance of a particular crop (Ibid). Reversion to local seed markets, rather than an increasing reliance on hybrid seeds, may be critical for long-term adaptation and resilience of food sources in the wake of climate change (Ibid). Contrastingly, seed security is defined as sufficient seed availability, access, and utilization (Ibid). Seed insecurity is normally acute, localized to specific countries as a result of external shocks such as climate change, poverty, and civil unrest (Ibid). One way to combat seed insecurity is government intervention through subsidy programmes or other seed handout programmes (Remington et al., 2002).

The movement of governments in Sub-Saharan Africa towards subsidization and favouring of hybrid seeds can be seen as exacerbating the impact of climate change on reducing overall crop production (Remington et al., 2002). A 2012 OECD report on Agricultural Input Subsidies in Sub-Saharan Africa found that 84% of all seeds supplied through government

subsidy programmes are hybrid-based rather than open-pollinated seeds (OPV).[1] Recently, the debate over the use of hybrid seeds to increase one-time crop production versus OPV varieties, also called "indigenous traditional methods," has emerged (Mngoli et al., 2015). Mngoli and colleagues (2015) studied the impacts of hybrid seeds and OPV seeds in semi-arid environments in the developing world, concluding that for approximately 45% of smallholder farmers, indigenous/traditional methods of saving and storing seeds for future harvest use is often a natural, preferred part of the farming process. A majority (70%) of smallholder farmers using traditional seed methods selected seeds during their harvest period (Ibid). Researchers go on to say that in the 40 sample farms there was an increase in use of traditional method for seed collection and use despite heavy government support and promotion of hybrid seeds (Ibid).

The extent of climate change on promotion of seeds and long-term agricultural production cannot be ignored. However, direct solutions for smallholder farmers, particularly in semi-arid environments in the developing world, are costly, one-time solutions as demonstrated through the discussion on hybrid seeds. Farmers need agricultural interventions already equipped to deal with the impact of climate change in a sustainable manner. The following section focuses on the varying forms of agricultural interventions used throughout the developing world.

2.1.2 Agricultural Interventions to Address Food Insecurity

This subsection discusses two particular forms of traditional farming practices: ridges and Sasakawa. Traditional farming practices, defined by the FAO (2011) as "those practices that

[1] Open-pollinated seeds rely in insect, bird, wind, human , or other natural mechanisms to pollinate and germinate a seed while hybrid seeds are specific, genetic-modifications done to select for certain traits in a crop.

have been used by African farmers for generations without formal documentation or scientific research," dominated farming techniques in Malawi from the 1930s to modern day. Today's traditional farming practices focus on ridge tillage: a system of pilling up dirt into tall, narrow piles in which seeds can be placed (Mloza-Banda et al., 2014). Ridge tillage was found to control for weeds, incorporate crop residues from previous harvests, and prepare the seedbed while increasing access to nutrients (Ibid). Furthermore, it resulted in the reduction of residue- and soil-borne diseases, controlling of pests, incorporation of previous crop residues/weeds to the soil for provision of nutrients, preparation of seedbeds for better crop growth, and it smelt better for people to work in the fields (Hobbes, 2007).

The limitations of tillage[2] were generally disregarded until the 1930s US Dust Bowl and the over-tilling of 30 million acres led to a food shortage. Since then, tillage has come to be associated with high labour costs, greenhouse gas release, and there is scientific consensus that consistently breaking the soil deprives the areas around seeds of nutrients while further damage to the earth is not yet known (Hobbes 2007). Tillage was no longer viewed as effective, leading to the call for new agricultural techniques.

As a specific response to a massive drought in the 1980s Sasakawa gained popularity for its ease of adoption. The Sasakawa Africa Association was established to, "alleviate hunger and poverty and improve health in Sub-Saharan Africa" through helping policy makers "design and implement more effective, smallholder-friendly policies" (Rwelamirea, 2014). The Association actively promotes government-level adoption and promotion of a small adaptation to traditional

[2] Tillage refers to any soil disturbance whereas RT refers to soil disturbance for the creation of ridges

farming methods: planting a reduced number of seeds into planting stations. Between 1986 and 2003, the Sasakawa Africa Fund for Extension Education operated in 15 countries (Ibid).

An international research coalition on agricultural policy interventions in developing countries suggests that rather than relying on external organizations, like the Sasakawa African Association to help create food security, governments should focus on actions they themselves can take (i.e. price stabilization inclusive of border protection and subsidies) (Mullen et al., 2004). The coalition goes on to conclude that by alleviating border tariffs and lowering costs of agricultural inputs, developing nations will be able to diversify crops and begins competing across borders, rather than within them (Ibid). Another government action can be the subsidization of farming input costs, such as seeds or fertiliser.

A report compiled by the OECD on Agricultural Policy Choices in Developing Countries synthesized the importance of agricultural input subsidies, but encouraged developing country governments to go further than fertiliser and include subsidies on tools and manure (Brooks, 2010). The report also suggests the importance of subsidizing the costs of healthcare and education as these indirect interventions would result in agricultural improvements in the long-term (Ibid).

A number of agricultural interventions have been implemented throughout the developing world, with some seeing greater success than others. Success rates are often determined through increases in crop yields, rates of adoption of programme concepts, and self-sufficient sustainability of progress in the long run. While each programme has specific definitions of success, these overlapping notions present a cross-programme discussion and analysis. Despite ongoing debates over many of these practices, Conservation Agriculture has been arguably one of most frequently debated and analysed.

2.1.3 Conservation Agriculture as an Agricultural Intervention Programme

This subsection focuses on Conservation Agriculture and the rationale of its adoption by smallholder farmers in the developing world. Arguments for and against the adoption of Conservation Agriculture are presented.

2.1.3.1 Background of Conservation Agriculture:

Conservation Agriculture (CA) is comprised of three interventions: reduced soil tillage, increased mulching, and crop rotation (Giller et al., 2015). Soil tillage refers to how often soil is dug, stirred, or turned over ("Agriculture," 2017) (Figure 1). Increased mulching requires leaving biologically decomposed organic materials such as crop residue or animal waste on top of soil for nutrients to be absorbed (California, 2014). Crop rotation incorporates the specific varying of successive crops either in the same planting season or from year to year to avoid total soil depletion, control weeds, and allow the return of certain nutrients to the ground (Ibid).

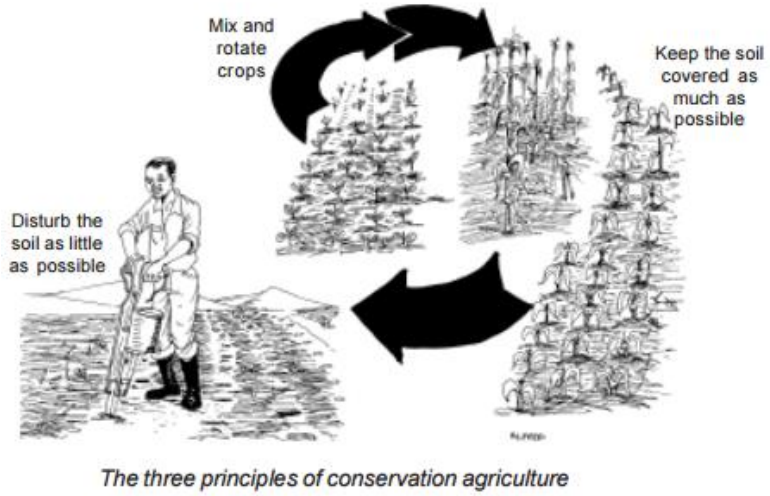


Figure 1: Conservation Agriculture Principles

With origins in the 1930s United States Dust Bowl, CA had much of its early success in Brazil and other tropical regions. Brazil underwent a "zero-tillage revolution" in the Cerrado region[3] starting in 1972 (Science, 2007). Initially, the country's farmers were hesitant to adopt the no-tillage technique, but by the 1990s, one million hectares (ha)[4] were using the method (Agriculture, 1997). Bolliger et al. (2006) traces the history of this practice and other agricultural interventions in Brazil from the mid-1980s to the 2000s. While their research does not use the term "conservation agriculture," the three interventions are named separately as the methods of agricultural intervention: cash and cover crops were used for crop rotation; permanent mulch covering from decomposition of organic materials; and the zero-tillage practice (Bollinger et al., 2006). Bollinger and colleagues question if zero-tillage actually improves crop yields as often farmers commit to minimal tillage rather than zero. Strictly adhering to the definition of CA, zero-tillage means absolutely no disturbance of the soil. However, rather than adhering to this, many farmers would simply till soil less often than they had in previous planting seasons (Ibid). The researchers question the impact of fertilisers, herbicides, and modified seeds on production yields. They conclude that herbicides are a "massive advantage for farmers with sufficient capital" but not enough information is able to be collected on modified seeds and fertiliser impacts.

A variation of CA was introduced into Zimbabwe in the 1980s: Conservation Farming (CF). Conservation Farming includes the three interventions of Conservation Agriculture and adds a fourth based on a zai pit system (Twomlow et al., 2008). The zai pits, also known as

[3] A tropical savannah region of approximately 204 million hectares
[4] Hectare = 2.5 acres

planting basins, require specific holes or 'pits' to be dug for seed planting (ICRISAT, 2009).[5] Twomlow et al.'s (2008) study specifies the difference between CA and CF in Zimbabwe. CF requires that seeds in these pits have micro-doses of fertiliser (Twomlow et al., 2008). Furthermore, the seeds themselves should be improved seeds with higher productivity than traditional seeds. Rapid yield increases and higher adoption rate patterns emerged with the addition of zai pits (Mazvimavi et al., 2011). The zai pit system requires seed pits to be dug in the same spot every year and is rarely adopted across entire farms (S. Twomlow, personal communication, May 2015). However, Mazvimavi's (2001) study on behalf of ICRISAT found that CF in Zimbabwe was beginning to decline in 2006 (Table 1).

Technique	**Cropping season**				
	2004/05[a]	**2005/06[a]**	**2006/07**	**2007/08**	**2008/09**
Winter weeding	51	87	76	71	63
Application of mulch	40	75	69	70	56
Digging of basins	100	99	99	97	89
Application of manure	89	88	89	87	80
Application of basal fertilizer	71	75	74	66	38
Application of top dressing	94	92	92	88	70
Post-planting timely weeding	94	98	99	96	85
Crop rotation	8	13	13	18	19

[a] Data for 2004/2005 and 2005/2006 seasons was obtained during the 2006/2007 survey

Table 1: Proportion (%) of farmers using particular components of CA techniques in Zimbabwe

Mazvimavi and colleagues find this decline is due to the increased labour requirements of the zai pits (Ibid).

[5] It is worth noting that Giller disagrees with this understanding of the zai pit system, writing that shallow pits are different from zai as zais are deep and more sparsely arranged (K. Giller, personal communication, May 2017)

The three primary interventions associated with CA have been deemed successful in a number of tropical-environment, developing countries, without consideration of the zai pit system. The rationale and motivations for adopting CA techniques is discussed in the following subsection.

2.1.3.2 Motivations, Benefits, and Reasons for Adoption of Conservation Agriculture

CA has risen in popularity since the 1990s, increasing from 2.8 million hectares (ha) worldwide in 1973 to 125 million ha in 2011 (Friedrich et al., 2008). In Sub-Saharan Africa alone, one million ha owned by over 400,000 small-scale farmers use CA practices. *The Journal of Field Actions Science Reports* (FASR) published a 2012 special issue in which CA is hailed as a "new alternative paradigm for the 21st century" as long as farmers have a "mechanism to experiment, learn, and adapt" (Friedrich et al., 2008). ICRISAT agrees, saying CA is "breathing new life into African smallholder farming" (Twomlow & Hove, 2006).

The FAO cites numerous benefits from using CA including carbon credit rewards, reduction in pollution, improved surface water quality, and a reduction in costs over a period of time (FAO, 2002). The International Centre for Agricultural Research in the Dry Areas (ICARDA), which promotes CA in Syria and Iraq, agrees with the FAO. ICARDA reports that small-scale farmers see a significant cost reduction ($80USD/ha) and increased profits ($100USD/ha), and not just simply a reduction in costs (ICRISAT, 2013). Researchers from Cornell University's College of Agriculture and Life Sciences measured crop yield increases at up to 48% in Paraguay, resulting in a $9000USD increase in profits.[6] Twomlow's 2016 report for

[6] Increase was from $23,467 to $32,608; Phillips, 2013

IFAD categorizes CA as a "climate-smart agriculture," arguing CA combines improved crop production, increased carbon sequestration, and better climate-resilient crops (IFAD, 2016). Additionally, the FASR special report lists the reasons for adoption of CA as better farm economy, flexible technical possibilities, yield increases and stability, soil protection, greater nutrient-efficiency, and better water economy. A 2011 study conducted by Li Ling-ling et al. in China found CA benefits also include soil conservation which in turn curbs erosions rates.

Researchers at Cornell University speak to the benefits of CA in terms of climate change, stating that CA operates with less labour, less water, and fewer chemical inputs than most conventional agricultural practices (Philips, 2013). The example of Ghana, which saw a 22% reduction in the amount of labour necessary once CA practices had been fully implemented (approximately seven years after initial intervention), is used (Ibid). Increased infiltration and enhanced water capacity can be obtained through adequate mulch coverings. This means less water is necessary over the course of a planting year (Phillips, 2013).

In a 2014 research article published by Tesfaye et al., the merits of CA in the developing world is noted to include "knowledge and technology intensive practice and [CA] may not be feasible under all conditions and farming systems." However, the techniques do show a potential advantage over conventional agricultural practices in environments subject to excess or deficit water.

Conversely, the CGIAR conducted an analysis of 41 studies that compared CA with conventional farming practices in Sub-Saharan Africa. The results of that report found CA is promoted as a mechanism for overcoming poor-profitability and soil degradation. It also concluded that CA, while highly effective if all three principles of intervention are used, depresses crop yields when only one principle is applied (CGIAR, 2014). The exception to this

finding was the use of adequate mulch coverings, which when used by itself, did increase crop production. The following discussion elaborates on the concerns and potential consequences of CA.

2.1.3.3 Concerns and Perceived Limitations of Conservation Agriculture

Despite its apparent successes, there are numerous concerns regarding CA. In particular are the initial costs, long-term technique sustainability, and success in different environments. The first concern discussed in this section is the increase in costs upon initial transition to CA techniques. Despite positive feedback from ICARDA, upfront costs for small-scale farmers totalled $20USD/ha in herbicide alone (ICARDA, 2013). ICARDA stipulates that success with CA is heavily correlated with efficient use of regular/predictable rainfall and/or irrigation systems, a rarity in places like rural Malawi. The FAO cites starting costs (e.g. herbicide, fertiliser, seeds, and farming equipment) as a major disadvantage to CA, a finding corroborated by Cornell University (FAO, 2015; Cornell, 2015). The primary issue with starting costs is that rather than existing as a one-time expense, starting costs often occur during the "transition period" between traditional farming methods and CA, estimated to be five to seven years (Cornell, 2015).

A 2003 study by Maonga and Maharjan finds that, "some traditional technologies and practices of smallholder farmers are more sustainable," especially as farmers often know their land the best. Farmers have likely adapted their techniques and planting schedules to their specific land and can plan accordingly for crop placement, spacing, and other factors of the basic agroecosystem. Halbrendt et al.'s 2014 article published in *Global Environmental Change* raises concerns over the ability to judge local population priorities in adoption of new technology by

external actors. The researchers conducted a case study on longevity of intervention programmes concluding that mental models, defined as the existing beliefs held by farmers and the local population[7], often reappear when development projects end (Cochran, 2003). The article suggests that intervention programmes must rely on interdisciplinary teams comprising of local members if there is to be long-term success on any programme, not just those limited to agricultural development (Ibid). Of primary concern to the researchers was the imposition of so-called scientific methods without understanding the cultural motivations and reasoning for traditional farming practices. In other words, Halbrendt and colleagues (2014) conclude that adoption of new farming techniques is most successful when techniques are integrated with cultural values and implemented in a culturally sensitive manner. It is a generally agreed upon conclusion that CA will not work until the farmers themselves buy into the process, find long-term success and cost saving results, and feel as if the process is inclusive of their traditional practices (IFAD, 2016).

A second critique of CA is that true sustainability of CA requires adequate mulch covering. Mulch covers require decomposition of organic material, such as animal or plant waste. Giller et al. (2009) point out the restrictions of this requirement if farmers do not have sufficient livestock. Limited livestock and species diversification diminish farmers' ability to use natural fertilisers.[8] Furthermore, the costs of feeding livestock must be measured against feeding family members in periods of limited crop yields (Ibid).

[7] Mental models were first discussed by Craik (1943) and are widely accepted in the field of social sciences (Gray et al., 2014)
[8] Natural fertilisers refers to animal manure, using crop residues, etc.

Photo 1: Mulching over Traditional Farming soil

A third critique is the lack of adaptability of CA successes in non-tropical environments. A December 2016 report for IFAD on Designing and Implementing Conservation Agriculture in Sub-Saharan Africa concluded that thus far, CA has been "promoted insensitively [. . .] and uptake has been generally disappointing." The report goes on to argue the reasons for failure for CA, discussed as a lack of continued use of CA techniques, are often not the fault of the programme itself, but rather mixed messages to farmers, too short a trial period by farmers with too little success, and inadequate incentives to try a new (and potentially risky) technique (Appendix A) (IFAD, 2016). Of notable concern to farmers is how long it takes to see results (Ibid). IFAD further argues that the infertility of Africa's soils means yields in the initial years following CA adoption can be greatly reduced compared to yields expected from traditional farming methods (IFAD 2016).

Giller (2015) concludes that CA proponents such as the FAO, EU, ICRAF, and ICRISAT are too optimistic in the ability of CA to transform an environment. Giller believes that the 3

interventions are too narrow and restrictive to allow any kind of sustainability. There is little doubt that agriculture plays a critical part for smallholder farmers if intervention programmes are tailored to smallholder needs and environments (Ibid).

For the purposes of this thesis, agricultural interventions specific to semi-arid regions is the focus. The following section presents and discusses literature on agricultural intervention attempts and successes in Malawi specifically, beginning with a brief country profile on the demographics of the population.

2.2 MALAWI COUNTRY PROFILE

Affectionately known as the "Warm Heart of Africa," the Republic of Malawi, formerly known as Nyasaland, was granted independence from the British in 1964. A predominantly Christian nation, 83% of Malawi's 18 million residents practice a conservative form of Christianity, while 13% practice Islam (CIA, 2017). Characterized by limited access to food and income revenue, Malawi's Human Development Index ranking is 0.445 (categorized as a low developing nation), placing the country at 174 of 188 in the global listing (United, 2015; UNDP, 2015). An estimated 22% of the population is categorized as ultra-poor,[9] with an additional 52% living below the global poverty line (Republic, 2008; World Bank, 2007)[10]. The population density equates to 177.08 people/sq. km (Google, 2014; Trading, 2017).

[9] Ultra-poor is equivalent to extremely poor; phrase is native to Republic 2008 source
[10] NSO (2012) cites this statistic at 56.6%

Although agriculture officially comprises 35% of the country's GDP (Ngwira et al., 2012), 80% of the population identify as subsistence farmers, growing maize for food and income (National, 2008). Maize is the staple crop of Malawi, planted on 1.66 million ha, 80% of cultivated land, and filling 80% of the average Malawian's caloric intake (Ngwira et al., 2012). All crops, whether for subsistence farming or exportation[11] are grown on 59.2% of the 94,080 sq. km of available land (CIA, 2017). Total crop production averages less than one tonne per ha and is unable to meet the nutritional needs of most Malawian households (Jere, 2012).

In Malawi, an average of 24% of homes are female-headed households (FAO, 2011). On average, these female-headed households have 1.56 ha of land while male-headed households own 2.15ha (Kakota et al., 2015). Additionally, female-headed households are more vulnerable to food insecurity because of low access to resources for food production and purchases, often attributed to being unable to find work or having to spend time caring for family members/children (Ibid). Furthermore, females are tasked with domestic tasks such as water collection, which, depending on the time of year and proximity of water sources, can take several hours a day (Kakota et al., 2015). Water access can improve substantially during the rainy season.

The vast majority (90%) of Malawi's rains fall between December and March (Mloza-Banda et al., 2014). The country's semi-arid environment should generate less than 20 inches[12] of rain each year ("Semiarid," 2017). Despite fitting this criteria for a semi-arid environment, from 1967-2016, Malawi experienced 43 rain-related disasters in the form of droughts[13] or floods

[11] Primary crops for exportation are tobacco and tea
[12] 20 in = 508 mm
[13] Drought refers to circumstances where soil moisture is insufficient and therefore results in the lack of crop growth and production; (Drought, 2017)

(Université, 2016). These water deficits or abundances impact the ability of farmers to plant, harvest, and maintain crops as shallow-well water reserves can be dangerously depleted or soil can become oversaturated and lose critical nutrients. One potential aftermath of these natural disasters is often famine.[14] Two such instances where massive famine resulted from flooding and droughts were in 2001—affecting over 2.8 million people—and in 2005—affecting 5.1 million people (Université, 2015). Another consequence is an effect known as price scissors. Price scissors refers to an economic phenomenon in which the overall valuation of a crop fluctuates depending on limited supply rather than demand; in the case of Malawi there is a 400% price difference between the price of maize right before the harvest occurs and afterward (a drop of 400% after supply increases) (Devereux, 2008).

The severity of both consequences can be measured through a Presidential Disaster Declaration: a formal request for international assistance from the President of Malawi (ReliefWeb, 2016). These declarations are often used to reassure the Malawian population and the international community of the commitment to finding solutions to food insecurity while providing critical information on the status of food in the country and the number of people negatively affected (Ibid). Local experts from the University of Malawi, agricultural stations around the country, and leaders of NGOs in addition to international experts are consulted to create and implement sustainable agricultural programmes.

Presidential Disaster Declarations and new policies on food security issues often centre on the Farm Input Subsidy Programme run by the Ministry of Agriculture and Food Security (MoAFS). MoAFS is charged with providing innovative food security solutions for the people of

[14] Famine refers to catastrophic disruption of the social, economic, and institutional systems that provide for food production, distribution, and consumption (Phillips, 2013)

Malawi, and that often means dealing with the short- and long-term consequences of climate change.

2.2.1 Malawi Food Production and the Impact of Climate Change

Just as the number of people facing hunger around the world is projected to increase dramatically, so will the population of Sub-Saharan Africa. Dr. Rwelamira's (2014) presentation estimates that the population of Sub-Saharan Africa will increase from 800 million in 2014 to over 1.5 billion people by 2050. This population increase, coupled with the effects of climate change on the global food supply could have devastating impacts for Malawi. Furthermore, Chinowsky et al. published an article in 2015 in *Climatic Change*, warning of the dangers to Malawi should climate change continue at its projected rates. Chinowsky and colleagues (2015) argue that because of the proximity of Malawi to massive amount of water in Lake Malawi (Map 1), the country is at risk for 100% country-wide flooding in the next 100 years.

Map 1: Political Map of Malawi

Many scholars, including Devereux (2008), Alexander et al. (2004), and Nordhagen and Pascual (2013), argue that the Malawian government introduced seed subsidy programmes as a way to combat the short-term consequences of climate change. The notion of seed security, as previously discussed, is also relevant to Malawi where farmers depend primarily on informal sources for seeds (Alexander et al, 2004).

The government of Malawi does have a subsidy programme which focused on seeds in the past. The Government of Malawi established the Farm Input Subsidy Programme (FISP) to increase maize production deficits attributed to periods of drought and flooding (which were in turn attributed to climate change) (Devereux, 2008). FISP introduced the "start pack" programme in 1998 which included necessary farming inputs (seeds, fertiliser, hand tools) for families determined to be at severe risk[15] for poverty (Nordhagen and Pascual, 2013). Then in 2000, the programme was revised to only provide inputs in the form of OPV seeds (over hybrid seeds due to costs) (Ibid). The programme was revised again in 2005 to reverse this decision and focus on hybrid seed distribution (generally for maize crops) instead of OPV seeds through the introduction of a "smart voucher" system (Ibid). Nordhagen and Pascual (2013) conclude that the FISP has done more harm than good for the majority of Malawians as policy changes in favour of hybrid seeds have driven up the cost of local seeds, decreasing the amount of seeds Malawians can purchase. The researchers further conclude that FISP decreases variation in crop production, leading to overcrowding at the markets (Ibid). Therefore, emphasis should be spent on encouraging the growth of farmer-determined networks for seed sharing and exchange. This

[15] Government does not have a constant or publicly available definition for how it determines who is categorized as severe risk.

process will not mitigate climate change, but it will lessen the cost of inputs and increase potential incomes through crop diversification (Ibid).

Despite the preceding discussion, the impacts of climate change are a relatively new dilemma Malawian smallholder farmers have to face. Challenges generally centre on what types of farming techniques to use and the types of seeds farmers would choose. The subsequent section discusses a brief history of agricultural intervention programmes in Nyasaland, the name of the former-British Protectorate now called Malawi.

2.2.2 The History of Agricultural Intervention Programmes in Malawi

Traditional farming practices, discussed in preceding sections, focused on the importance of RT and making ridges. This section discusses how RT was introduced in Malawi and provides a brief history on the adoption of RT in Malawi during colonial rule.

While under British domain, Nyasaland's purpose was to grow high quality tea and tobacco to be exported to Europe and other countries for profit (Green, 2009). Conservation efforts for agriculture resulted in increased crop quality in Uganda and Tanzania and anti-soil erosion techniques were introduced in Malawi in the 1930s (Ibid). At this time, agricultural extension services were directed by colonial officials' perceptions about African farmers rather than detailed empirical knowledge about existing farming methods and initially concentrated in a small land area with a few farmers (Green, 2009). As such, and with the goal of quality over quantity, interventions in African farming communities remained modest from the lack of capital for investment (Ibid). Furthermore, British colonials had little concept of what the traditional

farming practices were in Malawi. In 1931, the Director of Agriculture in Nyasaland wrote he was "not sure that the native systems can or even must be improved, but they are worthy of study to show how best they can develop" (NA, 1931).

Three distinct periods of agricultural extension can be identified in the history of Nyasaland: 1920s-1930s—the colonial administration reached to changes in the British economy by focusing on improving quality of select crops in select regions of the country; 1930s-1940s—agricultural extension services were slowly integrated into the Department of Agriculture with focus on tobacco and tea production; 1945-1960s—funds increased for agricultural extension services and more comprehensive programmes throughout the country were established such as RT (Green, 2009). These periods indicate a change in the application and understanding of agricultural practices, and that techniques believed to be successful in the past or in other regions may not find sustainable success in Nyasaland (Ibid).

Ridges were nearly nationally adopted by the mid-1950s, using the Master Farmers Scheme (Green, 2009). The Master Farmers Scheme trained an estimated 200 key farmers in local areas in so-called proper techniques. Farmers were provided incentives such as cash bonuses or farming inputs such as fertiliser for training others and adhering to new laws on farming techniques (Ibid). To ensure the success of the scheme, laws were passed in Nyasaland that would fine and jail anyone caught not using ridges to farm (Ibid). This period was called the, "darkest era in the history of agricultural extension service in Malawi," while also being recognized as the most successful in "convincing Malawians to adopt a new method" (Ibid). Today, ridges are known as the traditional method of farming, and a number of new intervention programmes have been launched in Malawi. The subsequent section discusses some of these

programmes, with special focus on the impact of Conservation Agriculture and its potential for success.

2.2.3 Agricultural Interventions in Malawi

Focusing the discussion to central Malawi, farmers make their ridges annually by removing or burning crops residues from the previous harvest (Photos 2-3) and using a hand-held hoe that permits shallow depth of cultivation (Mloza-Banda et al., 2014). These depths are then built up into hills traveling the length of the farm and seeds are pressed into them (Ibid).

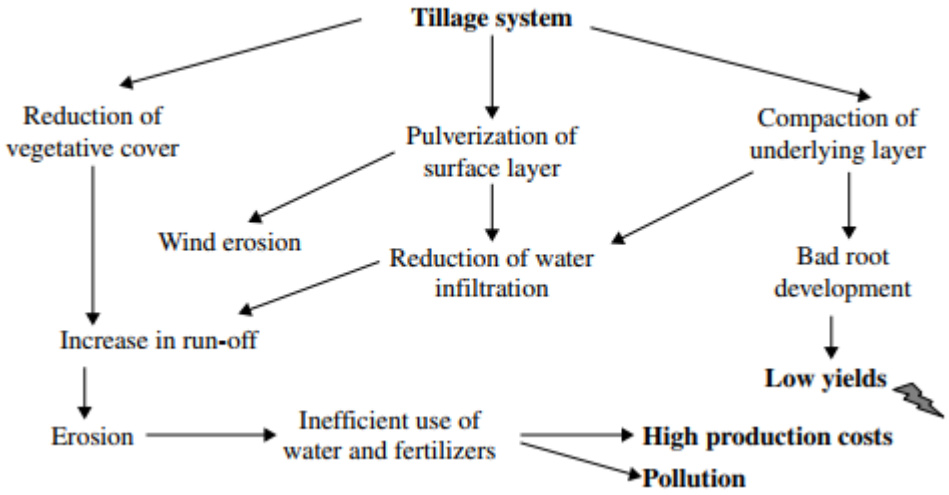


Figure 2: Effects of Ridges

The goal of ridges is to trap rain water on the farm, avoiding run-off and increasing soil saturation (Mloza-Banda et al., 2014). Traditional farming practices in Malawi still consist primarily of tillage: purposeful soil disturbance into which seeds are planted (Hobbs, 2007).

Photo 2: Preparing Crop Stalks for Burning

Photo 3: Ridge Tillage in Malawi

As RT was discussed at length in previous sections, this portion of the literature review will focus on additional agricultural intervention programmes currently in operation in Malawi including agroforestry, seed types/seed security, permaculture, and fertiliser dependency.

Garrity et al. (2010) examines the effects of agroforestry in Malawi and the effectiveness of the newly established Malawi Agroforestry Food Security Programme. The first year of the programme saw 17 nurseries created with 2.18 million seedlings, and established 345 farmer groups throughout the country (Pye-Smith, 2008). The study finds that over 120,000 Malawians were trained in agroforestry and these trained Malawians shared their knowledge of trees with an estimated 1.3 million people throughout 40% of the country as of 2009 (Garrity et al., 2010). Despite apparent success in use of agro-ecology techniques and agroforestry, Garrity's research discusses concerns over the heavy reliance on subsidized fertilisers for the programme to be successful (Ibid). These fertilisers contain chemical components that can negatively impact nutrient supply and have other unknown consequences.

Rather than focusing on above ground growth, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) prioritized seeds and seed development (ICRISAT, 2015).

Their agricultural intervention approach focuses on improving resiliency and food security through intercropping[16] as a mechanism to remove the need for fertiliser in Malawi and other semi-arid countries. In Malawi, ICRISAT commercially sells seeds with greater resiliency through the Malawi Seed Alliance (ICRISAT, 2015). These "more resilient seeds" have been bred and/or genetically modified to grow in spite of harsh local environment conditions. As these programmes will not be completed until 2018, there are few data available with conclusions as to the effectiveness of this programme (Ibid). Without concrete data, it is hard to determine that seeds are an appropriate agricultural intervention in semi-arid environments as crop yield and adoption rate information has not been released. In contrast to seed focused interventions, Permaculture seeks to revitalize environments to their fullest production value.

Permaculture is an agricultural intervention rooted in a philosophical approach to life and the relationship between humans and the earth (Permaculture, 2016). Permaculture stems from 12 design principles and ethics which relate, "Everything in the world to everything else with primary attention on the intersecting values of caring for the earth, caring for the earth's people, and sharing what one has with others" (Ibid). In Malawi, permaculture is applied through the use of zones. There are 5 zones of agriculture in which nothing is destroyed, and the zones are based on energy usage (J. Walker, personal communication, May 2017) (Photo 4). The issues with this form of permaculture in Malawi is that it requires an enormous amount of water on a consistent basis, something that is not possible for most Malawians if they do not live directly by the lake (Map 1) (J. Walker, personal communication, May 2017). However, those who practice permaculture in Malawi do not believe it is a sustainable method of agriculture intervention, nor

[16] A process in which two or more different types of crops are planted in close proximity to one another, often in alternating rows (Intercrop, 2017)

does it provide access to maize as the focus is on things such as community sharing of produce and growing items like fruits rather than staple or cash crops (Ibid).

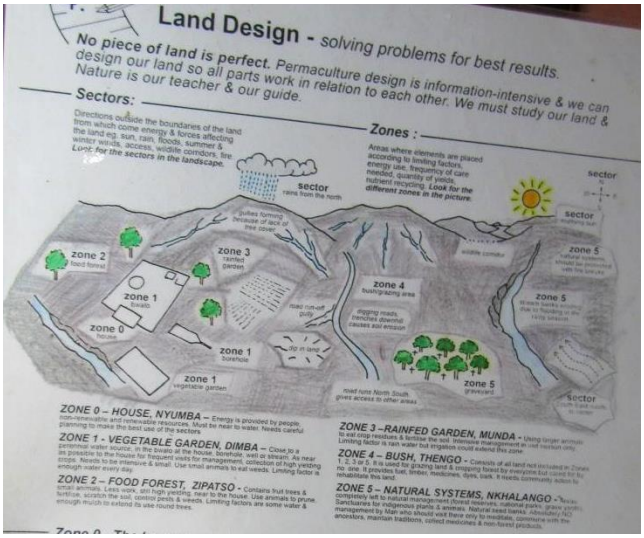


Photo 4: Five Zones of Permaculture (source: June Walker)

Fertiliser dependency in Malawi resulted from FISP vouchers and focus on fertiliser to improve crop production. A 2015 joint report on the Status of Fertiliser in Malawi noted that Malawians increased their fertiliser use from less than 20 kilograms per ha to over 43 kilograms per ha in less than a decade (Mutegi et al., 2015). The soil throughout Malawi needs nitrogen, phosphorus, sulphur, and zinc for crops to be most successful, and fertiliser is viewed as the way to resolve these deficits (Ibid). This report concludes that fertiliser needs to be given out to all farmers, not just those deemed at severe risk by the government if the soil is to regain its necessary nutritional value for crops to thrive (Ibid). The FISP is understood by many Malawians as being distributed from the government to local chiefs, and from local chiefs back to the government without actually making its way to the people who need it most (Veritas, personal communication, May 2017). Furthermore, if the FISP does reach people, it can only be used on the most chemical-heavy fertilisers (ibid).

These are not the only agricultural intervention programmes in Malawi. An additional approach exists: Conservation Agriculture. Its merits and critiques are analysed below.

2.2.4 Conservation Agriculture in Malawi

Understood as using the three interventions already discussed, Conservation Agriculture was estimated to be used on 47,000ha of land in 2009 (Thiombiano and Meshack, 2009). As of 2015, this number is believed to have declined by as much as 50% (Tesfaye et al., 2015). Promotion of CA has been focused towards "reducing the loosening and moving of soils done under RT practices which depletes organic soil matter and poorly conserves water" (Mloza-Banda et al., 2014). Furthermore, CA is believed to improve water filtration and fertility of soil through increased microbial community growth, and decrease run-off and erosion of soil (Ngwira et al., 2013). However, when put into practice, smallholder farmers in Malawi reported only seeing subtle changes to their soil (Ibid).

A few studies on the impact of CA in Malawi have been completed. One, published in 2012 by Ngwira et al. followed two small farming communities from 2005-2011: one in the drier environment of the south, and the other in the wetter environment of the north (Ngwira et al., 2012). The researchers found that in the drier southern environment, CA resulted in crop production gross margins three times higher than conventional methods but that success aligned with an increase use of fertiliser (Ibid). The researchers also determined that using CA solely on maize crops resulted in a 35% labour savings: 9 days saved in land preparation and 19 days saved in time spent weeding (Ibid). However, smallholder farmers indicated their reluctance to continue using CA techniques because it took several years to see success (Ibid).

A second study on CA in Malawi looked at maize and CA techniques. As a follow-up to Ngwira's 2012 study, this focused on the comparison of TF techniques to CA on maize crops in 12 farming communities around Malawi from 2005-2011 (Ngwira et al., 2013). This time, Ngwira and colleagues determined that maize grain yields on CA treatments in low-altitude areas with frequent dry spells outperformed TF techniques by a range of 22.1-23.6% (Ibid). In the highest performing community, CA resulted in an increase of 49.5% maize grain yields over TF techniques. Ngwira (2013) notes that farmers who were able to understand they would likely incur a loss in crop production the first year of implementing CA techniques did best if said farmers also had frequent support through an extension worker[17] who visited at least twice a year (Ngwira et al., 2013).

A third study published in 2011 utilised a similar methodology as Ngwira's 2013 study, but concluded that maize grain yields in differing treatments did not follow a similar trend across the selected communities. This confirms the need to target and adapt CA to local conditions even within country borders (Rusinamhodzi et al., 2011). Rusinamhodzi and colleagues identified barriers to CA adoption in Malawi: removal of crop residues for fodder, lack of appropriate seed drills that can sow in unploughed fields, high crop residues and the lack of availability or prohibitively high costs of herbicides/other inputs (Ibid). The use of CA in various countries has led to adaptations of the three techniques with missed results on crop production over longer periods of time.

[17] Government extension workers are "well-informed, village-level people who would visit farmers frequently and regularly to provide relevant technical messages and bring farmers' problems to the attention of researchers; workers receive regular training with the most recent techniques and technologies on farming and are tasked with training local farmers in them" (World Bank, 1999).

2.2.5 Adaptation to Farming God's Way

As Zimbabwe adapted the principles of Conservation Agriculture into an agricultural intervention programme known as Conservation Farming, a subpopulation residing in the central province of Malawi created a CA-adaptation called Farming God's Way (FGW). FGW uses the 3 interventions of CA, but adds a distinct Christian component through association with being a "good and Godly Christian" (Andersson and Giller, 2012). By renaming the interventions Farming God's Way and stressing the relationship between crops and people as one of a Christian nature, the principles of CA are reinforced through the establishment of cultural and moral ties to farming techniques. The no tillage intervention is adapted to, "little to no tillage," as farmers preferred tillage practices in small amounts compared to not making any ridges. Mulching is renamed God's Blanket, referring to the act of covering the ground in the same manner God covers individuals with His grace (Ibid; Etter, 2013). The third intervention, crop rotation, is done on an annual basis (Veritas, personal communication, May 2017). Additional elements of FGW include praying for the crops to succeed and rains to be plentiful, feeding the soil with organic manure, and good weed control (understood as weeding as necessary rather than a fixed number of times a year) (Ibid). Prior to being known as Farming God's Way, FGW was taught as Foundations of Farming (FF), which encouraged the use of hybrid seeds, included promotion of agroforestry, and was a less detailed process than FGW (Veritas, personal communication, May 2017). Since FF, FGW evolved into the three interventions described above and incorporates the belief that use of hybrid seeds is not only bad, but undermines the sustainable nature of FGW techniques (Etter, personal communication, May 2017). Some Veritas

members still refer to FGW as FF, confusing long-time trainers and farmers when Veritas conducts newer training sessions (Veritas, personal communication, May 2017).

While both FGW and CA can be taught through training sessions, FGW is nearly exclusively taught through Bible-interpretation training sessions rather than solely as a set of agricultural practices (Etter, 2013). This training relies heavily on the integration of Christian values and actions such as prayer along with the three interventions of CA. The sessions are run by Veritas College-Malawi (Veritas, 2016), a Christian university and non-profit organization seeking to "transfer and transmit knowledge gained at the college into the local community" (Holzhausen, 2016). Training sessions normally last one week and are comprised of lay leaders. These lay leaders are Veritas-associated people who train church members throughout central Malawi (Veritas, personal communication, May 2017). Missionaries are also trained as ambassadors to conduct training sessions (Ibid). Veritas reports that in the 15 years training sessions have included FGW, a total of 1,000 people have been trained, but many people fail to adopt FGW correctly because they do not have access to livestock and the techniques themselves are difficult for Malawians to understand (Veritas, personal communication, May 2017). Furthermore, Veritas does not want to force people to adopt FGW as the colonial powers did with ridges (Ibid). Rather, the leaders and trainers understand that people do not learn FGW techniques quickly because "there is a worldview [meaning people's minds are too focused on what they have been told, rather than what is best]. The mind has to be changed first" (Veritas, personal communication, May 2017).

Etter's 2013 case study in Nkhoma Mission, Malawi focuses on this association of Biblical goodness and farming techniques. Local area farmers were sampled regarding their motivations for implementing new technologies, with and without training sessions (Appendix

B). Etter (2013) found that farmers who had completed traditionally-sensitive training sessions were more willing to try new technologies. Traditionally-sensitive training sessions are sessions in which there is respect shown for TF, rather than dismissing TF as out-of-date or wrong (Giller et al., 2009).

Etter's published thesis determines that FGW is too lecture-based to be fully understood by smallholder farmers, and that to truly have an integration of FGW agricultural techniques, a relationship must be established between people and the ground through use of the Christian Creation Story[18] (M. Etter, personal communication, May 2017; Etter, 2013). Etter also clarifies the difference between CA and FGW stating that CA tolerates intercropping and relies on post-harvest weeding while FGW does not permit intercropping to alleviate competition for resources (Ibid). Presently, FGW is looking at controlled burning of fields post-harvest for faster soil revitalization (Ibid). Similar to Zimbabwe and the zai pit system, FGW has also started to promote the use of basins but farmers are still reluctant to adopt the techniques as they feel they have no support from Veritas after training sessions (M. Etter, personal communication, May 2017). Etter argues that the primary reason farmers reject FGW is a lack of mulch/fertiliser and therefore a perceived lack of progress (Ibid).

Established in 1999, Veritas's mission includes teaching "livelihood skills to [community members to] improve food and nutrition security, and for the care of and prudent use of the earth's resources" (Veritas, 2016). Veritas believes that by linking CA principles to Christian ideals and morality, farmers are more willing to try new farming practices. This belief is what has led Veritas to focus on "community outreach by local churches, not communities" (Etter,

[18] Biblical story found in the first chapter of Genesis, discussing how God built the earth in six days

personal communication, May 2017). This closely held opinion that the Church should be involved and initiating community development stems from Biblical teachings in the Ten Commandments and thus is easily promoted as part of the Veritas training sessions (Ibid).

2.3 KNOWLEDGE GAP IN EXISTING LITERATURE

Having reviewed a number of agricultural intervention options, the Malawian government created the National Conservation Agriculture Task Force (NCATF) with the mandate to "oversee the proper application of sustainable use of natural resources/land management practices and the advocacy of CA initiatives throughout Malawi" (Marenya et al., 2015). Yet, Bollinger's review in 2007 concludes that while there is a plethora of literature on agricultural intervention programmes, there is little research about whether or not conservation agriculture should be adopted by farmers in true semi-arid environments (Bollinger et al., 2007). Even though Ngwira discusses the successful impact of CA in Malawi, these case studies focused on the north or south of the country; not the central region where the capital city Lilongwe and the majority of the population resides.

This literature review supports Bollinger's conclusion that there is still a knowledge gap on CA's effectiveness in semi-arid environments like Malawi. Giller identifies this knowledge gap and a short-term disappointment in crop yields, but acknowledges it is possible that proper training can alleviate these concerns. Etter's work concludes that the Veritas adaptation of CA is most effective because of the connection between farming and the prevalence of Christianity in Malawi; FGW aligns with cultural values. However, the existing literature does not discuss

FGW. It discusses CA and the impact of the three interventions. Furthermore, FGW is taught by one organization to a subset of the population through Biblical interpretation trainings. It is not primarily marketed as an agricultural intervention, but rather as a way to be a better Christian.

What the literature fails to do is provide insight on the success and sustainability of CA in the central, most populated area of a semi-arid country like Malawi. While CA is discussed as successful in the long-term, nearly all studies mentioned farmers not wanting to continue CA because of the time between adoption and results, leading to questions about why smallholder farmers would risk a year's harvest in a country like Malawi which constantly deals with food insecurity. This thesis is an attempt to resolve the question of adoptability of CA techniques and CA's effectiveness in a semi-arid environment through a case study of Conservation Agriculture and Farming God's Way in central Malawi.

3.0 METHODOLOGY

This chapter is divided into three sections. The first explains the selection of Nkhoma Mission, Malawi as the study site for this thesis, along with the justification of both the location and time of year the data collection took place and gives a brief history of Nkhoma Mission. The second part explains why case study was adopted as the research methodology, and contains information pertaining to interview question generation, language selection, and limitations of the methodology. The chapter concludes with a description of the full research designed used in the field work collection.

3.1 STUDY SITE SELECTION AND JUSTIFICATION

The following section discusses why Nkhoma Mission, Malawi was selected as the study location and the rationale in choosing to collect data during May-June.

3.1.1 Rationale of Study Site

Nkhoma Mission is located in Lilongwe Province in the central region of Malawi (Map 1). Founded in 1889 as a mission site of the Dutch Reformed Church in Capetown, South Africa

by Reverend AC Murray and TCB Vlok, Nkhoma Mission was originally located on Achewa tribal lands in Dowa, Malawi[19] (CCAP, 2016). The mission was relocated in 1912 to Nkhoma and now serves as the headquarters of all mission centres in Malawi's central region. Around the same time of this relocation, Nkhoma Hospital was founded, incorporating modern medicine techniques and missionary doctors with Malawian nurses and patients (Nkhoma Hospital, 2016). Run by missionaries and foreigners, in 1962 Nkhoma Mission was handed over to the local Malawians to maintain. Nkhoma Mission today serves as the headquarters of Nkhoma Synod, Church of Central Africa, Presbyterian which is tasked with continuing the work of the original mission and overseeing decisions and governance of the hospital (Malawi Med, 2003). The reputation of this hospital and location of the Synod headquarters led the government to include an official turn off to Nkhoma Mission when it built the national highway: the M-1.

This road and its subsequent proximity to Nkhoma Mission increased relationships between Malawians living in and around the relatively-formal mission boundaries, along with the availability of missionaries conducting community outreach programmes. Many of these programmes include farming components, including Farming God's Way and Conservation Agriculture. For the purposes of the field work, Nkhoma Mission is taken to include the area within the 50km radius from the Nkhoma Mission turn-off from the M-1.

Nkhoma Mission is a revered and respected location in Malawi, providing guidance to the majority Christian population while serving as a beacon of hope through the work done at the hospital. Studying farming techniques in a centrally located, well-populated geographic region with a relatively homogeneous population and multiple farming intervention programmes trying

[19] Retained name as Nkhoma Mission despite settlement in Dowa

to address agricultural techniques maximizes the amount of accurate data available in the study period. The data collected is controlled for rain/dry spell patterns based on the geographic constrictions described above. This area potentially includes intervention programmes by dozens of agriculturally-focused organizations operating out of Lilongwe and Nkhoma Mission. Furthermore, Nkhoma Mission fits the criteria of a semi-arid environment based on rainfall quantities and availability of sustainable water sources.

3.1.2 Justification of Time Selection

The case study was conducted during a six-week period from May-June 2017. This time period was specifically selected as the monsoons/planting rains typically end in early-to-mid April, thus preparation for the next planting season has begun (Appendix C). After consulting with local experts at Veritas College and on-the-ground contacts from Mtenthera CCAP,[20] it was decided this time frame would be the best to talk with farmers about their previous farming techniques and their motivations, plans, and predicted outcomes for the next year. Additionally, conducting conversations about farming techniques during the harvesting season allows for discussions of ideal farming techniques. Local farmers are experiencing a 'period of plenty' where food is available and opportunities for work are easier to come by and, psychologically, people are more optimistic and willing to engage conversations regarding hypothetical scenarios (e.g. perfect farming conditions, plethora of disposable income, etc.).

[20] A Christian church operating in Nkhoma Mission in affiliation with Veritas College

3.2 CASE STUDY JUSTIFICATION

Given the prevalence of agricultural intervention programmes operating in Malawi, it was not possible to collect baseline data in the six-week time frame. Ideally, an impact evaluation comparing traditional farming methods and harvest yields before various agricultural programmes began to impact farmers would have been collected, but such baseline information was not available. Consequently, the nature of this thesis and the focus on Nkhoma Mission as a geographic location with multiple agricultural intervention programmes is analysed as in-depth case study. Data collected is restricted to recollections/perceptions of change from local farmers across the six-week timeline.

Given that the Christian-related motivations associated with FGW have been studied by Etter, this thesis is specifically interested in secular motivations, perceptions, and adoptions of agricultural intervention techniques by smallholder farmers. Consequently, this case study focuses on CA components and their potential adoption rates in Nkhoma Mission. To do so, two particular measurement tools are utilized: interviews and observations.

3.3 RESEARCH DESIGN

The primary objective with data collection was to conduct between 100-150 semi-structured interviews in six weeks. Interviews were planned to take place one-on-one in English in a semi-private setting to try to control for peer pressure, prejudice, or otherwise censored responses. If an interview subject preferred to speak in Chichewa, the local tribal language, a

translator was made available. Access to interview subjects was obtained through the use of a snowballing technique, relying on personal relationships and generous assistance from local leaders in the villages. Interviews were often set up a day in advance in an "open-call" manner where one by one, people would be invited to sit and answer some questions on farming. Attempts were made to speak with equal numbers of males and females, but the gender balance in Nkhoma Mission heavily favours women and, as such, the data collected reflects this demographically.

In particular, local village chief headmen provided access to approximately 60 people to be interviewed over a few hours. To best ensure everyone had a chance to participate and provide answers to questions, the inductively created interview questions were posed to small focus groups, no more than five people at a time. Additionally, due to time constraints[21] the language used switched from English to Chichewa with the assistance of a translator for focus groups.[22] Given the nature of focus groups with a translator and hesitation over the use of the voice recorder expressed by numerous participants, essentially all notes were taken by hand and marked in various colours to indicate which participant responses belong to. No identifying information (name, geographic location, etc.) was collected beyond basic demographic questions (age, sex, education level, farm size, etc.). The semi-structured nature of the interviews did not exist with the focus groups as time was a motivating factor in the length of conversations. Focus groups were conducted using a standard set of open-ended questions and going around the circle for each participant to voice his/her response. Focus group meetings normally started around 12noon.

[21] Sun sets at 5pm and there is no electricity
[22] Further discussion on potential impacts this change had on the data is presented in section 3.4

For focus groups, introductions and a welcoming ceremony by the group village headmen established a relationship. Then, the objective of the thesis was explained to the participants along with the intended distribution of responses, and participants were given an opportunity to ask questions in front of the group or privately. As an expression of gratitude for their patience and time, all participants in a focus group were provided a beverage while they were waiting to participate.

Standard demographic inquiries and a semi-inductive approach were used for questions, adapted from Etter's case study (Table 2). Responses were entered into charts created to gather, collect, and sort information on types of technology used and perceived effects observed by farmers (Appendix D).

Which farming practice is used? Is use seen to be successful?	**Before training**	**After training**	**Improvement seen?**
1. Mulching/God's Blanket use			
2. Flat planting/minimal tillage			
3. Composting/use of organic manure			
4. Crop rotation			
5. Proper seed spacing			
6. Planting on time			
7. Timely and regular weeding			
8. Final end of season weeding			
9. Improved livestock housing			
10. Shepherding life stock in dry season			
11. Proper manure collection			
12. Shallow pit latrines and planting up with fruit tree			
13. Planting trees for fodder, fruit, fuel, and timber			
14. Use fuel saving stove			
15. Discuss my farming with other farmers			
16. Feeding the family food from the 6 food groups			
17. Preserving/drying fruits and vegetables			
18. Able to save money			
19. Regular prayer for my farming			
20. Controlling bush fires			

Table 2: Etter (2013) Farming Practice Question Table

The final list of questions was created following discussions of farming techniques and programmes operating in Nkhoma Mission. This information was obtained through conversations with local experts and was reviewed by a University of Pittsburgh faculty member prior to data collection. The objective was the collection of qualitative data for analysis in the final paper, but the collection of demographic information allowed for minor quantitative analysis to take place. Relevant quantitative variables included sex, education level, size of farm, and age. Quantitative variables also included type of farming practice currently used, and questions related to use of ridges, composting/organic manure, mulching, weeding, and flat planting. Most of these variables were referenced in Etter's thesis in which information was collected on adoption and success of FGW and supported through formal and informal conversations with local experts in various agricultural practices (Etter, 2013). Qualitative analysis is based on open-ended questions which were created to encourage storytelling and better understanding of personal motivations in farming practice decisions (Appendix E). Nearly 40 one-on-one English interviews were conducted using the semi-inductive questions.

In addition to interviews and focus groups, farm visits and on-site observations were scheduled to better understand the farming techniques being taught in Nkhoma Mission. These observations showed visible differences amongst the various farming techniques and intervention programmes while providing an opportunity for lead farmers[23] to discuss their farming practices in a comfortable setting with information readily available. Sample farms also served as a chance to speak with local experts about farming practices found to be successful and various ways they share that expertise with others.

[23] A farmer with substantial community influence (Appendix F)

Observations and interviews were recorded through a combination of handwritten notes and voice recorders, although the majority of the notes were recorded by hand because many interview subjects did not consent to be audio recorded. None of the information gathered will be maintained indefinitely and all notes will be properly destroyed in accordance with the University of Pittsburgh Institutional Review Board policy. While abroad, notes remained locked in a travel bag in a locked room when not being read or created and the few voice recordings that had been created were uploaded each night to a secure internet file under password protection.

In summary, the data coding and analysis are generated through qualitative inductive approach/grounded theory with quantitative analysis based on demographics such as gender and age. Discussion of the results is heavily influenced by responses to the open-ended questions.

3.4 LIMITATIONS

The primary limitation of the methodology adopted for the case study is associated with the interviewer effect. In Bintrim's (2014) anthropology-focused dissertation, the encounters between the local community and Western volunteers in Malawi were explored. While the researcher did not be travel to Malawi in a volunteer capacity, Bintrim's conclusions about trust-building, initial impressions, and cultural understanding are relevant. Bintrim argues that Malawians are more distrustful of Westerners who are paid to be in the country (Ibid). Randall et al (2015) support this, finding that the first impression/title (researcher, volunteer, missionary, etc.) is the one always affiliated with an outsider, and that many Malawians associate foreigners with missionaries. Adida et al (2016) published in Comparative Politics Studies discusses the

interviewer effect pertaining to skin colour and cautions that when non-Africans interview Africans, results tend to be focused on potential monetary assistance. Lastly, Houle and his colleagues (2016) discuss interviewer effects when there are gendered and age differences between the interviewer and respondents. Particularly in Southern Africa, Houle et al found older interviewers more trustworthy than younger ones and females were generally believed to be more trustworthy and honest than men (2016). However, females interviewers were seen as less knowledgeable compared to males (Ibid). Every attempt was made to dissuade people of missionary affiliation, financial benefits, knowledge deficits, and ulterior motivations through the initial conversations, welcome ceremonies, and the beginning of interviews and focus groups.

The second limitation of methodology was the change from interviews to focus groups. As such, a translator was needed to ensure all participants were able to voice their opinions in the given time constraints. Some interviews were conducted in Chichewa rather than English. The translator is a trusted person who provides translating skills to many organizations, but he is not certified according to Western standards. The need for a translator was an unfortunate result of good intentions, but it does not mitigate the possibility that some information may have been reported inaccurately.

A third limitation is that groupthink may have been present in the answers received. This may have altered accurate responses to the questions and may impact the validity of the final conclusions. Every attempt to account for groupthink, including notation of when the group conflicted with the response of an individual member, perceived hesitations in responses, and reluctance to participate in the conversations were marked in the author's notes. Where possible, this is taken into account in the final data analysis and the data is provided and analysed with comments indicating hesitations, etc.

4.0 CONCEPTUAL CONSIDERATIONS AND HYPOTHESIS

This chapter presents critical definitions of terms as they are understood for data collection. These terms are listed and defined in the first section of this chapter. The second section contains the hypothesis for this thesis in consideration of the definitions provided. Definitions listed are applicable to the questions posed to interview/focus group participants. If a participant understood a term to mean something different, the difference was noted and is discussed in the data analysis chapter of this thesis.

4.1 DEFINITIONS OF CRITICAL TERMS

This section is subdivided by term defined. Under each sub-heading is the definition as it is understood by the researcher and any additional information, such as the rationale of determining the exact wording of the definition, is discussed where appropriate.

4.1.1 Nkhoma Mission

Defined as the 50 kilometre (km) radius around Nkhoma Mission site. Using this definition is important for this paper because the 50 km radius around the Nkhoma Mission

indicator on the M-1 lies in two Traditional Authority (TA) districts[24] while having a relatively homogenous ethnic population. This difference in TA jurisdiction means people around Nkhoma Mission are obligated to follow different laws depending on where exactly they live. This relates to agricultural practices such as field burning and livestock containment, and affects whether NGOs are officially welcomed into an area to give suggestions/training (TA Kalumbu, personal communication, June 2017).

4.1.2 Conservation Agriculture

Defined as the combined use of three principles of intervention: minimal tillage, crop rotation, and use of mulching/crop residue /organic manure; in some combined manner. This definition is specifically looking to include attempts at Conservation Agriculture for ease of analysis and discussion. If elements are present in addition to these requirements but those elements do not conflict with the three principles identified above, the farming technique is considered an adaptation of Conservation Agriculture.

[24] The TA is both a geographic location and a hereditary position in the traditional leadership structure; each village has leaders (called village headsmen) who elected a village headman (or woman); village headmans elected a group village headman (or woman) to oversee a number of villages in a geographic territory (this is normally a hereditary position). The TA oversees all village and group village headmans. There also exist sub-chiefs above group village headmans but below the TA (Commonwealth, 2017)

4.1.3 Farming God's Way

Defined as the three principles of Conservation Agriculture as defined above in addition to incorporation of prayer for crops/rains and belief that farming techniques are linked to Christian values and behaving in a good and Godly manner.

4.1.4 Semi-arid

Electronic discussions with Dr. Giller raised concerns over the categorization of Malawi as a semi-arid environment. Semi-arid is most often understood as locations with 700mm[25] or less of rain in one 'rainy season' and is defined as such for the purpose of this thesis. Malawi technically meets these requirements and is therefore categorized under this term for the purpose of this paper and analysis.[26]

4.1.5 Success

Measured in terms of overall crop yield and production; success is defined as noticeable increase in the output of a farm from one year to the next by the smallholder farmer owner.

[25] 700 mm = 27.56 in
[26] According to entities such as the CIA, Malawi is categorized as a sub-tropical environment (CIA, 2017)

4.2 HYPOTHESIS

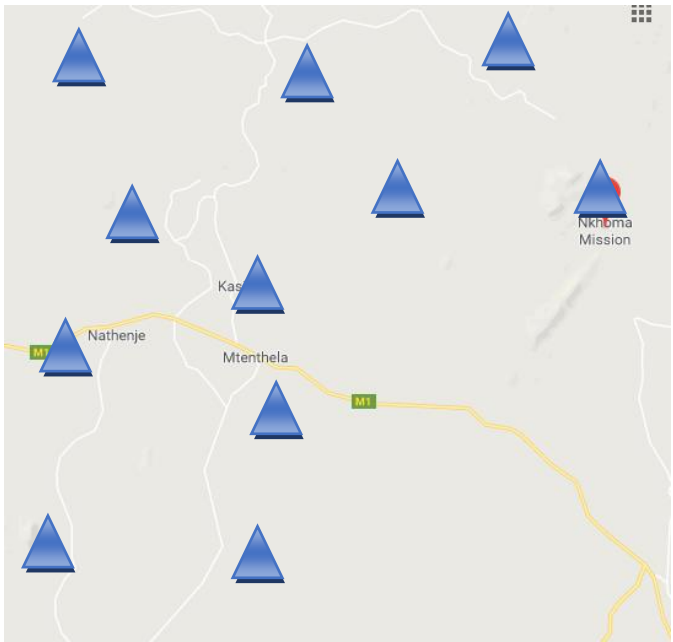
This thesis hypothesizes that if Conservation Agriculture is the primary agricultural intervention programme adopted in throughout Nkhoma Mission, then data collected will find CA to be successful in the short-term only. The required maintenance involved in mulching and perceptions regarding fertiliser, will result in CA being abandoned for easier methods. Furthermore, if smallholder farmers are given the choice between maintaining traditional farming practices such as ridge-creation, multi-seed planting stations, and heavy use of fertiliser, or changing to a new set of agricultural practices, then farmers will choose to remain either with traditional methods or accept a slightly-altered form of farming techniques .

Farming God's Way will be understood the same as Conservation Agriculture in Nkhoma Mission because of the overlapping nature of the three primary principles. Therefore, the same predictions presented above on Conservation Agriculture apply to Farming God's Way and its chances of sustainable adoption.

5.0 DATA PRESENTATION AND ANALYSIS

Data was collected from 115 participants living in the 50 kilometre radius of Nkhoma Mission in Lilongwe Province, Malawi (Map 2, 3). This area exists in two Traditional Authorities (TA) and three group village headmen territories. The dataset consists of participants from 10 different villages although no formal record of village location was kept for anonymity reasons.

Map 2: Regional Location of Research Area



Map 3: Approximate Location of Villages in Dataset and Research Area; not to precise scale (triangles indicate villages)

The first series of participants (23 in total) were volunteers from a local church who had participated in Veritas training sessions relating to FGW and were eager to provide feedback on what they liked and did not like in the aftermath of the training. From there, participants were recommended using the snowball technique regardless of what type of farming practices they used. Ultimately, 17 focus groups were created from select microfinance groups in group village headmen territories.[27] These microfinance groups are unable to participate in Veritas training sessions as they live too far away from main church locations. As such, many of them had never heard of Farming God's Way but instead relied on techniques like Sasakawa or Conservation Agriculture if they had deviated from TF. The following sections present the data collected along a number of different variable lines. The first section looks at the demographics of the participants, with attention paid to age, sex, education level, and farm size (Appendix G). Discussion then is centred around responses to open-ended questions.

5.1 DEMOGRAPHIC ANALYSIS

This provides an overview of the demographics and basic information of farming techniques used. Of particular interest is the brief discussion on farming technique responses at the end of this section.

[27] See Footnote 23 for clarification on chief ruling structures in Malawi

5.1.1 Age and Sex Distribution of Participants

The majority of participants (55.66%) were between the ages of 21-39 which fits with Malawi's generally younger population (Appendix G). This table includes a category of age labelled 'unknown.' This refers to older persons who were either unable to recall their age or did not know because their birth was not registered or kept track of.

Age Range of Participant	Number of Participants
Unknown	3
15-20	4
20-29	39
30-39	25
40-49	15
50-59	12
60-69	9
70-79	8
80-89	1

Table 3: Age Distribution of Interviewed Participants

The group village headmen chiefs arranged for discussion with several microfinance groups operating in their territories. The chiefs had started these groups on the advice of the TA to help widows and orphans, but the concept of microfinance groups and microcredit loans spread throughout the villages and groups formed on their own (Thethe and Kamphata, personal communication, May 2017). Two of the largest microfinance groups were women only, and

contributed to the skewed nature of the male-female ratio. Additionally, according to many informal conversations, men are more likely to seek work outside of Nkhoma Mission, with some sending money back for their family to live on. As such, 77.39% of all participants identify as female.

Sex of Participant	Number of Participants
Females	89
Males	26

Table 4: Sex Identification of Interviewed Participants

5.1.2 Education Level of Participants

Levels of primary and secondary education in Malawi are marked by standard and form years, rather than grade levels. The standards equate to American grades 1-8, with the form levels corresponding to high school grades. For example, Standard 1 in Malawi is considered the same level as Grade 1 in the United States.

Education Level	Number of Participants
None	6
Primary Level (Standards 1-5)	32
Primary Level (Standards 6-8)	26
Secondary Level (Forms 1-4)	34
GED	1

Bachelor's	2
Masters	1

Table 5: Education Level Distribution of Interviewed Participants

Of particular note are the 38 people who continued with education past Standard 8, when the compulsory education laws no longer apply. Nearly all of the participants had some form of education and, because agriculture is taught in all levels of schooling in Malawi, some formal training on basic agricultural principles. The most common level of schooling completion was to Standard 8 with 18 people indicating that was their last year of school. The second most frequent level of education was Form 2 with 17 students indicating they completed their last year of schooling at that level.

5.1.3 Farm Size

The average farm size (Appendix H) in dataset was a half-acre (44.34% of participants), much lower than the numbers provided in the literature review.[28] The second most frequent farm size was one acre. Interestingly, the most common farm size throughout the developing world is one hectare, or 2.5 acres, which only 6.09% of this dataset indicated.

[28] On average, female-headed households have 1.56 ha of land while male-headed households own 2.15ha (Kakota et al., 2015)

Farm Size of Participants (Appendix I)	Number of Participants
1/2 acre or less	53
.51-1 acre	33
1.1-2.4 acres	13
1 hectare (2.5 acres)	7
Greater than 1 hectare	8

Table 6: Farm Size Distribution of Interviewed Participants

5.1.4 Current Farming Practices

Farmers were asked to identify what types of farming practices and/or intervention programmes they currently employ. Definitions on what each type of farming meant were developed inductively.[29] Discussions around mixed types of farming practices came out in the beginning sets of interviews, which were longer and more detailed than the focus groups permitted.

World Vision was mentioned as a farming intervention programme, but no participant was able to identify what about their farming practices were associated with World Vision teachings. A basic web search reveals that World Vision conducts agricultural interventions through seed disbursement (World Vision, 2017). As participants did not discuss this at length, there is not a discussion about World Vision farming techniques in the remainder of this section.

[29] Presented in chapter 4 of this thesis

Current Farming Practice	Number of Participants
Traditional Farming	38
Sasakawa	40
TF/Sasakawa	5
CA	1
TF/World Vision	14
Mulching	2
Mixed: Hybrid seeds, fertiliser, World Vision, TF	6
Mixed: Hybrid seeds, fertiliser, World Vision	2
Mixed: Other	6

Table 7: Current Farming Practice by Interviewed Participant

5.1.5 Farming Technique Responses

This subsection focuses on the presentation of information gathered about specific farming techniques including tillage, no-tillage, mulching, water sources, etc. Data collected about specific farming techniques relates only to current use. For many of these variables, saturation was reached within the first 20 interviews conducted. Specifically, 112/114 (98.25%) participants relied on human labour to farm and maintain their farms over animal labour.[30] Similarly, 112/114 participants did not have insurance for their farms. One participant did, but he noted that he was considering dropping it because he "wasn't sure how much help it would really be." When participants were asked how often they weeded their farms, 104/115 (93.69%) said

[30] One participant did not answer the labour question

they weeded each crop twice a year. Seven participants (6.31%) indicated they weeded each crop only once a year. 100% of people interviewed said they relied upon rains to water their farm and three participants noted they also ran irrigation systems during the hot season. An additional 10 participants relied on a "nearby river" as well.[31] Two participants indicated they were currently constructing reservoirs to hold rain water to be used in the dry season.

5.2 OPEN-ENDED QUESTION RESPONSES

This part of the chapter consists of selected quotes and responses to the various open ended questions posed in interviews and focus group sessions. Reponses found to be unique or representing a pattern are presented and discussed below.

5.2.1 Differing Interpretations of Agricultural Interventions

Participants were asked first what type of farming techniques/intervention programmes they use, and then to define what their answer(s) meant. The idea behind this question was to understand better what each farmer believes are the key elements associated with each technique, and to explain techniques as the participant him/herself understood them. Rather than finding TF occurs most frequently, the most common response was the adoption and use of Sasakawa. One of the group village headmen's explained Sasakawa as: "making ridges and then plant three seeds in one station (planting hole) instead of one or two seeds of the same crop" (Chiefs,

[31] No indication was given as to exact location of river or its proximity to the village where the focus group took place

personal communication, May 2017).” With more participants identifying Sasakawa as their preferred/used agricultural practice, increasing variations in the definition emerged. Some of these are below:

> “Sasakawa means planting in the ridges and it seems to work. I see higher yields from my crops but the crops are very closely spaced.”
>
> (Anonymous female #47, personal communication, 23 May 2017)

> “Sasakawa means a good harvest because each plant will produce a large crop which is not the same as when you just put more seeds in the planting station.”
>
> (Anonymous female #45, personal communication, 23 May 2017)

> “Sasakawa means even if you apply a little fertiliser, you will harvest a lot because there is little competition [between crops].”
>
> (Anonymous female #104, personal communication, 25 May 2017)

> “Sasakawa is no ridges and lots of mulching.”
>
> (Anonymous female #62, personal communication, 23 May 2017)

Interestingly, of the 40 people who use Sasakawa exclusively, only one person said no ridges were used; thus, it seems to be an exception to not make ridges under Sasakawa. All other definitions collected regarding Sasakawa mandate using ridges. The primary benefit of this farming intervention programme is that a slight change by farmers results in observable

improvements in crop production when compared to TF. One farmer described an additional benefit of using Sasakawa is the use of more fertiliser than traditional farming, so she is able to harvest more (Anonymous female #56, personal communication, 23 May 2017). Contradicting her, a second woman said that Sasakawa uses less fertiliser than traditional farming, making it less expensive in the long run. Understanding what practices specifically are associated with Sasakawa vary from person to person, but in general the consensus appears to be using TF techniques through ridges, weeding twice a year, and annual crop rotation to plant but using a lesser number of seeds (either one or two) in each planting station.

The definition disparities are obvious here in terms of the amount of fertiliser used compared to traditional farming practices. The difference in understanding of whether more or less fertiliser is used in Sasakawa will greatly impact the rates of success and increase the amount of variability in results. Some people described a precise nature to Sasakawa, including how far to plant seeds and, more importantly, how many seeds should be included in each hole, called a planting station. The chief who first defined Sasakawa to the researcher dictated that one seed be deposited per planting station. This "decreases competition and gets better crops" (Chiefs, personal communication, May 2017). Some of her villagers had contradictory understandings of Sasakawa seed counts:

> "Sasakawa means fertiliser with two seeds per planting station because without fertiliser the crops won't do well."
>
> (Anonymous female #86, personal communication, 25 May 2017)

> "Sasakawa: cover the soil and make ridges with three to four seeds per planting station or clear and cover the field with new soil, make ridges and plant three to four seeds during planting time and alternate seeds and fertiliser in planting stations."
>
> (Anonymous male #65, personal communication, 24 May 2017)

Still, a different village had a different precise understanding of how to use Sasakawa, but they too could not agree on the specifics:

> "Sasakawa is defined as a 90 cm hole and planting one seed. If it's local seeds, 25 cm between stations, if it's hybrid seeds, 75 cm between stations."
>
> (Anonymous male #77, personal communication, 24 May 2017)

> "Sasakawa: mulching and one seed per planting station on the ridges. You then make a square hole by 30 cm on each edge and plant one seed in each corner."
>
> (Anonymous male #69, personal communication, 24 May 2017)

Again, the differences in individual definitions are apparent. Particularly during the focus groups, the different understandings created some controversy over which definition was right and which was wrong. Several people stated they were trained by a government extension worker, but could not reach a consensus on whether one seed or two seeds needed to be used, passionately debating which was more effective. The issue lies in the training provided by the

government extension worker and the differences in the smallholder farmers' understanding of Sasakawa. While no definitive evidence was provided, based on the conversations and descriptions of the extension worker, it appears the same government extension worker operating in one village either told different farmers different numbers or there was confusion during the initial training that was now engrained into the techniques.

Traditional Farming followed many of the same patterns in understanding as Sasakawa: the more people interviewed the more variations in the definition. Based on the literature, Traditional Farming was understood to include making ridges, not covering the field with mulch or maize stalks, planting seeds in the weeds, and using a significant amount of fertiliser when affordable. Nearly all the definitions collected on TF included making ridges. Some included specific elements such as distance between planting stations, use of maize stalks, and motivations for making ridges. In general, the consensus of using TF involves making ridges and planting multiple seeds in each planting station. Some farmers argue the number of seeds is, "two per planting station" (seven participants) while others say it is, "three per planting station with 75 cm between ridges" (seven participants). Other interesting definitions include:

> "Traditional farming means making ridges to control runoff and creating the garden[32] on a steep slope. Without the ridges, all the water would be lost."
>
> (Anonymous male #7, personal communication, 10 May 2017)

[32] Garden refers to a small farm, which Malawians consider to be anything less than 1 ha (personal communication, May 2017).

"It's to cover the soil and make ridges with three to four seeds per planting station, or clear and cover the field with new soil, make ridges, and plant three to four seeds during planting time and add two fertiliser doses, one of basil and one of top."

(Anonymous female #35, personal communication, 17 May 2017)

"Traditional farming means a labour intensive method with ridges and banking of the soil."

(Anonymous female #20, personal communication, 15 May 2017)

"Ridges made using hoes and fertiliser is needed in a large quantity. Most people don't apply manure but they should. It's more labour intensive than FGW, which also needs less fertiliser so it's less costly."

(Anonymous female #27, personal communication, 15 May 2017)

"Clearing the field, making ridges with whatever was cleared from the field, putting seeds in the ridges and planting in them."

(Anonymous male #24, personal communication, 15 May 2017)

"Traditional farming is manure scattered in the field and then cleared and covered to add to nutrients. Making ridges and dig planting stations on top, then plant the seeds."

(Anonymous male #66, personal communication, 24 May 2017)

Essentially, TF is seen as “harvesting a lot of crops” and a “labour-intensive process.” Some of these definitions include using manure/compost/maize stalks to cover portions of the field, contradicting the assumed definition of traditional farming methods.

As with Sasakawa, participants held very strong beliefs about the right way to farm, often citing that farming had been conducted ‘this way’ for generations. Farmers most often learned their techniques from family members. New farming techniques appear to be accumulated primarily through observation of either neighbours or key members of the community, such as the richer farmers, lead farmers, or a village chief (Anonymous male, #9, personal communication, 10 May 2017). One village chief is trying to incorporate CA techniques in his village through a partnership with a local government extension worker.

5.2.2 Perceptions of CA and Other Agricultural Intervention Programmes

One chief and a handful of farmers were familiar with Conservation Agriculture, stressing that it primarily used “less fertiliser.” This chief was actively trying to encourage others to use CA, defining CA as “flat farming or planting in existing ridges, but not making new ones” (Chiefs, personal communication, May 2017; Anonymous male #33, personal communication, 17 May 2017). The simple act of not making new ridges was the indication that CA techniques were being used. One government extension worker participated in an interview, saying that he does not teach Sasakawa, like the other government extension worker discussed earlier, but rather he “advises on CA and the zai pit system.” He explained that:

"CA found success because it was seen to be impactful based on a visit from an ambassador from Ireland. So it's successful, but it's not widely adopted. It was taught but people don't follow through on it. So then why does the government support CA? Four reasons. One, when farmers use it, they don't have to work as hard because CA doesn't use ridges, there's less weeding, and covering is easier because when the rains don't fall as much, the soil moisture levels are still protected. Two, there is not heavy run off if the rains are heavy, and the soil remains protected under the coverings. The fertiliser is also protected unlike with the ridges where the fertiliser actually would go away. Three, the decrease in time spent working the farm can be used for other crops or on other people's farms which increases yield potential for the country overall. Finally, CA requires less fertiliser because you can replenish the soil with mulch rather than with chemicals."

(Chiefs, personal communication, May 2017)

More farmers had heard of CA and other programmes. Many of them were sceptical there could be success. One of the church members noted in her interview that she had:

"Heard this [TF] isn't the best. I've heard of CA, permaculture, and although these methods are really different, I think I agree that that traditional farming is not the best for the land. I've been considering this for a long time but I haven't made up my mind because I've been too busy to really think about it. And it's easier to keep with traditional farming because that's what my workers know.

> Even when I've told them in the past to do things differently, like making no ridges, I'll come by a week later and there are ridges everywhere. They think I'm crazy for suggesting new techniques and so they 'help me' by doing what they know and think works."
>
> (Anonymous female #6, personal communication, 10 May 2017)

Conservation Agriculture, Sasakawa, and Traditional Farming techniques are not the only options in the Nkhoma Mission area. Farming God's Way, as Etter concludes, is still used by a small subset of the population.

5.2.3 Farming God's Way

Despite Veritas's location near Nkhoma Mission, none of the 115 people interviewed identified using Farming God's Way as their primary method of farming. The group village headmen indicated this is because churches are located several kilometres away and while many villagers attend church at prayer houses,[33] often times they are not included in the activities and benefits seen at the main station[34] (Chiefs, personal communication, May 2017). Veritas indicated that of the limited people trained in FGW, there is essentially no networking between churches growing sample farms and it is nearly impossible to follow up with farmers because of limited staffing, so people will often abandon the process (Veritas, personal communication, May 2017). The people who did mention FGW used it in restrictive manners on their land. Most

[33] Satellite buildings or locations affiliated with a church but run by local church elders rather than a pastor
[34] The primary location of a church headed by a formal pastor; responsible for coordination with several prayer houses in a geographic location

allocated one-third or one-half of their usable farm land to the FGW techniques. One woman said:

> "I went to training by Veritas College and [FGW] is working. Farming God's Way is working. I didn't do [FGW] on a lot of my land at first. I wanted to see if it would work but yes. I see more crops. I see I am doing less work. I have a small amount of land but I get eight to ten bags of maize in just one year. This is good."
>
> (Anonymous female #8, personal communication, 10 May 2017)

> "I wanted training and since I'm a pastor, I just called Veritas and said if they taught me, I would use my garden as a demonstration for my congregation. They agreed and where I used to get 10 bags before, now I get 80 bags. Vegetables too."
>
> (Pastor, personal communication, 23 May 2017)

Others discussed how the training made sense, once they were taught about how soil nutrition works at deeper levels:

> "Veritas claims they are the ones who are teaching us to put the maize stalks back on the soil but this is not true. It just makes sense to do this. I do not understand those who would not do it. If you look at the soil you have done this too, it is healthier. It has more nutrients (Photo 5). Putting the stalks back to the soil makes sense."

Photo 5: Nutrient-rich soil

"I saw success in using FGW. It took less work and I got bigger maize. So next year, I will try it on one acre instead [of one-quarter acre]."

(Male, Interview #9, personal communication, 10 May 2017)

"I did FGW and got more yield on smaller land than with local farming. Manure seems to be better than fertiliser but I still use it because I don't think it's actually better."

(Anonymous female #11, personal communication, 11 May 2017)

One of the male participants was absolutely convinced FGW would produce more crops, and lead to a complete lifestyle change for himself and his family. Despite his initial certainty, the longer he spoke, the less confident he appeared:

"Farming this way [FGW] gets me more production from my farm. Yeah. It means that I can spend more money on fertiliser and seeds. Yeah. It means I have more money to pay for school fees and care for my family, so I am a better person

from it. Yeah. It is good. I had some problems with FGW. I didn't do it on all of my farm because I wasn't sure if it would really work. I mean, I had seen that it worked but I only did it on part of my farm. There was a dry period. The rains did not come but the 1 acre I did FGW on did better than the two other acres. People even commented on how much better the 1 acre was doing. So next year, I will try it on more land. But not all because the 1 acre was swampy and maybe that is the reason it did better. It had more rain during the dry spell so next year I will try it on a sloped area. But for flat areas, I will still make ridges so the water does not run off. "

(Anonymous male #9, personal communication, 10 May 2017)

Discussions with a local lead farmer using FGW, who had trained 50 others in the techniques with 100% of those people seeing improvements on their farm, clarified his understanding of how to implement FGW:

"When I teach people, I tell them to use fertiliser. But only in the first year. This makes them feel better. They want to use fertiliser. But I go back. I help them. I teach them how to pull out the weeds, which are very easy after the first year. And I make sure they don't use fertiliser. They don't need it. I was using six bags before FGW. That was six years ago and now, I use none. Mulching is much better for farming. I used to micro-dose but now, the soil is fertile. I don't need it. See most people, they are willing to try FGW because they have spent a lot of money on traditional farming methods and because the rains

> are strange and they harm the harvest. These people wanted food, and FGW works to get them even if the rain doesn't come on time. Now, me and people I have trained are the first to harvest."
>
> (Maxwell, personal communication, 2 June 2017)

Regardless of the farming techniques used, the important aspect of fertiliser came up time and time again.

5.2.4 Smallholder Farmer Reliance on Fertiliser for Crop Success

Of the 115 people interviewed, 109 people (94.78%) responded that they currently use fertiliser. Everyone interviewed (100%) said that if they could have more of anything, they would want more fertiliser. It seemed that any time a question was raised about how to make a farm more successful, what the ideal farming inputs contained, or simply what people wanted, fertiliser was the response. Nearly all of the farmers expressed this belief that fertiliser is the key to a successful harvest. One farmer went as far as to say, "Using fertiliser means you don't have to do anything to the soil." It was asked if fertiliser would work without water. He pondered his response for a moment, replying, "I mean, you need a little water but with enough fertiliser, I'm thinking it could rain for a week and the crops would grow enough to eat." The idea that fertiliser is not only necessary, but also almost has an ability to grow under any condition was echoed by others:

"Without fertiliser, nothing will grow. It doesn't matter if [the] rains come. It doesn't matter. Fertiliser. Fertiliser is what makes good crops. And I cannot afford fertiliser. So I have bad crops."

(Anonymous female 51, personal communication, 23 May 2017)

"If I have fertiliser I would have a higher yield. More fertiliser would eliminate the need for more rains. I wouldn't need the rains to get more crops."

(Anonymous female #93, personal communication, 25 May 2017)

"Fertiliser is critical and the challenge for good farming is a lack of fertiliser."

(Anonymous female #102, personal communication, 25 May 2017)

The chiefs expressed concern over the high dependence on fertiliser given its cost. They were actively working to train their villagers in micro-dosing but faced resistance because of the belief that more fertiliser is better. One chief noted that she recommends to her village using a "little fertiliser. We can give them bottle caps like this [cap of glass Coca-Cola bottle] to show them how to measure enough. Many think it won't be enough but I tell them it is. I tell them I've seen it and I use it this way. So they will try." TA Kalumbu also expressed his preference for micro-dosing and how he encourages others to use it if they cannot afford enough fertiliser (Chiefs, personal communication, May 2017).

The dependence on large amounts of fertiliser can cripple a family's ability to harvest, as a bag costs 22000MK,[35] while the average Malawian earns up to 20000MK a year. At the time of the harvest, when food is most plentiful, maize buying prices drop to "maybe 5000MK[36]" (Anonymous male #2, personal communication, 10 May 2017). Before harvest, "fertiliser is a little lower. Maize is much more expensive." Farmers could charge a higher price of "five, 10 times more" if they had maize to sell before harvest. Roughly 80% of all interviewees said they sold maize they needed for food in order to purchase fertiliser.

When asked about the willingness to try new techniques, farmers were enthusiastic as long as they received fertiliser. The question was posed a second time, specifically discussing techniques other farmers had been successful at, such as CA. Despite it being explained that agricultural intervention programmes like CA do not require fertiliser and in fact would replace the need for fertiliser through composting, participants were still adamant that fertiliser was needed. A large number were willing to attend a training session, should the opportunity arise, but they "need more fertiliser first."

> "I went to a training session at the lay centre where if they can't get fertiliser, they said we should grow legumes and buy the maize instead. I would never try that because how would I know how much to grow and what I would get for it?
>
> (Anonymous female #12, personal communication, 11 May 2017)

[35] MK = Malawian Kwacha, Malawi's currency; exchange rate understood at 725MK = 1 USD
[36] Indirect reference to price scissors concept discussed in literature review

I found that other people using this [CA] technique did find success but only because they were using a lot of fertiliser."

(Anonymous female #38, personal communication, 17 May 2017)

"I've seen people not make ridges. I would never try this because those people don't use fertiliser. How can they expect to have a good crop if they don't use fertiliser? It just won't work."

(Anonymous female #64, personal communication, 23 May 2017)

"I've seen others without ridges but they use a lot of fertiliser because fertiliser makes the differences, not the ridges."

(Anonymous female #34, personal communication, 17 May 2017)

"No fertiliser means termites. And termites means no crops. Fertiliser fixes the soil and give me good crops, so why would I try something without it?"

(Anonymous male #5, personal communication, 10 May 2017)

One farmer had observed someone using CA techniques. He asked clarifying questions at the end of his interview, remarking that when CA techniques are used, he did see that less fertiliser was needed. He found it odd and thought the farmer would fail but, "they had a greater harvest. I would say four times greater than mine" (Anonymous male #31, personal communication, 17 May 2017). He was asked if after seeing that success if he would be willing to try CA. His reply: "I think so. Yes. But not on all the farm. Just a little part. And I would still

put fertiliser." I explained that CA uses mulching and composting rather than fertiliser but his thinking was if the harvest was four times greater without fertiliser, "it would be 10 times as big" with fertiliser (Ibid).

The high costs of fertiliser often leaves the most vulnerable unable to afford it. When participants were asked how much fertiliser was used on farms, the range varied from one plateful to 12 bags per layer with 3 layers[37]. Participants relayed that the best use of fertiliser is "one bag per half acre." Those who had less fertiliser believed this was the reason they had poor harvests that did not last the entire hunger season. Looking to collect information on fertiliser disbursement and how FISP was distributed, each participant was asked if they either had already received or expected to receive an FISP voucher for 2017.

5.2.5 FISP Distribution Limited to Essentially None

In the one of the group village headmen regions, 21 of 400 households are granted FISP (Chiefs, personal communication, May 2017). Of the 115 participants interviewed for this thesis, four received the Fertiliser Subsidy from the MoAFS. This subsidy is intended to help the poorest and most vulnerable of the population purchase fertiliser to successfully harvest crops (Fisher & Chibwana, 2011). Ultimately, the distribution of the subsidies is left to the discretion of the local chiefs, but the number of vouchers available was cut by 50% for the 2016-2017 harvest year (Basani, 2016). One participant shared his frustrations saying, "The subsidy is a joke. No one gets it. And the few people who do get it don't get very much. It's maybe half a

[37] Application of fertiliser understood to be bottom layer, fertiliser around the seed itself, and top layer once seed is in soil

bag." As mentioned before, most people rely on fertiliser to have a good harvest. The belief that more fertiliser results in a higher crop yield encourages excessive use of fertiliser, with some using as much as "12 bags per layer.[38]" One of the group village headman chiefs admitted even he was frustrated by the system:

> "It is my responsibility to hand out the subsidy. I have 400 people and only four coupons. How am I to pick? But it is my job. So I do it. I know it is not enough but there is no more available. So I try to help in other ways."
>
> (Chiefs, personal communication, May 2017)

Micro-dosing, as mentioned in a previous section, is one of these other ways of helping out. However, it seems to be slow to catch on. Another chief noted that "I tell them [my village] 1 cap. That's it. But then I see them using handfuls of fertiliser for 1 seed. They say they will change when the subsidy returns. That is not likely to happen." Nearly all participants smiled and laughed when asked about FISP. One farmer in particular said:

> "I could use the subsidy but because I am seen as rich, I am not allowed to have it. I don't know how it is that I am rich. I have very little. I cannot afford a lot of fertiliser. I can afford some. But it is not enough. The subsidy would have helped."
>
> (Anonymous male #14, personal communication, 11 May 2017)

[38] Participant continued to say she normally does 3 layers per crop of fertiliser.

With the subsidy essentially non-existent, the chiefs have been looking for alternative ways to help their villages. One such method is through microfinance groups, a relatively new concept to the Nkhoma Mission region.

5.2.6 Creation and Use of Microfinance Groups

Microfinance groups exist to provide microfinances to people in the villages, where each group has a set membership quota with shares[39] available to be purchased (Chiefs, personal communication, May 2017). A bank book is used to keep track of the total fund with an emergency fund established as a secondary account (Ibid). Loans are mostly for members only but some groups will allow outsiders to take loans at higher interest rates (Chiefs personal communication, May 2017). Generally, loans are used for purchase of fertiliser, seeds, or temporary food assistance when a harvest is not enough to feed a family (Ibid).

In total, four microfinance groups completed focus group discussions at Nkhoma Mission. The oldest group was established in 2010 and had 20 group members. The newest was created in 2015 and had five people but was looking to grow. The chief who established the first microfinance group spoke about the goals of the group: providing much needed loans for people to purchase fertiliser, supporting a widow when her husband dies, supporting people with unexpected family disasters, and providing a social support system for the members. She was proud to have established the first group and to see that others in the village were creating their own microfinancing organizations. She noted that "village banking is helpful but the challenge is

[39] Refers to the financial obligations members pay to the group in exchange for membership; shares of all members total the amount available for borrowing within the confines of the group.

we all struggle to pay the shares that people need" (Chiefs, personal communication, May 2017). Even as chief, the shares of 200MK per member per month was sometimes difficult to come up with and often times, groups required a number of shares to be purchased.

Out of 115 participants, only 49 did not use microcredits or microfinancing. For some it was because they did not have access to a microfinance group like the four groups set up in the villages:

> "How do I get more capital to grow my business? I don't have access to microcredits and even if I did, I would just go between getting a loan for the business which I will then have to spend on my family because I don't make enough at the business and then I have to sell the food my family needs to repay the loan. How am I supposed to succeed?"
>
> (Anonymous female #29, personal communication, 17 May 2017)

Others noted that even if microcredits/microfinancing groups were at their disposal, it would not make sense to participate in them because of high interest rates (ranging from 20-50% in the groups interviewed) with fast payback requirements:

> "Microloans can help if you can find a group but often they are very expensive and cannot give a lot of money so it isn't really worth it."
>
> (Anonymous male #67, personal communication, 24 May 2017)

> "Microcredits are an option for me but the interest and the time to pay back the money isn't possible. It's just impossible."
>
> (Anonymous male #68, personal communication, 24 May 2017)

With microcredits available to a limited number of people, and in limited amounts, the choice of which farming techniques to use often comes down to what is comfortable and what is most familiar. Sasakawa and Traditional Farming techniques are incredibly similar, with slight variations in terms of the number of seeds used and size of plots. CA and FGW are newer, introduced in the last decade or so, and still facing much hesitation. Ultimately, each farmer decides for him/herself which techniques are the most worthwhile.

5.2.7 Farming Technique Selections

Farmers were asked why they chose/continued to use the farming practices they self-identified. This question attempted to discover if motivations on adoption of techniques was a conscious choice or if farming was conducted in the same manner as generations before. For most participants, the latter was true, with 84.35% choosing to use techniques they had grown up seeing. As one farmer put it:

> "What you [the researcher] call traditional farming, that's just what's known and I just haven't bothered to change. I got better at it as time went on and really, I taught myself through observing what others in my village where doing. I know

so many people who farm this way; a lot more [people] farm this way than those who don't. I never thought about changing."

(Anonymous male #1, personal communication, 10 May 2017)

For the few farmers who were trying the newer techniques, Etter's conclusion of Christian morals motivating a farming practice switch was supported:

"I went to Veritas training and since some other people had gone and said it was working I thought maybe it would work for me too. I went to learn and improve how I farm and to be a good Christian. I think many will adopt it [FGW] eventually because many are Christians and want to be more pleasing to the Lord Most High. I believe in this farming method because I have less problems when I use it and I know I am doing what God wants me to do."

(Anonymous male #2, personal communication, 10 May 2017)

"I learned from Veritas that God has given the earth to me. He gave it to me. He told me to protect it. The way I was farming, I was not protecting it. Now, I protect God's creation. I make Him happy with me when I farm like this."

(Anonymous female #13, personal communication, 11 May 2017)

Regardless of the farming techniques used, all participants expressed dissatisfaction at the lack of production, farming inputs, amount of labour required, and other

related variables. All participants were asked to identify their top agricultural needs, regardless of cost or feasibility. Saturation on the number one request was quickly reached.

5.2.8 Ideal Farming Conditions

Perhaps not surprisingly, 100% of participants listed fertiliser as the top desired item for a better crop production. The request for fertiliser came almost immediately when the question of what would make a perfect farm and a perfect harvest possible was asked. Even the government extension worker who discussed the merits of Conservation Agriculture listed fertiliser as his top priority to improve his annual harvest. The focus on fertiliser as the solution to harvest concerns was shared across participants, even those who used FGW and CA techniques which stress little to no fertiliser use.

The second aspect of farming most wanted was a means of transportation so maize can be easily moved from the farm to the home and the home to markets. Of those interviewed, 21.74% asked for a small truck or another way to move maize in one trip. Many farmers expressed frustration that they were unable to sell large maize quantities for higher prices because of the limited amount they could carry. Several women in the focus groups also discussed the distance between where they live and where the markets are. Some of the village homes are several kilometres away from the M1, where the largest markets are held one day a week (Map 3).[40] A few of the men interviewed specifically wanted an ox-cart to transport the maize, along with the livestock to pull them. One said:

[40] Specific locations vary based on the day, but markets operate on a set schedule

> "I would like a better way to transport my maize from my farm to my home or from my home to the market. Now it's very hard to do and I cannot sell as much as I would like because I don't have a way to get it there. So a means for transportation."
>
> (Anonymous female #100, personal communication, 25 May 2017)

The third most prioritized item was more land. The average farm size in the dataset was one-half acre, while the average farm size for smallholder farmers in the developing world is generally believed to be one ha.[41] More land was requested by 17.39% of participants. The phrase "more land to grow more food" was echoed by 16 different participants and was often accompanied by a request for hybrid seeds to be planted in the additional land. One farmer stated that, "I could buy all the hybrid seeds in the country but if I have nowhere to plant them, they go bad after only one year. Only one year and they are gone" (Anonymous female #92, personal communication, 25 May 2017). Another said: "I need to be able to afford hybrid seeds. That's what will get me a better yield. Until I get the hybrid seeds I won't be as successful. And they can be hard to find" (Anonymous female #112, personal communication, 25 May 2017). Farmers told stories of looking along the ground for seeds and discussed the territorial nature towards seeds (Photo 6), something expanded upon while observing two sample farms. One farmer uses CA techniques and often finds that he is asked to provide seeds to his workers or to members of the village. However, he refuses to give out his seeds because he is convinced that

[41] 2.5 acres

until people are trained to use CA techniques, they should not be given "good seeds they can use again and again" (CA farm, personal communication, May 2017).

Photo 6: CA-grown maize to be used for future planting seeds

A number of other requests include pesticides to remove insects and help prevent weeds (three participants), equipment for irrigation and mechanized farming (e.g. ploughs, machines), animals to increase access to organic manure, and more labourers to work during the harvest seasons. Some participants expressed confusion over why animal waste was limited to only the owners of the animals. One participant stated:

> "If people share their manure with us, we'd have more success. Some people in the village have three pigs and we can use the manure in the village from what's thrown away. And that is good. But it depends on whether or not it can be found."
>
> (Anonymous male #24, personal communication, 15 May 2017)

Several participants discussed the desire for different seeds, noting that, "more variety in the crops I grow [means] I can sell something different than what all the others sell." While nearly all participants (97/115) said they used hybrid seeds for maize crops, a few of these participants showed some reluctance. It was not explicitly said, but during focus groups there would be staring if someone did not respond immediately in affirmation when asked if they farmed using hybrid seeds. Despite the appearance of hesitation, hybrid seeds are clearly favoured:

> "It is good to use hybrid seeds because sporadic rains may end prematurely but hybrid seeds will still grow and increase your crop yield. So your crops will be bigger if you use hybrid seeds even if the rains end."
>
> (Anonymous male #1, personal communication, 10 May 2017)

One of the interviewees who was proud of not using hybrid seeds noted that, "local seeds are better for nsima,[42] but hybrid seeds are better for selling. I don't like the way the hybrids taste and you can't use them again" (Anonymous female #48, personal communication, 23 May 2017).

It is evident from these responses that fertiliser, means of transportation, hybrid seeds, and access to inputs overall play a critical role in the hypothetical situation posed to the farmers.

[42] Nsima is a staple food made from ground up maize kernals

However, the question of whether or not farmers would actually adopt new techniques had yet to be answered. The next subsection focuses on those responses.

5.2.9 Willingness to Try New Techniques

The role of fertiliser in a farmer's decisions to try new techniques has already been discussed, but the willingness of farmers to adopt new techniques warrants discussion. In particular, this subsection presents open-ended responses to an inquiry focusing on what conditions need to exist for famers to adopt new farming practices. Specifically, farmers were asked if they had seen other techniques used and if so, whether or not they would consider farming that way in the future. Two primary observations were described: using compost and not planting with ridges. These two techniques overlapped occasionally according to the participants, but are discussed below in two separate categories.

Regarding composting, participants said they saw limited success, but many indicated they would never actually try it because of the amount of labour and time required to implement it. In one focus group alone, 10 people agreed when someone said, "I have seen people mulching but I would never do it because it looks like too much work. It's just too much. I don't have time for that much work" (Anonymous female #109, personal communication, 25 May 2017). One interviewee hesitantly indicated he was willing to try composting: "I have seen others composting and that they seem to have better maize. I will start doing this soon. I must use manure with the fertiliser, I think. Then I will have more [crop production]" (Anonymous male, #114, personal communication, 25 May 2017).

Much more discussion focused around farming without ridges. As mentioned previously, the perception associated with those farmers who do not use ridges is generally that they are "crazy" but sometimes there will be adoption rates. Discussed briefly in the subsection on CA, the following quotes expand on the ideas of adopting no-RT. Of the 115 participants, 23 do not use ridges. Many participants had seen flat-farming and some many indicated they would be willing to try it, if they had fertiliser and support from trainers:

> "I will try no ridges because I have seen that the chief has tried it. But I will only try if the chief teaches me and if I am given fertiliser. Otherwise I will fail anyways."
>
> (Anonymous female #57, personal communication, 23 May 2017)

> "A government extension worker told me not to make ridges. He said it was bad for the soil so I stopped. Unlike other people, he comes back to check on me and sees how well I'm trying what he taught me. He works for Banking and Agriculture I think."
>
> (Anonymous male #9, personal communication, 10 May 2017)

> "I think we should be encouraging people to not make ridges because of erosion. They should just mulch on top to keep the water. And it's less work which is good."
>
> (Anonymous male #2, personal communication, 10 May 2017)

It appears that the second most frequent factor (behind fertiliser supply/dependence) in adoption of new farming techniques is support from professional trainers. This was alluded to during discussions about FGW and CA, but explicitly, participants stated that they would stop

using new techniques because they were “given knowledge, not support” (Anonymous male #14, personal communication, 11 May 2017). This was echoed by other participants: “I was taught by a government extension work to cover the ridges. He said he would come back and check on my techniques every once in a while but he has not come” (Anonymous female #80, personal communication, 25 May 2017). One participant temporarily stopped using ridges: “I tried to plant with no ridges and it fell away. It fell away so bad. I had no water. I didn’t want to try again but maybe I will because now I understand that the moisture is kept underneath and not on top of the soil” (Anonymous female #28, personal communication, 15 May 2017).

What is particularly interesting about the decision of farmers in adopting new techniques is that slash and burn, a farming technique where fields are cleared through burning crop residues, was used in TA Kalumbu’s territory until a few years ago when he banned its use. Participants living in his area stopped burning because “the chiefs outlawed burning and will punish you if they see you have set your land on fire” (Anonymous female #53, personal communication 23 May 2017). Another participant stopped using slash and burn because “a government extension worker told me it was bad. I do not know if he was right” (Anonymous female, #50, personal communication, 23 May 2017). In total, only 16/115 participants used slash and burn techniques (Photos 7 and 8), and none resided in TA Kalumbu.

Photo 7: Slash and Burn

Photo 8: Clearing Planting Field

Informal observations confirmed that burning could be seen in neighbouring TAs, but not in TA Kalumbu. This shows that there are conditions under which farmers change their farming practices: fear of punishment and/or when someone in authority shares a new technique. While the influence of the government extension worker is more questionable, the adoption of Sasakawa (previously discussed) and the decision to stop using slash and burn techniques demonstrates that influence does exist for government extension workers. TA Kalumbu plans to use these influencing forces to help his people better their crop production in the future.

5.2.10 TA Chief Conservation Agriculture Competition

TA Kalumbu was trained in both Sasakawa and CA techniques and dedicated 1 ha of his farm to using each method. He found that using CA, his crops had a better production value at market (TA, personal communication, 7 June 2017). As a result, he has announced that starting with the 2018 harvest season, all farmers in his area must use CA techniques. He understands the three interventions as identified in this thesis and is working with government extension workers

to promote teaching and adoption of CA (Ibid). To help farmers adopt CA, TA Kalumbu has banned heaping soil (ridges are still permitted), planting three seeds in a station, and burning of anything associated with farming (Ibid). If farmers use any of the three newly-banned practices, they will be fined a goat (or what TA Kalumbu declares is the equivalent if no goat is available) (Ibid). Previously, TA Kalumbu declared that livestock was no longer allowed to move about and must be caged at night or fines will be administered (Chiefs, personal communication, May 2017).

To help promote CA adoption further, TA Kalumbu has opened a competition with a cash prize for the farmer who is seen to be using CA the best in his territory (CTA, personal communication, 7 June 2017). The competition will have several levels including village, village headmen, group village headmen, and finally TA-wide, with money being supplied by the all chiefs in the TA. The winner will be selected by a committee that TA Kalumbu will choose himself and there will be a number of categories including livestock care, use of the 3 interventions, use of fertiliser or lack thereof, etc. (TA, personal communication, 7 June 2017). The final scores will be tallied using a unique formula designed to normalize all farmers so that those with more money are not automatically able to perform better than those with less income (Ibid).

Thus far, there have been several training sessions on CA offered throughout the TA, but there has been little attendance and interest (Chiefs, personal communication, May 2017). The group village headmen and village headmen chiefs were trained first and are expected to use their own farms as sample farms for successful implementation of TA (Ibid). TA Kalumbu plans to ensure any local NGOs operating in his region comply with his preference for CA, however,

there has been difficulty contacting organizational representatives to determine what programmes are being run in TA Kalumbu and Nkhoma Mission.

5.2.11 Other Organisations Operating in Nkhoma Mission

Officially, ICRISAT, World Vision, WFP, and IFAD have agricultural intervention programmes operating in the Nkhoma Mission area. However, attempts to communicate with local officials or visit country headquarters in Lilongwe were met with no response. TA Kalumbu noted that this is fairly typical of NGOs and IGOs:

> "I have heard that organizations are operating in my area. But do they come to me? No. Because I will not just take their advice. I want to see results. And when I try to communicate with them, to talk to them about my ideas or to gather them together so we are all telling the people one thing, I am ignored."
>
> (TA, personal communication, 7 June 2017).

Veritas echoed these sentiments:

> "NGOs just make it worse. They come in here. They tell us what to do. They leave. They do not help. They give people false hope [. . .] we need organizations to provide a safety net. Veritas cannot do this. We cannot. [FGW] is a year-plus process but people believe they have long term partners to help. It's not all about money per say, but we want to be a big brother and help out. We just can't"
>
> (Veritas, personal communication, May 2017)

The frustration in not knowing which organizations are officially operating in Nkhoma Mission and what each organization is focusing on makes it difficult for research to accurately analyse the situation across agricultural programmes. Furthermore, multiple organisations operating in Nkhoma Mission means there is a greater variation in what farmers are being taught, along with a greater chance for cross-use of techniques.

Given the quantity of the data presented, this chapter ends with a results summary section.

5.3 RESULTS SUMMARISED

Over a period of six weeks, 115 participants participated in interviews or focus groups. A basic demographic breakdown categorized a majority of the participants as young/middle-aged females with an education level at Standard 8 and a farm size average of equal to or less than one-half an acre. Nearly all participants relied on human labour, did not have farming insurance, relied on rains for their water sources, and weeded their farms twice a year. Several participants were members of microfinance groups despite high interest rates and expensive shares. Essentially none of the participants received the FISP, but all 115 indicated that in a perfect world, they would have more fertiliser for their farms. The most used form of agricultural intervention used by smallholder farmers in central Malawi is Sasakawa, which is seen as successful because it is easy to implement and results can be seen at harvest time the same year it is adopted.

Generally speaking, smallholder farmers' were cautious and generally negative towards non-traditional farming mechanism. In particular, many thought that non-ridges and non-fertiliser techniques would not be successful. However, many farmers were willing to try techniques seen to be successful through observations of lead farmers. This willingness extended to a small number of participants, and with the caveats farming inputs and continuous training would be provided.

CA appears to work in the short-term but there needs to be additional data collected at Nkhoma Mission to determine its effectiveness through long-term use. The primary concern with a potential conclusion that CA is successful is that the amount of fertiliser used and the varying definitions make it difficult to conclude what is and is not CA. The agricultural interventions used under CA as it is defined in this thesis were not always the only inputs or impacts on a farm. FGW is considered an adaptation of CA, although it is only available to main-station church members who attend Biblical training sessions. FGW is successful because people have learned to associate the techniques with a more important value than success or fear: being a Christian.

Fertiliser plays an abnormally large role in the decision to adopt new techniques in Malawi, due to the strong correlation between success and fertiliser's use. If agricultural interventions like CA and FGW do not incorporate fertiliser, the techniques are essentially discarded and ignored. The second most critical factor to long-term adoption of agricultural intervention programmes is the amount of support farmers receive from trainers. When the support fails to show up, or when farmers feel they are alone in their undertaking of risk, new techniques are abandoned for traditional methods.

CA will be adopted by most of the farmers in the Nkhoma Mission study area because TA Kalumbu has mandated it will be practiced by all living in his region. This will be supported and promoted through a cash prize competition for farmers who implement CA techniques the best. TA Kalumbu is concerned his actions will be undermined by outside organizations promoting non-CA techniques, but he has been unable to organise a meeting with representatives of said organisations due to lack of communication.

5.4 FINANCIAL COSTS, RISKS, AND LABOUR ANALYSIS CONSIDERATIONS

Responses to the open-ended questions can be categorized into two larger clusters: financial cost/burden and perceptions of risk. The preceding data illustrate underlying concerns of failure in adopting a new technique, even if said technique saw success in smaller amounts on local farms. While farmers did not categorize their responses into these two areas, the repeated concerns related to having fertiliser and support lend to either subconscious or otherwise underlying concerns which do fit into the aforementioned categories.

Farmers spoke to the financial burdens of farming whenever they discussed fertiliser or additional equipment currently unattainable. While not listed as a direct cause of choosing to not adopt certain practices, financial costs were shown in the literature review to dissuade farmers from adopting techniques or abandoning techniques after a short period of time.

The second cluster speaks to the risk farmers feel in trusting new information about farming techniques or trying anything different than traditional methods. This goes along with

the concerns participants expressed over not feeling supported by local experts through additional training and follow up sessions.

The next section uses these clusters to frame a better understanding of the data along bi-variable and multivariable analyses.

5.5 CROSS-VARIABLE ANALYSIS: AGE AND GENDER

Using the three clusters as independent variables, this subsection focuses on further analysis of the data presented above using two or more variables. The objective of this analysis is to synthesis the data further and to name patterns and relationships present.

Regarding perceived financial burdens, the intersection with age is particularly interesting. While gender did not play a statistically significant role in the perception of trying a new technique based on financial concerns,[43] older smallholder farmers seemed to be more willing to incur financially difficult scenarios than younger farmers. While 37.4% of participants were aged 29 and younger, only one-quarter (11/43 participants) of this age group were interested in trying new techniques in spite of fertiliser and farming input costs. Participants aged 50 and older (30) were more willing to take microloans and microcredits compared to younger age groups, despite concerns over raising interest loans (93.3% compared to 69.8%).

Focusing on concerns regarding risk, the intersection with gender is most notable. While nationally, 24% of Malawi's households are female-headed, in the research area

[43] Understood in this context as costs associated with starting, switching to, or using a new technique; also includes perceived costs in lost revenue from under crop yield production

approximately 67% of participants said they would consider their home female headed. Females dictated how money should be spent in the majority of these households, frequently discussed as finances related to keeping or selling parts of the annual maize crop harvest. Of the male respondents, 54% (14/26 male participants) indicated they sell all of their maize and then buy food and other materials they may need. In contrast, only 8.9% (8/89) of female participants indicated they would sell all of their harvest. Most females, 80.9% (72/89), chose to sell some of their harvest but hold most of it for as long as possible to have food for the family. This data may allude to the gendered differences in risking taking, indicating men are more likely to risk security than females.

This allusion is strengthened when responses to the direct question regarding the willingness of smallholder farmers to try new techniques is analysed. As section 5.2.9 discussed, smallholder farmers were generally unwilling to adopt new techniques without substantial support and fertiliser assistance. However, of the 58 participants who directly expressed they would be willing to try new techniques (regardless of stipulations), 21 (36.2%) were males. So of the male participants, 80.8% were willing to try new techniques. Of the 23 participants who do not use ridges, 14 (60.9%) were males. In contrast to this generally strong association of females being more cautious, 11/16 (69.9%) participants who still use slash and burn techniques despite TA laws are female. Even though the data is skewed in favour of females, it appears that males are more willing

A secondary variable intersecting with risk is age. As in the discussion regarding financial burden, the relationship between age and risk favours older generations. Participants aged 29 and younger often voiced concerns over paying for their future family members, needing to purchase land to live off of, and paying school fees for siblings or children. As a result, 37.2%

(16/43) were willing to take the risk of trying a new technique on their own farms. In contrast, 65% (26/40) farmers between the ages of 30 and 49 and 76.7% (23/30) farmers aged 50 and older would willingly try new farming techniques on their own land (with various stipulations).

6.0 RECOMMENDATIONS AND NEXT STEPS

This chapter presents a series of recommendations for Malawi and the researching community on agricultural interventions. First, recommendations specific to Malawi are discussed with priorities on better understanding of the reliance on chemical fertilisers and how to reduce this, re-interviewing participants from focus groups for greater depth of information, and coordination of legal regulatory efforts between varying levels of chiefs in the Nkhoma Mission area. The second section presents recommendations for the expert community, aiming to continue moving the research community towards universal definitions of agricultural terms, techniques, and practices. The third section discusses the creation of an evaluative framework for cross-geography and cross-understanding comparisons of CA techniques. The framework would also allow for objective determinations of success of CA and greater quantitative analysis for comparisons. The fourth section emphasizes the need for better direction and customization of training sessions both in and out of Nkhoma Mission so farmers feel supported as they take risks with their food sources. The final section of this chapter calls for the need for improved coordination of organisations focused on agricultural intervention programmes, the need for understanding in why the FAO and other organizations have chosen to promote CA over other agricultural intervention methods, and potential next steps.

6.1 RECOMMENDATIONS FOR MALAWI

It is clear from the data collected that there is a bias in favour of using fertiliser, even in instances where it has been proven to be unnecessary. Understanding the underlying link between fertiliser and perceptions of success would be a crucial next step in understanding which agricultural intervention programmes should be adopted due to recorded and confirmed success in semi-arid environments. Forced adoption of fertiliser and ridges from colonial times were discussed in the literature review, but beyond these roots, there is limited (if any) proof for Malawians that fertiliser is required for success. Even in instances where techniques advocating for organic manure or the removal of fertiliser from the farming process are seen as successful, the link between fertiliser and a successful crop harvest remains. Furthermore, the cost increases associated with fertiliser limits what other inputs farmers can apply to their fields. Malawians need a better way to observe and understand the role fertiliser plays in crop production and perceptions of success. To do this, it is recommended that a large sample farm be created. This farm should be divided into eight equal sections. The farm should be divided into two columns and with one column of land using fertiliser while the other will not. Additionally, the farm needs to be further divided into four rows. The first row uses CA; the second TF; the third Sasakawa; and the fourth will use intercropping techniques under both Sasakawa and CA. This sample farm is done both to show the difference between the techniques, especially CA which appears to work at least in the interim in Nkhoma Mission, and to illustrate that crops can be

successful without using fertiliser if the right techniques are applied. A diagram of what this sample farm[44] would look like is produced below:

Conservation Agriculture with Fertiliser	Conservation Agriculture without Fertiliser
Traditional Farming with Fertiliser	Traditional Farming without Fertiliser
Sasakawa with Fertiliser	Sasakawa without Fertiliser
Intercropped Sasakawa	Intercropped Conservation Agriculture

Table 8: Recommended Sample Farm Layout

The sample farm would use organic manure on the portion farmed with CA techniques. Ultimately, this sample farm would determine which techniques are most effective in the semi-arid environment of Malawi and would show people living in and around the area of the sample farm (ideally created somewhere within the geographic boundaries of this thesis) the difference in performance levels of the techniques. This sample farm should be supported over a 3-5 year period so that the progress seen in CA techniques would be given an opportunity to present itself and to allow people to visit the sample farm to gather seeds, ask questions, and even spend some time learning the techniques in an on-the-ground manner. While this sample

[44] Given the difficult in acquiring large land plots, this could be created either through the donation of land on a church property or thought collaboration between several farmers with adjacent land plots. Based on the data gathered, a farmer in the Nkhoma Mission area has decided to plant using a version of this recommended farm plot for a period of two years. He will directly compare the results of CA and TF on maize crops, and will finance the pilot programme himself.

farm would not immediately answer the questions of longevity in using CA techniques, it could if the farm was maintained for a longer period of time. As time goes on, the sample farm can either be expanded if there is sufficient land to show the effects of intercropping with and without fertiliser under various techniques and other expansions that may be relevant to the local farmers.

A second recommendation from the data collected is to study the patterns of fertiliser price changes more extensively to determine when the best time of year is for farmers to purchase fertiliser. A 2015 presentation from the Adoption Pathways project began to study hypothetical effects of fertiliser subsidy programmes like FISP, looking at fertiliser-maize price ratio simulations under hypothetical policy changes. The Malawi FISP was compared to similar programmes scenarios in Ethiopia, Kenya, and Tanzania: Malawi had the highest cost in fertiliser use (Marenya et al., 2015). Policy simulations on lowering fertiliser costs through reallocation of the subsidies to focus on industry cost reduction, rather than distribution of vouchers reduced the cost of fertiliser available to the general population of Malawi by over 40% (Ibid). Moreover, the researchers found that by lowering the costs of inputs, farmers were encouraged to try new techniques, particularly CA (Ibid). If this hypothetical could be piloted in a village or two, perhaps it will find success as the government would have concrete data to draft future food security policies. However, the researchers stopped collecting data after three years, presenting their conclusions before the most recent climatic change and food security disasters in Malawi.

A third recommendation is to re-interview some of the focus group participants. The necessary adaptation from interviews to focus groups means that the data may be skewed to an unknown degree. If interviews could be completed a second time, but strictly as interviews,

with many of the same participants or at the very least, residents from the same geographic areas, it would be easier to ask additional clarifying questions on statements about understanding of technique, different usage statistics, and other potential areas of anomalies.

Fourth, baseline data in TA Kalumbu could be collected so that an impact evaluation on the new law requiring smallholder farmers to use CA can be conducted. The TA's new law provides a unique opportunity to conduct a true impact evaluation on CA's short- and long-term success in the region. The same questions used in this thesis can be repeated to farmers in TA Kalumbu or be adapted into a survey instrument for greater quantitative data comparison and analysis in the future. The situation with the TA and the new law creates a natural experiment which can be studied over a longer period of time with authentic results which can be quantifiably measured and observed.

Finally, given the differences in application of laws in either of the TAs encompassing Nkhoma Mission, it is recommended that the TA Chiefs work together to decide on important agricultural practices. With TA Kalumbu and TA Mazengera issuing competing orders, farmers expressed confusion over whether the banning of a practice such as the slash and burn technique is motivated by something other than crop production. TA Kalumbu's decision to create a competition encouraging CA techniques through cash incentives will directly conflict with farming actions in the neighbouring TA. Furthermore, the creation of the competition forces everyone to use the TA's definition of CA techniques. The concern with definition disparities are further discussed in the next section, which also lays out recommendations relevant to experts and trade sources pertaining to agricultural intervention programme definitions and evaluations.

6.2 RECOMMENDATIONS TOWARDS UNIVERSAL DEFINITIONS OF AGRICULTURAL INTERVENTION PROGRAMMES AND TECHNIQUES

The discrepancies in the definitions being used for agricultural intervention programmes create misunderstanding in application and interpretation of techniques. As shown in the data, there were variations in understandings of what terms like Conservation Agriculture, Sasakawa, and even Traditional Farming meant. More comprehensive, universal definitions need to be established not only in the literature but for use by on-the-ground workers as well. The need for common definitions has risen to the forefront of debate in the past few months. Dr. Giller and Dr. Twomlow, both cited in the literature review of this thesis, were contacted for clarification on definitional disparities. These leading experts disagreed with one another over specific inclusions in CA technique and TF. The issues on the definitions of techniques has become more prevalent in the past 6 months, as experts focused on agricultural interventions have begun to study definitions in agriculture more prominently.

Brown et al.'s 2017 article on understanding the utilization of CA in Africa states that the diversity in definitions makes it difficult to properly analyse the effects of CA. Brown states that the FAO's definition includes specific quantities for the components of CA: minimum tillage: a soil disturbed area of less than 15cm (or 24%); stover cover: 30% ground cover at planting; crop diversification: three crops in rotation (Ibid). Twomlow's working paper on Precision Conservation Agriculture argues that modifications of CA should be called "precision conservation agriculture (PCA)" if the modifications are applied to farmers in "low potential zones, where a majority of the most resource-poor and vulnerable farm households exist" (Twomlow et al. Working Paper). Specifically, PCA adds a fourth intervention: micro-dosing

(Ibid). Under this new definition, the focus of this thesis could be classified as PCA rather than CA. The debate focusing around definition issues, but rather than looking for consolidation and universal understanding, experts are adding new terms and interpretations to accommodate the variations in techniques. This thesis recommends the opposite: consolidation of definitions for ease of understanding and analysis.

Whether or not experts agree on the success of CA or other farming intervention programmes is a separate issue from whether or not there is a common understanding of what is being debated. If CA is understood in all of the varying ways presented in the data section, the ability to analyse its effectiveness and collect quantitative measurements on specific interventions cannot be cross-compared in different areas. It is difficult to compare the potential success on crop production if CA as defined in this thesis is being compared to CA as it is understood by each individual farmer interviewed.

One way to move the local Malawian community towards adoption of a universal definition is to gather the agricultural intervention programme trainers operating in Nkhoma Mission for a meeting/sharing session of various techniques. This serves to help to clarify what is being used, initiate better understanding of existing programmes, consolidate repeat/overlapping programmes, and increase awareness of the other actors in the field to alleviate confusion for farmers. The extensive nature of agricultural intervention programme trainers and informal ways in which techniques can be spread means that this meeting should be open to the public, offered at no charge, and moved around to various locations so that a wider girth of people can be involved in the discussion for clarification. Moving to the national/regional community, if existing NGOs and IGOs with officers operating in the Nkhoma Mission area and throughout

Malawi responded to inquiries, coordination among researchers, local experts, local farmers, and other international organizations looking to promote various techniques could be improved.

Definition variations also affect government extension workers and their ability to be successful. The evaluation of techniques is considered an essential element of a government extension worker's job, and is necessary for accurate and efficient policy evaluation and alterations. Furthermore, it would assist researchers working to compare and conclude which techniques are more (or less) effective in certain locations, circumstances, or implementations. The following section presents recommendations on the creation of a widely-applicable evaluation framework to better evaluate agricultural interventions, especially CA, across environments and countries.

6.3 RECOMMENDATION TOWARDS AN EVALUATION FRAMEWORK

Currently, the FAO studies which support CA are based on, "estimates from ministries of agriculture, by farmer organizations, and/or well-informed individuals in research or development organizations […] many field studies are based on personal estimates and observations" (Brown et al 2017). This concern over the ability to analyse the effectiveness of CA and other agricultural intervention programmes in an objective, quantifiable manner is growing as debates continue over CA's effectiveness in a variety of environments.

The data collected supports CA's effectiveness in the short-term, but fails to rationale that CA is a long-term, sustainable intervention as techniques are abandoned or manipulated away from CA alone. It is highly recommended that a single evaluation process be established for ease

of comparison across regions, environments, and time. A single evaluation process uses unified definitions and incorporates all information into one model of understanding so the process and its analysis can be applied to multiple settings and circumstances. One such framework is in the process of development: the Conservation Agricultural Appraisal Framework (CAAF). Brown and colleagues (2017) suggest that CAAF, understood through the graphic below, can and should be applied for evaluation determination of CA techniques. The framework measures each of the three components of CA under precise conditions, allowing for findings to be standardized for comparison across location, environment, and extent of techniques applied.

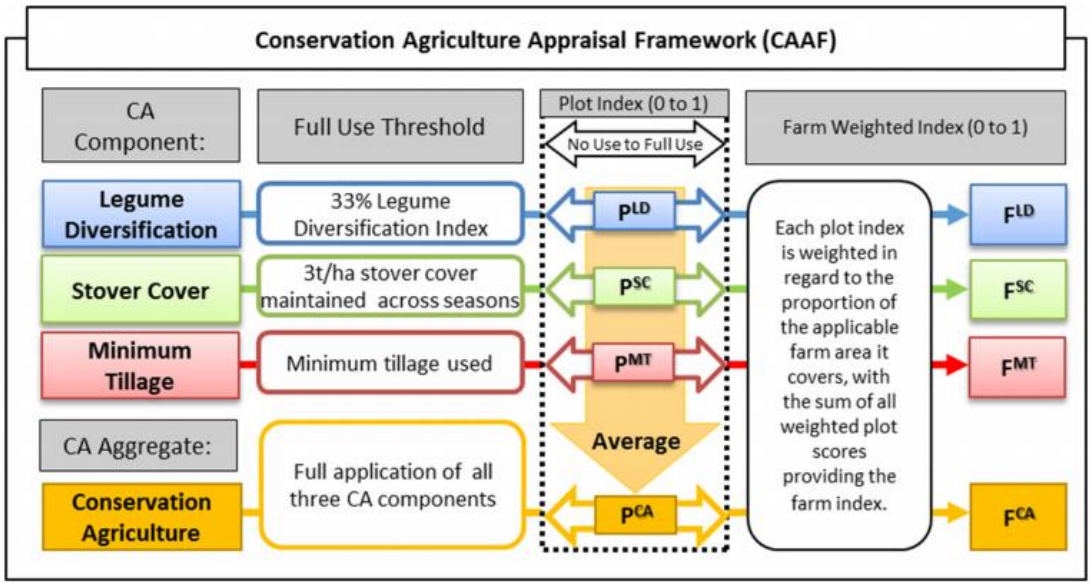


Figure 3: Conservation Agriculture Appraisal Framework (Brown et al. 2017).

The data presented in this thesis was based on subjective observations from participants calling into question the applicability of the results to other semi-arid environments. If a quantitative framework, like the one above, can be used and universally accepted, the value of information gathered (and its ability to be applicable to other situations) greatly increases. Government extension workers, researchers, local experts, and even smallholder farmers can be

taught the framework for their own use. In particular, farmers could be taught at training sessions how to use the framework to make their own conclusions about whether or not CA is successful. However, these training sessions need to be adapted to meet the demands from farmers for follow-up services and feelings of support found in the dataset.

6.4 RECOMMENDATION TOWARDS MORE SUPPORT FOR TRAINERS AND FARMERS

Farmers need follow-up training, in addition to the initial sessions, for reassurance that they are performing techniques correctly and to ask questions when they encounter unpredicted situations. As the data showed, many of the participants who were initially willing to try new techniques such as CA or FGW quickly abandoned the principles after 1 harvest season because they did not feel as if they were correctly performing the interventions, they had questions and were unable to have them answered, or they believed they would have support in the form of a face-to-face follow up and when that did not happen, they felt uncomfortable taking the risks associated with changing farming practices. Government extension workers and Veritas College should increase their efforts to communicate with farmers three, six, and 12 months following initial training sessions. This can be done either through the initial trainers or lead farmers can be employed/volunteer to assist local farmers with technique implementation.

Veritas may be able to adopt this recommendation more quickly and effectively than the national government because of the church relationships and emphasis on community engagement. The churches could have a committee trained in FGW and members of this

committee could volunteer to be responsible for a particular geographic area the church has members in. Whenever a farmer in that area receives FGW training, the church member responsible for that area would be notified and would arrange to provide support and follow-up advice at the intervals deemed appropriate. This could be seen as a community engagement service and done at little to no additional cost to Veritas once initial trainings are complete.

For the Malawian Government, it may be too expensive to have government extension workers continue to follow up with smallholder farmers. Perhaps a similar system to the Veritas recommendation could be implemented, with the local politicians taking the responsibility for farming technique follow-up as part of their assigned duties or the local chiefs receiving training.

A potential drawback to this technique is that there are still a number of different organisations and agricultural intervention programmes operating in Nkhoma Mission. Chiefs and church members may need to be trained in more than one area or there needs to be some sort of consensus on what techniques are taught to reduce confusion.

6.5 ADDITIONAL RECOMMENDATIONS

Government extension workers need to be coordinated so that the same information in different villages/TAs/regions is being conveyed. The confusion expressed in the data over what government extension workers were teaching people should not be contradictory. If the extension workers are not teaching a uniform policy throughout a region, there cannot be a reasonable expectation of improvement in crop production for smallholder farmers.

Additionally, determining why CA was promoted over other techniques by the FAO and other major organisations would provide insight as to why CA was considered sustainable in Malawi when the results of CA long-term are mixed at best. An initial inquiry to the FAO library in Rome, Italy found that there were no documents focusing on CA for semi-arid environments despite heavy promotion for CA. If information and datasets can be obtained explaining the decision to support CA, these findings can be replicated or refuted using modern data.

Additional research into the link between risk-adverse behaviours and sources of income for smallholder farmers should also be explored. In particular, the link between a second or third source of income and a farmer's decision to try a new agricultural technique (or similar risk) may provide greater understanding as to why the participants in this study were unwilling to fully adopt CA techniques. Literature on risk-adverse behaviour primarily focuses on gendered difference and situations regarding violence. The situation proposed in this discussion has much room for further conclusions. This type of research exploration may also lead to conclusions on the culture of farming in Malawi and other developing countries. If so, understanding embedded thoughts and cultural adherences to certain farming techniques could help explain a farmer's decision to fully or partially adopt successful techniques.

Finally, some logical next steps continue communicating with agricultural experts to establish universal definitions on agricultural techniques while expanding the research area to the rest of Malawi and other similar environment countries. Malawi, as mentioned in the literature review, is considered both semi-arid in terms of rainfall and tropical in terms of general environment. Other countries in similar situations include India, Kenya, Namibia, Botswana, and Zimbabwe. If the conclusions in this thesis can be replicated and supported in other semi-arid

environments, then CA's short-term effectiveness in semi-arid environments is upheld. However, there remain concerns over the long-term sustainability and effectiveness of CA given the heavy dependency on fertiliser. In order to determine CA's effectiveness over several years, the sample farm discussed in the first section of this chapter needs to be established and maintained.

7.0 CONCLUSION

Conservation Agriculture has mixed results in Malawi due to variations in the understanding of the three techniques. This does not mean that CA cannot be effective in Malawi. It does mean that more research is needed. The primary objective of this thesis was to identify answers to a literature gap on CA's effectiveness and long-term sustainability in semi-arid environments. This meant collecting information through focus groups and interviews in central Malawi over a six-week period. The data collected from 115 participants showed that Sasakawa, rather than CA or Traditional Farming methods, is the most adopted agricultural intervention programme in the region. Sasakawa is simple for smallholder farmers to adopt, saving them money on farming inputs through the purchase of less seeds and time spent planting the seeds. It encourages farmers to continue to use ridges and fertiliser, two elements the data showed to be integral to perceptions of success for smallholder farmers.

The data also showed a strong preference towards continued use of fertiliser, even when agricultural interventions are seen to be successful without it. More research is also needed to better understand the association between fertiliser and successful crop production, and what can be done to either reduce or sever that link in the future. If Malawians do not need to buy fertiliser at 20000MK a bag, then they can put that money towards other farming inputs, housing improvements, or whatever they wish.

Farming God's Way, identified as an adaptation of CA, was found to have success in the interim, as CA was. The fact that the adaptation and the original format of CA both have short term success, but are easily abandoned over longer periods causes doubts about how CA can be sustainable in semi-arid environments. Conversations with farmers found that if support was increased for farmers through additional training sessions or personalized visits by trainers and experts, farmers would be more willing to stick with a programme. To determine the truth of this, it is recommended that Veritas implement a community development committee at some of their partnership churches to provide this support. If maintained for a few years, this would show whether or not CA/FGW can truly be sustained.

Definitional and categorical disparities were discussed at length in the course of the data collection and recommendation chapters. As experts continue to add definitions, there also needs to be a consolidation and universal understanding of terms for cross-cultural, and cross-country analysis of success rates. As the development community continues to debate agriculture, data can be more focused and fact-driven with common understandings and interpretations of like phrases.

The findings of this thesis are not limited to Malawi, but rather can be applied to other semi-arid environments with similar agricultural intervention programmes and with similar histories of fertiliser dependency and ridge formulation. Countries like India, Kenya, and Trinidad may struggle with similar agricultural issues and adoption rate changes.

The international community continues to prioritize food security and agricultural intervention programmes as concerns about sustainable food sources and global distribution of food rise. If the estimates of experts like Dr. Rwelamire come true, and the risk of food insecurity reaches over 1.5 billion people, the time to discover sustainable agricultural techniques

may be too late. Malawi and other countries in the developing world already struggle to feed their populations. Climate change exacerbates this situation and demands that accurate research be conducted and distributed so that the farmers on the ground are being taught accurate techniques without the element of severe risk. The Sustainable Development Goals serve to encourage the global community to collaborate for innovative solutions for agriculture concerns. Perhaps instead of innovative solutions, the existing techniques should be better understood and improved. If Conservation Agriculture works in the short-term, it is possible that the techniques could work in the long-term. However, success of Conservation Agriculture relies upon greater support for farmers and better teachings on how soil/fertiliser works. This requires consolidating organizations and resources spent on agriculture techniques.

APPENDIX A

IFAD REPORT FLOW CHART DESCRIBING THE ISSUES SMALLHOLDER FARMERS IN AFRICA FACE

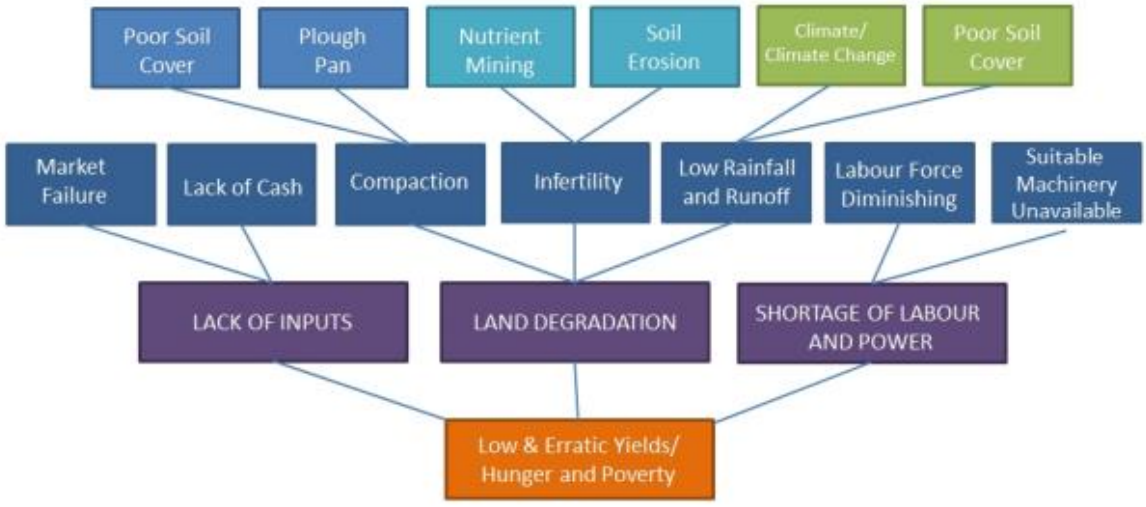
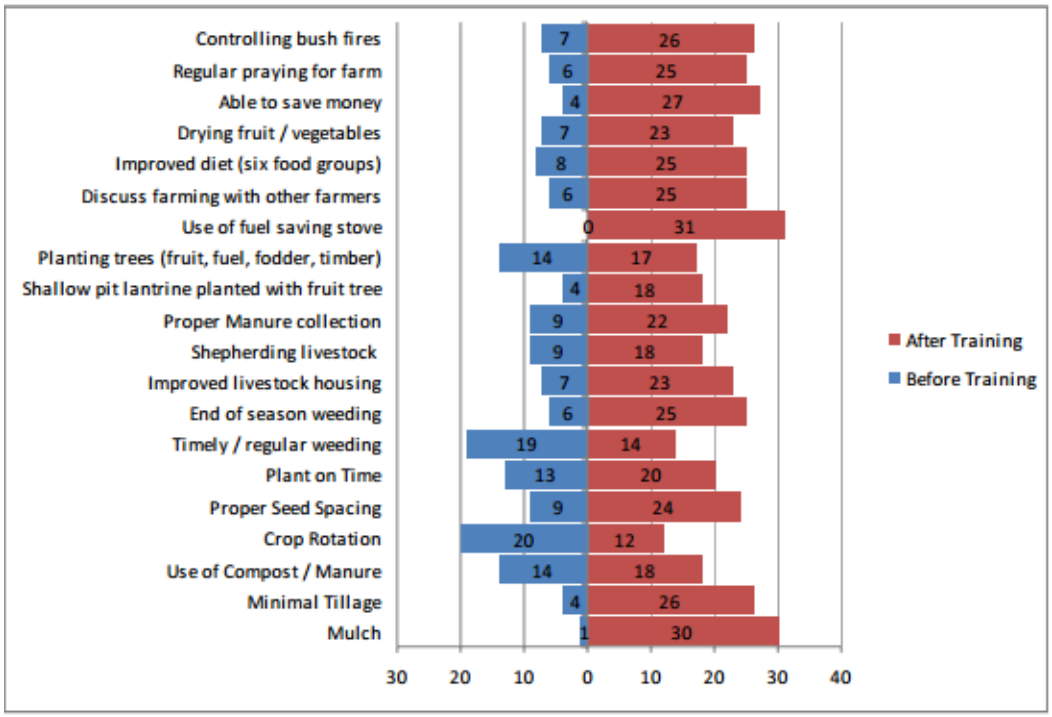


Figure 2. Generic problem path of smallholders in Africa

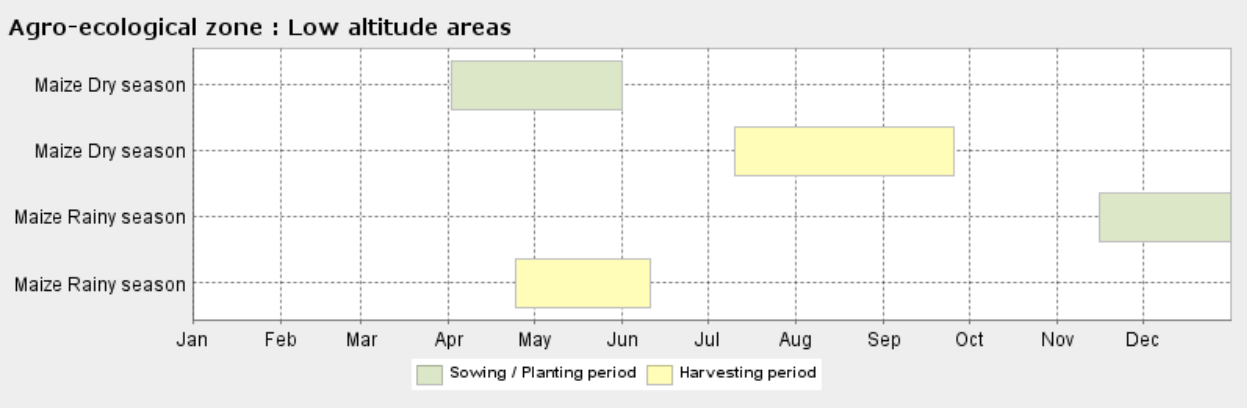
APPENDIX B

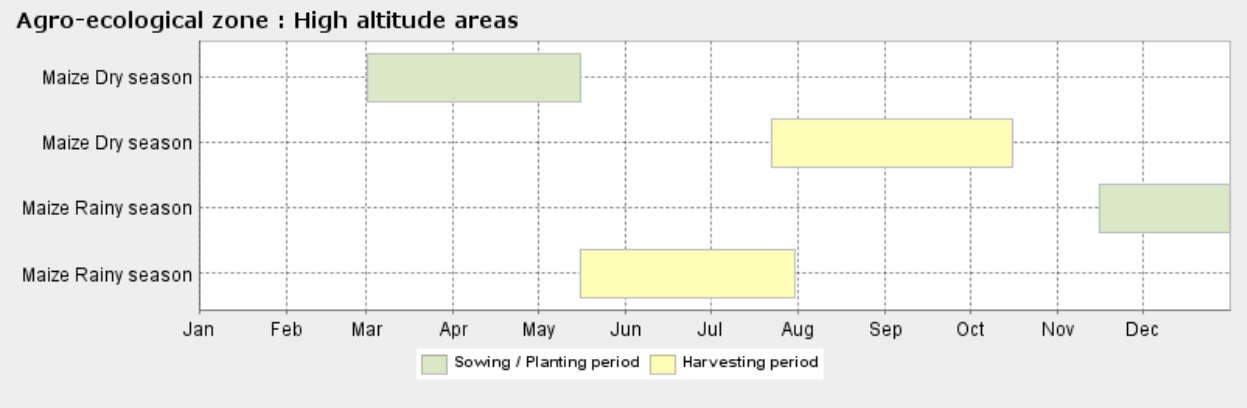
USE AND ADOPTION OF SUSTAINABLE FARM PRACTICES BEFORE AND AFTER TRAINING



APPENDIX C

FAO CATEGORIZATION OF TYPICAL GROWING PERIODS IN MALAWI BASED ON ALTITUDE; UNIQUE TO MAIZE CROP GROWTH





APPENDIX D

DEMOGRAPHIC, FARMING PRACTICE, AND QUANTITATIVE DATA COLLECTION TOOL

Date of Interview: _____
Age: _____ Male/female: _____
Education level (formal or informal):_____
Farm size (ha total, ha used):_____
Types of Farming Interventions (CA, FGW, CF, Sasakawa):_____

Which farming practice is used? Is use seen to be successful?	**Applies to % of land**	**Year started?**	**Improvement seen?**	**How long intend use?**
1. Mulching/God's Blanket use				
2. Flat planting/minimal tillage				
3. Composting/use of organic manure				
4. Crop rotation				
5. Government Subsidized Fertilizer				
6. Ridges in soil				
7. Weeding (Frequency)				
8. Hybrid Seeds (If yes, on what)				
9. Trees (nitrogen fixing?)				
10. Water source				
11. Microcredits/Loans available				
12.Insurance				
13. Slash and Burn				
14. Labour Type (human, animal)				
15. Livestock (# and type)				
16. Farm Workers (# and gender)				

Notes:

APPENDIX E

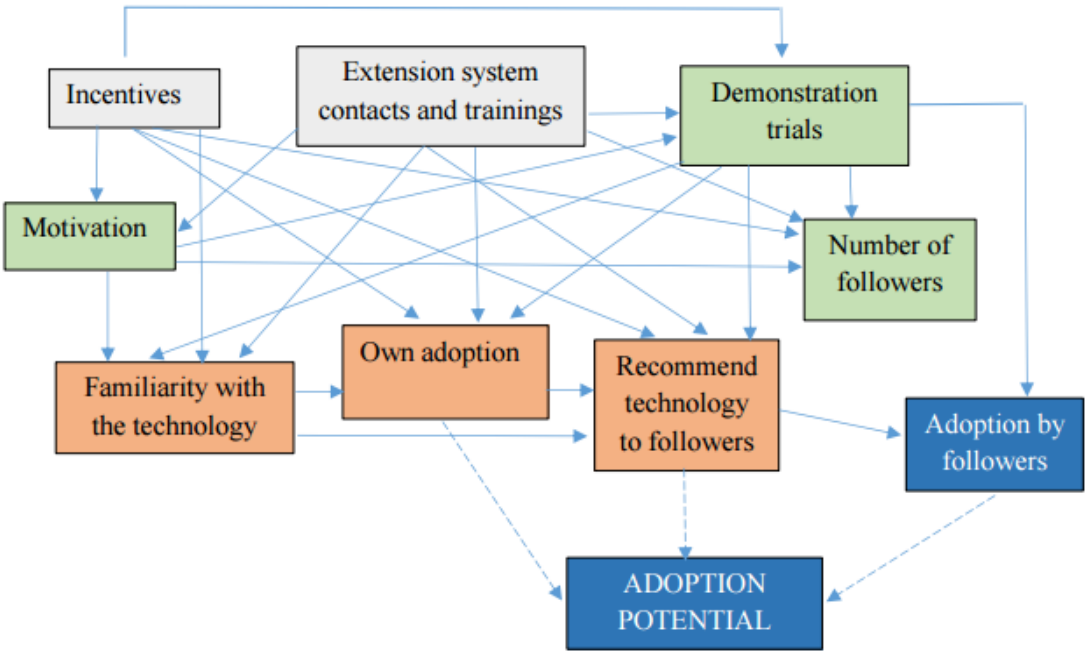
QUALITATIVE DATA COLLECTION TOOL

Open-ended questions:

1. If a particular intervention is named, what specifically does that programme mean to you?
2. Do you have additional sources of income outside of crops? If so, what are these sources?
3. Once you have harvested crops, what will you do with them (sell, store, consume)? % kept; % sold
4. Why did you start using these techniques (saw another farmer, training session, government worker, more profitable)? Was there a particular farmer who had success with a technique? How many farmers do you know you use the same techniques as you?
5. If you could imagine perfect conditions and money wasn't a concern, what would you need/want for your most successful crop yield?
6. What types of relationships/follow ups exist from adopting the new techniques?
7. Have you attended any training sessions previously? If so, for what?
8. Any clarifying language used throughout the interview?
9. Additional Notes:

APPENDIX F

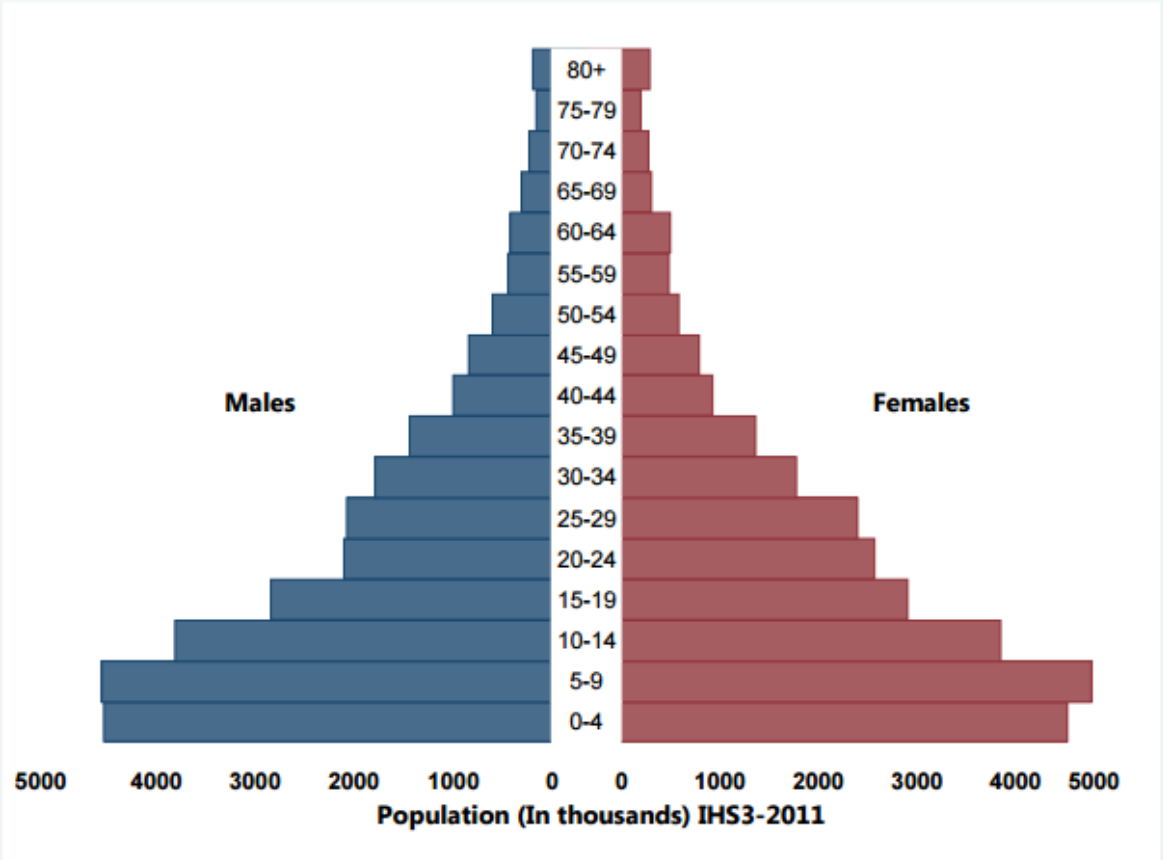
FISHER (2017) LEAD FARMER INFLUENCE



APPENDIX G

MALAWI POPULATION PYRAMID (2011)

Figure 2. 1 Population pyramid for Malawi, Malawi 2011

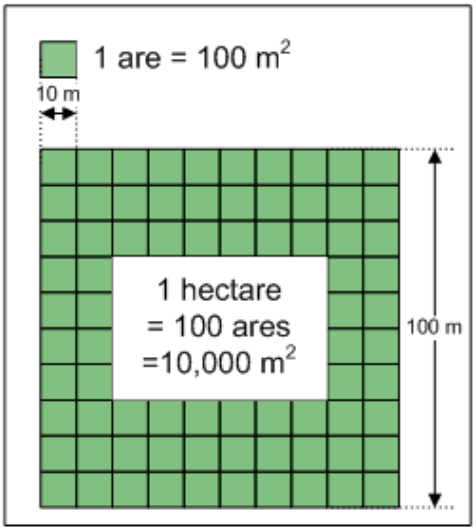


APPENDIX H

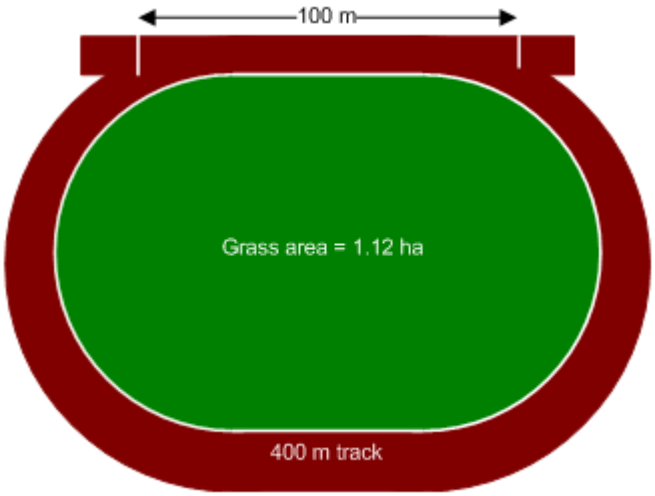
AVERAGE FARM SIZES IN NKHOMA MISSION, MALAWI

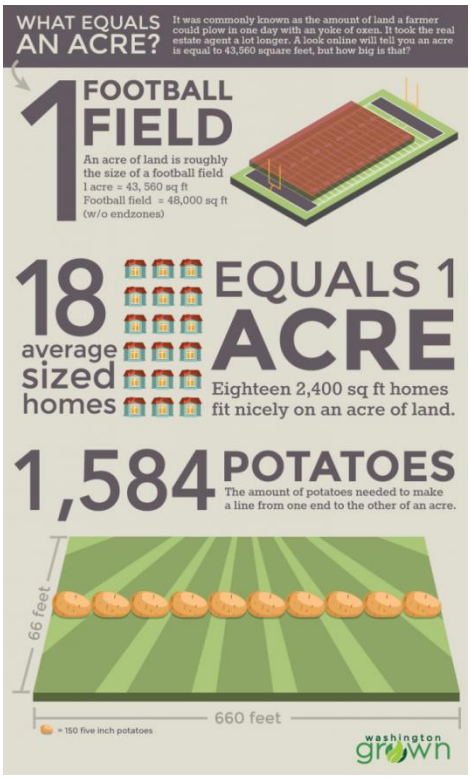
APPENDIX I

SIZE COMPARISON ILLUSTRATIONS FOR AGRICULTURE



1 hectare = 10 000 square metres = 0.1 square kilometres = 2.471 acres = 11 9 60 square yards





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