MSc. Thesis: Analysis of the social and technical factors that play a role in the adoption of Conservation Agriculture and Farming God's Way among smallholder farmers in northern Malawi.

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ABSTRACT

This report, based on research for a master's thesis, focuses on Conservation Agriculture (CA) and Farming God's Way (FGW) adoption among smallholder farmers in northern Malawi. It analyses the promotion and spread of CA and FGW by the Synod of Livingstonia Development Department (SOLDEV) and Foundations for Farming (FfF) in respectively Karonga and Mzuzu, the on-farm activities and the networks of farmers related to CA and FGW. Widespread adoption of CA and FGW has not happened and the reasons for adoption and dis-adoption are analysed in this report. The field research in northern Malawi was a qualitative study using as main methods in-depth interviews and participatory observations. Both adoption theories and theories about farmers' networks have been used to analyse the data. It was found that the strategy used to promote CA and FGW –training farmers– is based on a classic notion of diffusion, assuming that innovations will spread through communities by people talking to each other. However, farmers do not necessarily consider the uptake and sharing of information as the main aim of participating in trainings. Input support was found as a major reason to join a project. Additionally, the performance of CA and FGW is highly dependent on input use; hybrid seeds and fertiliser have a stronger effect on the increase in yields than the principles of CA and FGW. Factors encouraging adoption are the involvement of Village Headmen and the possibility to try out and observe the principles in practice. CA and FGW lead to a change in the on-farm activities of smallholder farmers; especially the shift and increase in labour hinders adoption. Mulching conflicts with the traditional free range grazing system and burning of the fields, it can attract termites and lead to water logging in specific areas. In other areas mulching prevents soil erosion and leads to better yields compared to conventional agriculture, especially in times of dry spells. Crop rotation is not attractive for poor farmers that cannot set aside a plot for legumes, while the no-till principle hinders adoption among richer farmers that own cattle and are used to plough fields. The networks in which smallholder farmers operate constrain adoption, since people want to conform to the group, are afraid of witchcraft, need to support the extended family, and have a negative attitude towards smallholder farming. This research stresses the need to focus on contextual factors before promoting or implementing CA and FGW.

Key words; *Conservation Agriculture, Farming God's Way, adoption, Malawi, smallholder farmers.*

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CHAPTER 1 - INTRODUCTION

In this chapter the research topic and context are introduced, including; a description of Conservation Agriculture (CA) and Farming God's Way (FGW), agriculture in north Malawi and a description of the CA and FGW project on which this research is focused. Then, the problem statement is worked out, followed by the theoretical framework. At last, the methodology for data collection is described.

1.1 TOPIC INTRODUCTION AND CONTEXT

1.1.1 INTRODUCTION TO CA AND FGW

It is widely acknowledged that poor soil fertility is the major constraint to agricultural production in smallholder farming in Sub Saharan Africa (Vanlauwe & Giller, 2006). The population of Africa continues to grow at high rates and soil fertility depletion is limiting per capita food production (Sanchez et al., 1997). Currently used farming practices often lead to soil degradation. Poor productivity of smallholder agriculture and soil degradation are challenging food security (Stoorvogel & Smaling, 1998; Drechsel et al., 2001). Conservation Agriculture (CA) and Farming God's Way (FGW) are two similar agricultural practices promoted by a variety of organisation to address these problems. It is claimed to be the solution for the problems of poor agricultural productivity and soil degradation in sub-Saharan Africa, however, empirical evidence is not clear and CA cannot be seen as the panacea for all problems (Giller et al., 2009). The potential is site-specific and promotion of CA should be tailored to local conditions (Knowler & Bradshaw, 2007; Erenstein, 2002; Kronen, 1994).

Conservation Agriculture and Farming God's Way are practices that aim to increase soil fertility and agricultural production, in particular the production of food crops. Conservation Agriculture has three important features: (1) continuous minimum mechanical soil disturbance; (2) permanent organic soil cover; and (3) diversification of crop species grown in sequences and/or associations (FAO, 2016). Farming God's Way has the same principles, see also figure 1.

CA and FGW are promoted by different organisations with a somewhat different focus. The Synod of Livingstonia Development Department (SOLDEV) promotes CA and allows farmers to use fertiliser on their plots. Farming God's Way, promoted by Foundations for Farming (FfF) stresses the use of compost manure instead of fertiliser. Yet, the principles of CA and FGW are the same in the context of north Malawi, therefore the practices of CA and FGW will be regarded the same in this report.

Figure 1. Key principles of Conservation Agriculture (FAO, 2016)

It is proven that CA can prevent soil erosion and increase soil moisture (Giller et al., 2015). CA can also reduce energy costs (for ploughing) and reduce the fallow time between crops. Reducing fallow time sometimes allows for an extra crop being grown within a year, which obviously leads to higher yields. The overall goal of Conservation Agriculture is to increase the efficiency of land, energy, water and nutrient use and prevent soil erosion in such a way that external inputs can be minimized (García-Torres et al., 2003). The focus of CA has shifted in the last decennia from a practice to reduce energy costs towards a practice that can increase yields, and currently towards being climate resilient.

This sounds promising, but the reality is different. Research in Paraguay showed that medium- and large-scale farmers succeed in practicing CA, while small-scale farmers do not (Derpsch et al., 2015). Derpsch et al (2015) state: "despite massive efforts to transmit the technology to small-scale farmers by development aid projects and local governments, widespread adoption of CA has not happened" (p. 1). Andersson and Giller (2012) found that CA uptake among large-scale commercial farms in South Africa was successful, but the question remains whether CA suits the circumstances of smallholder farmers in Africa. Giller et al. (2015) state that over the past 10 years CA has been promoted among smallholder farmers in the (sub-) tropics but with often disappointing results. Derpsch et al. (2010) agree and state: "adoption by smallholder farmers is limited to only 0.3% of the farm land worldwide under CA (p. 5). According to Friedrich and Kassam (2011) the question is not when and where Conservation Agriculture is applicable, but how it can be best made work and up scaled. They state that CA can be practiced in all climate zones of the world and the concept and principles are applicable to any size farm subject to availability of equipment. In contrast, Anderson and Giller (2012) and Giller and Witter (2009) emphasize the role of context, and possible contextual problems for farmers due to a new agricultural practice such as CA.

Literature has given many reasons to explain why widespread adoption of CA among smallholder farmers has not happened. These reasons have a predominantly technical character and do not zoom in much on the lives of smallholder farmers. Moreover, the context in northern Malawi is largely undiscovered. Therefore, this research aims to broaden the picture by focusing on both technical and social factors influencing adoption. This is further worked out in the problem statement.

1.1.2 BACKGROUND AND STUDY AREA

1.1.2.1 INTRODUCTION TO AGRICULTURE IN MALAWI

Malawi, formally called the Republic of Malawi, is located in the southeast of Africa. The agricultural sector in Malawi plays a dominant role in the economy. Malawi's main cash crops are tea, tobacco, cotton, groundnuts, coffee and sugar. The main food crops are maize, cassava, sweet potatoes, bananas, sorghum, rice, and Irish potatoes. Also, cattle, sheep and goats are raised (FAO, n.d.). The agricultural sector can be divided into smallholders producers who farm customary land and produce about 70% of agricultural output, and larger estate producers who use freehold and leasehold land to produce cash crops mainly for export (Harrigan, 2003). The average landholding size for smallholder farmers is around 0.2 ha in the southern part and 0.4 ha in the northern part, and on average 80% of this land is planted with maize (Chirwa et al, 2008). Soil degradation threatens household food sufficiency for smallholder farmers. According to Andersson and D'Souza (2014): "increased rural poverty and food insecurity opened the door for agricultural interventions aimed at reversing the

trend of declining smallholder production levels" (p. 119). These agricultural interventions came both from NGOs (such as SOLDEV, FfF and several more) and the Malawian Government. The Malawian economy has been subjected to several reforms by the International Monetary Fund (IMF) and World Bank (WB). Structural adjustment loans were targeted mainly at the agricultural sector and aimed at improving the performance of the smallholder agricultural sector; including diversification of the export base, ensuring appropriate price and incomes policy, expanding the role of the private sector in the marketing of agricultural produce, and increasing the efficiency and incomes of smallholder farmers. However, despite the reforms the sector performed poorly and food production failed to keep pace with population growth (Chirwa et al, 2008). According to IFAD (n.d.) the reforms in the agricultural sector did not take account of problems of declining soil fertility and unfavourable weather due to climate change. IFAD states that these issues, together with continuing poor access to markets, small landholdings and limited use of fertilizer, are the reasons for poor agricultural productivity. The use of improved varieties together with fertilizer and improved agricultural technologies can potentially improve yields. The Malawian government has subsidised improved seed varieties and fertiliser through their Farm Input Subsidy Programme since 2005 to give maize production and food security a boost (Manda & Makowa, 2012), but not all vulnerable farmers profit from this. Currently used farming practices still lead to soil degradation and low productivity, therefore, many NGOs and the government are shifting focus towards Conservation Agriculture.

Figure 2. Map of Malawi, Mzuzu and Karonga highlighted (Nyika Vwasa Trust, 2015)

1.1.2.2 AGRICULTURE IN THE NORTH OF MALAWI

The focus of this report will be on the north of Malawi, specifically on Mzuzu (Mzimba district) and Karonga (Karonga district). See figure 2 for the location on the map. Although CA and FGW are promoted by several organisations in the north, little research has been carried out in this area. Similar as in the rest of Malawi, conventional farming on ridges is widely practiced and the main food crop is maize. The maize is complemented with groundnuts, cassava and legumes. Also rice is grown,

which is typically for the north. Low incomes among farmers and low yields due to environmental degradation and extreme weather events, such as floods and dry spells, have resulted in food insecurity. The immediate effects of this are a reduction in household food reserves and subsequently, an increase in the hunger gap. In Karonga district, for example, around 10 - 20 percent of the households face a food deficit of two months (SOLDEV, 2015). There have been efforts to reverse this situation through soil fertility improving practices but these practices did not achieve meaningful results.

In northern Malawi CA is promoted by different organisations. The International Maize and Wheat Improvement Centre (CIMMYT) and the Research and Extension Departments of the Malawi government introduced CA in 2004 in Mzimba district (Thierfelder et al., 2015). They worked together with NGO Total Land Care (TLC). The Synod of Livingstonia Development Department (SOLDEV) has CA projects in Karonga district. Foundations for Farming (FfF) has a training centre in Mzuzu. Also NGOs Tiyeni and Find Your Feed are active in northern Malawi to promote sustainable agriculture. The projects that are the focus of this research –the CA project of SOLDEV in Karonga and the FGW project of FfF in Mzuzu– will be elaborated below.

1.1.2.3 THE CA AND FGW PROJECTS IN NORTH MALAWI

Synod of Livingstonia Development Department in Nyungwe

The Synod of Livingstonia Development Department (SOLDEV) is an organization of the Church of Central Africa Presbyterian (CCAP) that facilitates development processes in northern Malawi. The staff of SOLDEV has bachelor's degree in agriculture. The project staff is also trained in Farming God's Way at FfF in Harare, sponsored by SOLDEVs donors (Canadian Food Grain Bank and Tear Fund UK). Additional knowledge comes from extension workers of the government that have expertise in crop science, or from research centres such as CIMMYT. SOLDEV started two Conservation Agriculture projects in Karonga district, one of them is the three-year project in Nyungwe. The aim of the project in Nyungwe is to help farmers to achieve improved food security through Conservation Agriculture. The farmers in the project are encouraged to set aside three plots of 20x20 meter to practice CA. The first plot will be under maize pure stand, the second plot will be integrated with a legume (pigeon peas, cowpeas or lablab) while the last plot will have pure stand of the legume. The project recommends 75cm by 60cm spacing, 2 plants per planting station, a 100 percent mulch cover of minimum depth 3 cm, crop rotation and inclusion of a legume on the maize plot as green manure cover crop. The project provides seeds in the first year (OPV maize and cow peas, lab lab or pigeon pea) as a start-up input. In the second year the farmers have to return double the amount of seeds to a seed bank that is managed by the community. Right from the start SOLDEV made clear that no input support will been given to farmers. Input support can influence adoption and will be discussed in paragraph 2.2.

SOLDEV started the project in Nyungwe two years ago with 160 farming households, of which were 40 percent male and 60 percent female. After three years 360 farming households are supposed to be targeted. SOLDEV has been present in these communities for several years, so the local project staff know the people. Before entering the villages the project staff spoke to the chief first to introduce the programme. Then an introduction meeting was held for the whole village. The selection of the beneficiaries was done in an open forum, allowing maximum participation of all the

villagers. Only willing and capable volunteers were invited to participate in the program. The farmers are divided into clusters of ten farmers. In each cluster one farmer will take the lead. After the training, local staff members visit the farmers regularly for follow-ups, fields days and advice. They are assisted by a local committee that consists of the lead farmers from the clusters.

Foundations for Farming in Mzuzu

Foundations for Farming (FfF) is a religious organisation that aims to spread the gospel and to teach a farming method called Farming God's Way (FGW). The FGW principles are; maintaining mulch cover, not ploughing, making use of manure and compost, regularly weeding. Foundations for Farming bases their message on the bible, and aims "to bring transformation to individuals and communities through faithful and productive use of the land", to make profits and to escape from poverty (Foundations for Farming, 2015). Their motive is to inspire people to make sustainable life changes; they want people to get a living relationship with Jesus Christ, to base their life and farming on the foundations found in the Bible. According to Andersson and Giller (2012) for faith-based organisations practicing CA becomes a righteous act, an act of faith, where agronomic practices also have religious meanings. The message of FfF is based on the Christian notion of environmental stewardship, the belief that people are custodians of God's earth. People are motivated to farm on time, at a high standard, without wasting and with joy (Foundations for Farming, 2016).

Foundations for Farming provide trainings at the demonstration garden of their centre in Mzuzu, and off-site in the districts of Nkhata Bay and Mzimba. The agricultural knowledge comes from the headquarters in Harare, and the FfF training centres are informed on new technologies by Agricultural Extension Officers from the government. All trainings focus on the biblical principles of faithfulness (stewardship of the land) and unselfishness. In contrast with SOLDEV, there is no project format in which a certain number of farmers is selected. The trainings of FfF are on request and participants have to pay for it. After the training the farmers will be visited regularly for follow-ups and advice. Normally no input support will be given to participants, but exceptions are made if Foundations for Farming collaborates with donors and they request or provide input support.

1.2 PROBLEM DESCRIPTION

In this part, the problem statement as the basis for the research will be elaborated, added with the main research questions, the research objectives and the relevance of the study.

1.2.1 PROBLEM STATEMENT

Conservation Agriculture and Farming God's Way are presented by many organizations and NGOs as the solution for the problems of poor agricultural productivity and soil degradation in sub Saharan Africa. The technical side of CA and FGW might work, on experimentation plots in a laboratory setting, which does not mean that Conservation Agriculture works the same in practice. It is of major importance to include the social and contextual factors as well, because there is no one-size-fits-all solution for CA. This is illustrated by the following example on competing use for crop residues. A key principle of CA is to mulch the soil with crop residues. Smallholder farmers in sub Saharan Africa are often mixed crop-livestock farms. They have some cattle to feed and farmers prioritise feeding of crop residues to livestock over soil mulching (Giller et al., 2009; Erenstein et al., 2015). Practising only no-till without mulching the soil can have a counterproductive effect on yields, water retention and

erosion control (Giller et al., 2015). Although mulching might be beneficial from a technical perspective, this example shows that the importance of cattle as social factor can hinder CA adoption. The potential of the techniques are site-specific according to Knowler and Bradshaw (2007), Erenstein (2002) and Kronen (1994), therefore the promotion of CA should be tailored to local conditions. The way how CA and FGW are promoted affects adoption as well. Both organisations want farmers to change the way they used to farm, but for farmers adopting CA or FGW is not just a binary decision, they constantly refine their farming practices due to changing environment and they are influenced by their social network.

This study aims to research what social and technical factors do play a role in the adoption of Conservation Agriculture and Farming God's Way among smallholder farmers. First of all, the way both projects promote the techniques will be researched, because promotion influences adoption. The effectiveness of the promotion together with the spread of CA and FGW will be discussed, with the help of the Adoption and Diffusion model of Rogers (1995) and the theory of social and environmental learning of Stone (2007). Then, both the on-farm activities and the networks of smallholder farmers will be discussed, to find the interrelatedness of the social and technical aspects linked to CA and FGW. The Actor Network Theory of Latour (1996) and Law (1992) together with the concepts operation, path and network of Sigaut (1994) will be used to analyse this. All theories are described in the theoretical framework in paragraph 1.3. This focus on promotion, on-farm activities and network of smallholder farmers has been used in the sub questions and provides the framework for this thesis research.

1.2.2 RESEARCH QUESTION

The following central research question has been used in this study:

What social and technical factors do play a role in the adoption of Conservation Agriculture and Farming God's Way among smallholder farmers in northern Malawi?

The central question indicated above is worked out in the following sub questions:

1. How are CA and FGW promoted and does it spread through communities?
2. How are CA and FGW related to the on-farm activities of smallholder farmers?
3. How are CA and FGW embedded in the networks of smallholder farmers?

1.2.3 SCIENTIFIC AND SOCIAL RELEVANCE

As has been explained in paragraph 1.1.1, poor soil fertility is a major constraint to agricultural production in smallholder farming in Sub Saharan Africa. This challenges food security. Therefore, the **social relevance** of this study is shown in the fact that Conservation Agriculture and Farming God's Way could enhance the soil, agricultural production and lead to increased food security.

Although much is written about the technique in general, most research focuses on either technical factors or the social factors of adoption. This research is relevant in a sense that it combines the social and technical factors related to CA and FGW adoption. Besides that, Giller et al. (2015) emphasize the need for country or even region-specific knowledge related to adoption, and currently little is known about adoption in northern Malawi. This explains the **scientific relevance** of the research.

1.3 THEORETICAL FRAMEWORK

The theoretical framework is the fundament on which this research is grounded. As stated before, this research aims to investigate what social and technical factors do play a role in the adoption of CA and FGW among smallholder farmers. The focus of the research is on the promotion of the techniques, the on-farm activities of smallholder farmers and the networks in which smallholder farmers operate. Different theories are relevant for understanding the research problem. The *adoption and diffusion model* of Rogers (1995) and the theory of *social and environmental learning* of Stone (2007) will be used to analyse the promotion and spread of CA and FGW. The *Actor Network Theory* of Latour (1996) and Law (1992), and the concepts *operation, path and network* of Sigaut (1994) will be used to analyse the on-farm activities and especially the networks that are part of smallholders lives. The insights from these theories that will be used in the research are described in the synthesis, paragraph 1.3.5.

1.3.1 ADOPTION AND DIFFUSION MODEL

The process of changing behaviour is often conceptualised as a decision-making process. The adoption model of Rogers (1995) is a model that can be used to describe how people come to a decision, change behaviour, or adopt an innovation. Rogers (1995) defines the innovation-decision process as:

> The mental process through which an individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. (p. 990)

Rogers conceptualises five steps in the adoption process which are knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1995). The first step, knowledge, occurs when a person finds out about the existence of the innovation and gains some information about it. Persuasion happens when a person forms either an positive or negative attitude towards the innovation (Haider & Kreps, 2004). The decision step occurs when a person is involved in activities that lead to making a choice. The decision stage can lead to either adoption or rejection. Implementation takes place when a person makes use of the innovation. Confirmation takes place when a person rethinks the innovation-decision, for example while being exposed to contradictory information about the innovation (Haider & Kreps, 2004) or when evaluating the results. At this stage, the person can still choose to adopt the innovation or reject it.

The characteristics of an innovation determine its rate of adoption according to Rogers (1995). He states that innovations with greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations.

Relative advantage is the degree to which this innovation is perceived with a higher value than the idea it replaces. Thus, when a person classifies the principles of CA of higher value than the current practices, the new innovation has a greater relative advantage. Compatibility is the degree to which this agricultural practice is in line with former experiences, existing values and the desires and needs of prospective adopters. Complexity looks at how easy or difficult the use and understanding of the innovation is. People are more willing to adopt principles that are easy to understand. Trialability means the degree to which one can experiment with the innovation, for example by practicing the

principles of CA on an experimentation plot. The ability to try an intervention on a limited basis often encourages the learning process of a person. People are more willing to accept an innovation if they have the opportunity to test it themselves. At last, observability focuses on whether the outcomes of an innovation are visible to others or not (Rogers, 2002).

Rogers (2002) argues that most individuals evaluate an innovation not solely by themselves or on the basis of scientific research. They rather talk to people and listen to personal evaluations of peers who have already adopted the innovation. This social process of diffusion is a way people talking to people spread an innovation.

Innovations are not adopted by everyone at the same time. Some individuals or members of a social group are relatively earlier in adopting new ideas than others, while some people will never adopt them. Researchers found a pattern in the rate at which people adopted innovations, see figure 2. Rogers (1983) defined this adoption index as: "the degree to which an individual is relatively earlier than comparable others in adopting innovations" (p. 22). Five categories, on the basis of people's innovativeness, are: innovators (2.5%); early adopters (13.5%); early majority (34.0%); late majority (34.0%); and laggards (16.0%), see figure 3. These categories are based on the percentages of people, marked off by using one or two standard deviations from the mean (Rogers, 2002).

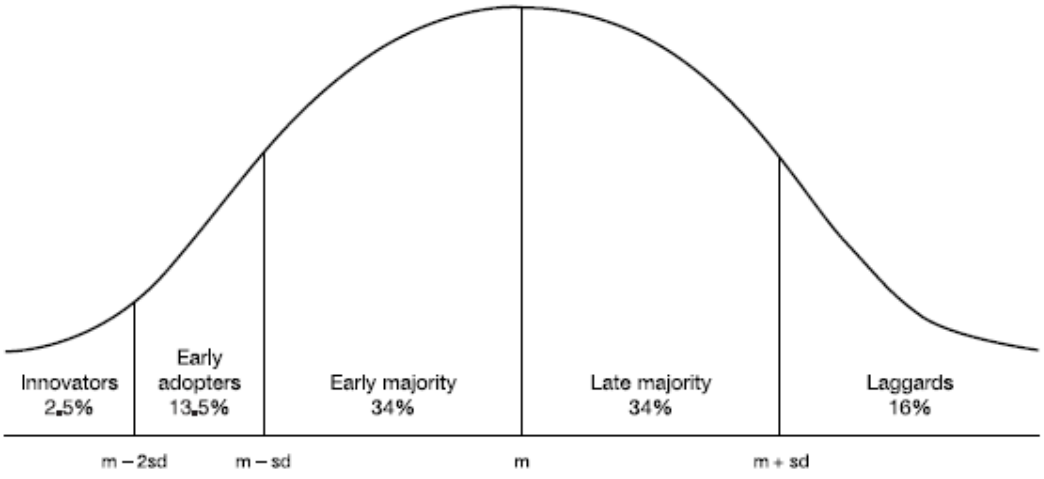


Figure 2. Adopter categories and their distribution (adapted from Rogers, 1983)

The Adoption and Diffusion model of Rogers (1995) will be used in this research to analyse the promotion and spread of CA and FGW in communities. It will be researched if and how SOLDEV and FfF use the characteristics of innovations –that can influence adoption– in their promotional activities. The spread of CA and FGW will be analysed using the diffusion theory of Rogers (1995).

1.3.2 SOCIAL AND ENVIRONMENTAL LEARNING

In contrast to the previous theory of Rogers (1995) in which the individual was central in the decision-making process, Stone (2007) focuses on the interaction between actors. Stone (2007) distinguishes social and environmental learning; interaction between people and their environment. Social learning is based on the influence of a person's peers (especially the more wealthy or powerful ones). A person makes decisions on the basis what their peers are doing and relies on their advice to

adopt or not. Environmental learning is based on experimentation with the innovation, such as the new agricultural principle of Conservation Agriculture, and bases the adoption choice on empirical feedback and evaluation of the principle (Stone, 2007).

Stone (2007) acknowledges that the two types of learning are not perfectly distinct. Social and environmental learning do contribute to each other, so any distinction will be artificial. The following example illustrates this:

> Even a direct environmental observation made on one's own crop ("Brahma cotton yielded 6 quintals/acre for me last year") is likely to be interpreted or contextualized through a form of social learning ("which was much more than my neighbour said he got with the same seed"). Even a classic case of conformist adoption ("I am planting Brahma because my neighbours are") assumes at least an indirect environmental basis ("and they wouldn't all be planting it unless someone had an indication it would do well"). (Stone, 2007, p. 71)

McElreath (2004) emphasises the overlap between the two types of learning. Social learning is seen as adaptive because it takes into account previous experiments by others. Environmental learning often has social aspects as well. Both environmental and social learning are involved in the process in which farmers observe, discuss and often participate in each other's operations. This process is called agricultural skilling and should incorporate environmental learning while taking into account it is a highly social process as well (Stone, 2007). The definition of agricultural skilling, given by Stone (2007), is: "the ongoing process of learning to perform with given technologies under changing conditions" (p. 393). Farmers should continually update and refine their practices, for example when there are changes in market conditions, technologies, pest and diseases, government policies or new ideas. Therefore, farming can be seen as a performance which is influenced by interactions between people and their environment.

The theory of social and environmental learning of Stone (2007) will be used in this research to analyse which interactions affect the decision to adopt CA and FGW. Farmers are part of a social, technical and economic context, they have to cope with changes in this context, and have to refine their practices due to this. This is called agricultural skilling and involves both environmental learning and social learning. The factors of this context that influence CA and FGW adoption will be researched.

1.3.3 ACTOR NETWORK THEORY

The Actor Network Theory (ANT) started in the sociology of science and technology. The ANT distinguishes from other socio-technical approaches by valuing both human and non-human elements as equal actors within a network. Non-human actors are called 'actants', and an actant can be anything (Latour, 1996). Therefore, ANT theorists use the term 'socio-technical network' or 'heterogeneous network' to overcome problems related to a division between human and non-human actors. A heterogeneous network can be used to describe everything, and everything (people, organisations, technologies, nature, politics, social order) is an effect of heterogeneous networks. The ANT argues that knowledge is a social product and is the effect of a network of heterogeneous materials, instead of something that is generated through a scientific method (Law, 1992).

Actors are defined by their relationships with other actors, objects, animals or institutions. Participating in such a network can both expand and constrain an actor's choices (Latour, 2005). The ANT focuses on the circulating nature of the social, which means that every local interaction effects a network, and the other way around, every network is a sum up of local activities (Latour, 1999).

A key concept in the ANT is translation; "the process by which entities and meanings that are built into technology are related in a socio-technical network" (Cressman, 2009). Translation can be seen as the process of technological development over time, for example how users shape and transform technology or how actors construct common definitions and meanings. This is done through the interaction of actors and actants.

The ANT can be used to show how farmers, experts, scientists and actants interact with each other and spread a technology, such as Conservation Agriculture (Schneider et al., 2012). The result of these interactions are heterogeneous networks. These networks are shaped because of these interactions and changing relations between the actors and actants. Participation of farmers in such a network defines types of knowledge and skills that are valued by the actors in the network (Gray & Gibson, 2013). Farmers thus influence the network. Gray and Gibson (2013) state:

> The roles that technologies such as genetically modified seeds, fertilizers, pesticides, herbicides, and farm equipment play in agricultural production are obvious enough. However, off-farm experts, technologies, and institutions such as farm credit, crop insurance, and crop consultants are today as significant to many farmers' abilities to plant and harvest as are seeds and tractors. (p. 94)

The focus in this research will be on the heterogeneous networks in which farmers operate, and how these networks shape farmers' decisions and identity. The ANT helps to identify how farmers make decisions, and why this often conflicts with how organisations promote CA and FGW and envision adoption. Additionally, the way how a new technology influences activities of smallholder farmers in their rural communities and networks will be researched.

1.3.4 OPERATION, PATH AND NETWORK

According to Haudricourt (1964) and Sigaut (1987) technology should be labelled as the science of techniques, which is above all 'a science of human activities' (Haudricourt 1964). Sigaut explains that technology is related to the particular way people do things. Technical facts are, according to him, facts of human activity.

Sigaut (1994) distinguishes operation, path and network in this theory. Operation is the activity or technical act carried out by a person. Sigaut describes operation as "the first kind of technical fact that can be observed directly" (p. 422). Operations do not occur in isolation, they are part of a sequence which is called path. All paths present in a society are interwoven into a sort of network. This is in fact the economic organisation of that society. According to Sigaut it is important to locate the technical facts within the social space, and the concepts of operation, path and network are instruments to do so. CA is not a package of instructions or principles that needs to be transmitted to farmers, it is a technology that can only function when embedded the social space.

In this research, the concepts of Sigaut will be used to analyse how technology is embedded in rural communities. As have been explained, a technology is not a package of instructions that need to be transmitted to farmers, it can only function when it is located in the social space. The distinction of social-material interactions in operation, path and network will be used to analyse farmers' changing interactions, activities and networks in relation to CA and FGW.

1.3.5 SYNTHESIS

The adoption and diffusion model of Rogers (1995) focuses mainly on the social factors in the adoption process of an innovation. Innovations spread through farmers talking to each other and farmers looking at others before adopting a new technology. According to the adoption and diffusion model, adopting an innovation or not is a binary decision often influenced by the social network of a person. In contrast, Stone (2007) emphasizes the role of agricultural skilling and farming as performance which can be influenced by both social learning (decision-making based on experiences of peers with the new technology) *and* environmental learning (decision-making based on experimentation with the new technology). According to Stone (2007) farmers need to update and refine their practices due to social-technical changes, which is called 'agricultural skilling'. The ANT describes that farmers are part of heterogeneous networks and update their practices due to their changing environment which includes not only soil and water, but also economic and policy arrangements (Gray & Gibson, 2013). These heterogeneous networks create knowledge through the interaction of both human and non-human actors, and influence an actor's decisions. Sigaut describes that technology is a science of human activities. These activities, that are embedded in people's networks, can be influenced by CA and FGW.

In sum, Rogers' (1995) insights help to research if and how SOLDEV and FfF use the characteristics of innovations (relative advantage, compatibility, trialability, observability and complexity) in their promotional activities. The concept of diffusion will be used to analyse the spread of CA and FGW in communities. Stone's (2007) ideas are helpful to research how farmers are part of their social, technical and economic context, and how they make use of social and environmental learning to refine their practices to their changing context. The insights of Latour (1996) and Law (1992) will be used to analyse how interactions between actors and actants influence farmers' networks, their activities and decisions. Sigaut (1987) concepts are helpful to analyse how technologies are promoted by organisations; as a package of instructions that needs to be transmitted or as a technology which is embedded in the social space. The changing interactions, activities and networks of farmers in relation to CA and FGW will be researched.

1.4 METHODOLOGY

In this part, the methodology of this research and the way the data has been collected is explained, together with some notes on triangulation and validity.

1.4.1 INTRODUCTION

Data has been collected in two areas in northern Malawi where CA and FGW projects are currently running. The first one is the CA project of the Synod of Livingstonia Development Department in

Nyungwe (Karonga district) and the other is a project of Foundations for Farming in Mzuzu (Mzimba and Nkhata Bay district). The projects have been elaborated in paragraph 1.1.2.3.

The aim of this thesis research is to learn from the promotional activities and the way how CA and FGW spread through communities or not. Also, much attention is paid to the lives of smallholder farmers and their networks, to find out whether CA and FGW are suitable to their context. A qualitative research is therefore chosen, to be able to get insights in the lives of smallholder farmers not only from the interviews but also from the (participatory) observations. This study is not a comparative study, because the projects differ too much to be easily compared. Moreover, the aim of the research is not to compare promotion strategies but to analyse different strategies and outcomes, and to gain insights in the lives of smallholder farmers.

1.4.2 RESEARCH TOOLS

1.4.2.1 LITERATURE RESEARCH

The first research tool is literature research and has been done throughout the research period. The focus has been on literature about Conservation Agriculture in Sub-Saharan Africa. Although there is no literature available on the specific region of northern Malawi, there is much information on Conservation Agriculture and farmers' adoption as a whole. Likewise, there is little literature on Farming God's Way, but there is abundance information on the similar technology CA. The used literature has been found via the online library of Wageningen University, Google Scholar and JSTOR by using keywords: *Conservation Agriculture, Sub-Saharan Africa, farmer's adoption, reasons for adoption, farming systems* and *sustainable agriculture*. A Boolean query (key words connected by logical operators 'and', 'or' and 'not' to define the search of the database) has been used to narrow down the search to the specific are of interest.

1.4.2.2 IN-DEPTH INTERVIEWS

The main tool for data collection during the field research has been through in-depth interviews. People who are directly and indirectly related to the CA projects have been interviewed. Direct related are the project staff and farmers, and indirect related are chiefs and an agro-dealer. These interviews have been conducted in a semi-structured way. The length nor the amount of certain topics was fixed, because the interviews were followed by both the input of the researcher and the input of the respondent and/or the translator. This gave the respondents chance to elaborate on what is important in *their* point of view, and gave me as the researcher the opportunity to analyse what is important in the view of the locals themselves. The questions for the semi-structured interviews have been discussed with the translators beforehand, to make sure they were understandable for the farmers and the translator knew what was expected. Some questions were altered to avoid cultural sensitivities. Because of the semi-structured character of the interviews, several questions were formulated during the interview to hook onto a remark of a respondent. This flexibility led to interesting insights, but sometimes created problems for the translation and comprehension. Moreover, sometimes respondents did not want to elaborate on a certain topic, for example on how (a fear for) witchcraft influences their behaviour and decisions.

1.4.2.3 PARTICIPATORY OBSERVATIONS

Besides interviews, participant observations (of the farmers and the practices on the farms) have been very important to gain useful data and information. In order to validate the information provided by the farmers, it has been very valuable to visually analyse the practices of the farm and project. Much time has been spent to walk around, see how the projects are promoted, how the trainings went, how people apply CA and FGW principles, how they organise themselves and so on. These observations led to a richer understanding of the social context of rural communities in northern Malawi, and the farmers' on-farm activities and position in their networks.

1.4.3 RESEARCH PARTICIPANTS AND STRATEGY

To find the factors that play a role in the adoption of CA and FGW in north Malawi, I started off with a list of possible factors found in literature. The factors were: access to mulch, labour burden, land rights, the role of livestock, access to input and output markets, promotion and knowledge. These factors have been used as a starting point during the semi-structured interviews and participant observations, while leaving space for input from the respondents. During the field research I found that some factors did not play a role and therefore were removed from the list. For example, access to input or output markets was not an issue influencing adoption. Other factors, such as the role witchcraft and group conformity play in adoption, were added. According to Sargeant (2012) the number of participants is not important in qualitative research, as long as you are fully informed upon all important elements relating to the phenomenon that is being studied. A researcher has sufficient respondents while noticing that further interviews do not result in new concepts. This is called data saturation. After conducting around thirty interviews no new factors or insights came up (data saturation occurred) and in total forty interviews have been conducted.

At the early stage of the research I searched for key informants, that have specialist knowledge about other people and communities. According to Payne and Payne (2004) their knowledge is more detailed, extensive or privileged than ordinary people. These key informants, who happened to be my translator and an agricultural expert, gave insights in what was going on in the community, how things were organised and who I had to talk to. When possible, research participants were found with simple random sampling. All farmers that joined the CA project of the CCAP were divided into groups (outstanding performers, average performers, poor performers, drop-outs, and farmers who had been to introduction meeting and did not adopt) and listed. From each of the groups two farmers were randomly selected and interviewed. This was done to get a broad picture of the farmers that have or have not adopted CA, and to avoid only speaking to farmers who did well under CA (because these farmers were easier accessible than for example drop-outs). Interviewing farmers that dropped out the project gave insights in how CA did not fully fit in the on-farm activities and networks of farmers. Interviewing farmers that have been to the introduction meeting but decided not to adopt gave insight in the considerations and concerns farmers have when deciding (not) to adopt a technology. As a consequence of this sampling strategy project staff or key informants could not influence to whom I should talk to. Other research participants were found by the use of key informants. The list of factors guided me in the search for suitable research participants. For example, when I found that adoption was influenced by the free range grazing system I searched for Government Agricultural Extension Coordinators who were involved in creating bylaws to prevent roaming animals. When hearing about the involvement of the whole community and local leaders in

CA and FGW, I made an appointment with a Village Headmen to discuss this. Some respondents have been interviewed twice, in order to build up trust, and to be able to elaborate on certain topics.

1.4.4 TRIANGULATION AND VALIDITY

Bernard (2011) describes that triangulation, the use of more than one method, will increase the validity of the research. Therefore, the data gathered during interviews have been complemented with (participatory) observations. The research report is grounded on both literature study and insights from fieldwork which ensures the validity of the research as much as possible.

It should be noted that the participant observations are conducted by a biased researcher, because the researcher is the instrument for data collection. This has affected the access to people, setting and the actual observations. To give an example; I visited a village in which a Western NGO had given input support to farmers when they adopted FGW principles. The famers probably thought I was linked to this NGO, because they directly approached me, asking for more fertiliser while praising the training and techniques. Another researcher would probably have a different response and therefore a different observation.

CHAPTER 2 – PROMOTION AND THE SPREAD OF CA AND FGW

In this chapter the CA project of SOLDEV in Karonga and the FGW project of Foundations for Farming in Mzuzu are elaborated, focusing on their lead farmer approach and involvement of Village Headmen as promotion strategy. The implicit assumption of unproblematic knowledge dissemination, that underpins lead farmer approaches, is questioned. The issue whether projects that promote CA and FGW require input support, and input support influencing adoption will be discussed. Furthermore, how smallholder farmers benefit from different projects and support is discussed.

2.1 STRATEGIES FOR CA AND FGW ADOPTION

2.1.1 INVOLVEMENT OF VILLAGE HEADMEN

The north of Malawi is divided in different districts such as Karonga, Nkhata Bay and Mzimba district. Each district is divided into Traditional Authorities (TA) that are ruled by Village Headmen. A village is the smallest administrative unit which is governed by a Village Headman. A group Village Headman oversees a cluster of villages (Malawi Government, 2015). Before starting the CA project SOLDEV will inform the Village Headmen, even before the introduction meeting for all villagers. Their motivation for this approach, explained by project staff member Kaweche: "*If you have the Village Headmen on your side, the project has more chance to succeed, therefore you should start from the top*". In contrast, Foundations for Farming has not such an approach. Interested individuals can be trained, without the involvement of any formal structures. However, sometimes Village Headmen are part of the Farming God's Way training.

Village Headmen are well-known in the village. They are valued as opinion leaders by the project staff. Opinion leaders are specific persons within a community who have great influence in shaping opinions of other persons (McEachern & Hanson, 2008). They can play an important role in either preventing or stimulating the spread of innovations.

It has been observed that in villages where the VH is involved adoption is easier for community members, illustrated by the following example. Farming God's Way has been promoted in two neighbouring villages. The chief in the first village has been to the FGW training and is in favour of the new technology. He has a demonstration plot at his own house and shows people around. He is visibly proud on his plot. Many community members adopted and perform well. In a neighbouring village the Village Headmen is not giving any support to the few farmers in the community that have been to the training and practice Farming God's Way on their plots. These few farmers stopped practising Farming God's Way after last growing season since community members, including the Village Headmen, laughed at them at first and were jealous on their yields during harvest time. These drop-outs explained: "*We did not get any support from the community nor the Village Headman, so we were bound to fail*". These findings show the importance of involving a Village Headman, to support CA and FGW adoption. A staff member of SOLDEV in Nyungwe agrees that the involvement of a Village Headman is of key importance. He explains: "*It is all about relationships here. You can't drive a ten ton tank over a one ton bridge. We are only as strong as the relationships we build. We can have a great CA project, but without the support of the Village Headmen and local community it will never be a long term success*".

Literature confirms these statements. Bulte (2016) explains that it is better to use already existing structures when targeting communities for development projects. He found that informal power relations are of key importance in rural areas in Sub Saharan Africa. Voors et al. (n.d.) found that community projects have a higher success rate if the local chief has been involved.

2.1.1 LEAD FARMER APPROACH

The CA project of SOLDEV in Nyungwe has a lead farmer approach, in order to spread the technology. The farmers involved in the project are divided into sections. Every section of ten farmers has a lead farmer, who is selected by the section itself. The lead farmers can read, write, can lead a group and are well-known. Lead farmers have direct contact with the farmers and the project staff. It is supposed to be an encouragement for farmers that a fellow farmer from the community can practice the principles of sustainable agriculture. Farmers rather identify with a fellow farmer than with project staff who have been to school and university. According to project coordinator Munthali: "*Fellow farmers are better role models than external people, if fellow farmers can be successful in sustainable agriculture, farmers believe they can do it as well, and sustainable agriculture will spread throughout the community faster*". SOLDEV has the assumption that lead farmers spread all the knowledge to other farmers in the cluster and community. According to Agricultural Extension Officer Nthara: "*Farmers can see with their own eyes the work, labour, weeds, maize stand, harvest, resistance in time of dry spells etc. Lead farmers each teach around 20 fellow farmers, so a new technology will spread fast in a community*". Even if the project phases out and there is no support from SOLDEV the lead farmers should carry on to encourage fellow farmers and spreading the principles. Lead farmers are normally not paid for their work, however, they sometimes get some allowances, see textbox A.

The trainings Foundations for Farming offers are open for anyone who is interested. After the three-day training course the participants are encouraged to apply the principles to their own farm and to invite fellow farmers to appreciate it. The participants are encouraged to spread the information on FGW and to acts as lead farmer or local trainer. Also the government works with lead farmers. When a new technology such as CA is tested, on experimentation plots from universities, and approved, it will be taught to extension workers. They in turn train lead farmers, who will practice the new principles on their field so that neighbours can appreciate the technique and harvest.

A. Lead farmers and allowances

The government and several NGOs give out allowances, bikes, goats and more to lead farmers. Farmers are eager to become a lead farmer, for the additional benefits that are attached to this role. Their motivation to spread CA/FGW is not necessarily present. Government Agricultural Extension Officer in Mzuzu explains that only hardworking lead farmers, who are selected by the government to spread the technique, can eventually get a bike to make them more mobile. At the same time, he acknowledges that all of a sudden all the farmers want to be a lead farmer. SOLDEV did not give any input support to the lead farmers at the start. Lead farmers were told that their job is on voluntary basis and they would not get paid for it. After realising there was not any reward for the lead farmers, some dropped out. The next year the remaining lead farmers got a little allowance, as a rewards for their work and a compensation for their travels.

The lead farmer approach sounds

promising, but information obtained through interviews with project staff from SOLDEV, Foundations for Farming and government officials shows that adoption of CA and FGW is still very low. The assumption that (lead) farmers will automatically spread knowledge, and that diffusion will occur, is not proven. It has been found that the farmers who are enthusiastic about CA and FGW and perform well, all tried out the principles for themselves. This type of learning is called environmental learning, in which people experiment with new technologies and base their adoption choice on empirical feedback. One farmer explained: "*This is the first year I try out Conservation Agriculture. I became interested after hearing about it and wanted to find out for myself whether I could make it happen on my own field*". Farmer Nyirenda, compared the harvest of 20x20m conventional plot with the harvest of the 20x20m Conservation Agriculture plot. She said: "*The results are remarkable, I got one and a half bag of 50kg from the conventional plot, and four bags of 50kg from the CA plot*". This was last year, when a dry spell hit the area. The CA plot did visibly better which convinced her of the benefits of CA. Another farmer said: "*Ngunde, one of my neighbours, practiced Farming God's Way. I did not know whether it was a good technology but decided to try it out on a small plot of my farm*". The last example shows that social learning (I saw one of my neighbours doing FGW) and environmental learning (I decided to try it out myself) overlap. It has been found that the majority of farmers want to try out new principles before adoption, and need to see how the technology works with their own eyes. This is in line with the characteristics of innovations from Rogers (1995), especially observability and trialability.

Farmers who have been to a CA or FGW training did not directly share the acquired knowledge with friends or relatives. They rather keep this for themselves. This is illustrated in the example of farmer Mbosi, who adopted CA. Her parents live next door but did not know about the principles nor benefits of CA. They knew about Mbosi being in a programme, but could not explain to me the reason for the mulch layer on her fields. Farmer Ngwira, who has been to the CA training of SOLDEV stated that his neighbours themselves should make decisions on what they practice on their fields. He shared that he does not want to openly discuss the conventional way of agriculture, since that is a common practice among community members. However, he is willing to answer questions if they notice a difference in yields of his CA plot. Lead farmers from the CA project did motivate and encourage other farmers in their section, but did not actively spread the technology to other farmers outside the project. The issue of farmers being cautious to (tell about the) shift from conventional agriculture to Conservation Agriculture has to do with the group culture in rural Malawi. Farmers that are part of a community want to conform to the socially accepted practices and do not want to be different from the rest. This issue affecting CA and FGW adoption will be discussed in paragraph 4.6.1. Examples of farmers that have been to the FGW training many years ago and who are still the only ones in their community practising FGW, strengthen the idea that farmers do not necessary spread knowledge nor question what others do in their fields. Government official Kupunda explains that Malawian society dictates that people should share finances and materials, such as food or clothes. If not, they will be marginalised by friends and relatives. In contrast, knowledge is not supposed to be shared and is often kept for people themselves. This might explain why the adoption has been slow. There are exceptions though. Ngunde, a farmer who has been to the training has spread the technique to five fellow farmers in his community and can be seen as lead farmer. Project coordinator states: "*Adoption rates have been slow. People do not spread FGW at a fast rate, possibly because of the Malawian culture".* People do not want to be different from the rest so will not actively speak about their new technique and convince others.

Bulte (2016) states that we have no real idea how people learn. We assume that people who are trained, for example in how to use fertiliser, will directly spread this knowledge throughout the community. Many development projects run on this principle. But according to him, people do not necessarily spread information unless they are paid for it. Sayinzoga et al. (2015) state: "*Implementing agencies often assume useful knowledge from trainings will spread beyond the directly targeted population – inflating the 'scale' or total impact of the intervention. But the empirical basis for such beliefs and assumption is extremely weak*" (p. 34). They conclude from their financial behaviour experiment in Rwanda and an agricultural project in Malawi that the benefits of the intervention stayed limited to those farmers receiving the training, and the knowledge did not spread to other members of the community.

According to FAO (2009) people tend to adopt faster if they see fellow farmers practicing a new technology. Kassam et al. (2009) state: "extension initiatives involving learning based on FFS-type [Farmer Field School] approaches, including the use of on-farm farmer discovery benchmark sites are showing promising results, particularly in Africa" (p. 315). Rockström et al. (2009) carried out experiments on the spread of CA in Sub Saharan Africa. They state: "Even today, five years after the finalisation of the on-farm trials, farmers who pioneered these experiments continue to practice and disseminate among fellow farmers the successful conservation farming systems" (p.30). FfF and SOLDEV make use of the adoption and diffusion theory in order to spread CA and FGW, for example through the lead farmer approach. But as has been found, farmers do not always share knowledge on the content of the trainings. CA and FGW do not spread as fast through communities as expected. The experiences from the field are conflicting with the social theories from the conceptual framework. SOLDEV and FfF focus on knowledge dissemination in their project approach. However, farmers might have another reason to join a CA or FGW project. The issue of input support as motive to join a project will be described in the next paragraph.

2.2 INPUT SUPPORT

2.2.1 INPUT SUPPORT INFLUENCING ADOPTION

Promotion of new farming methods is often supported by input provision. Malawian farmers are used to input support, whether it is from the government or NGOs. According to SOLDEVs project staff it is tough but necessary to start a project without input support. Staff member Mgamba explains that it has been clear right from the start that no support would been given in the CA projects. Farmers do get seeds the first year, but they have to return double the amount of seed in the second year. He explains*: "We want farmers to appreciate the principles so they become food secure in the long term, we do not want people to join for the sake of short term benefits as free fertiliser*". Also Foundations for Farming discourages the use of input support, even if it is used as a kick-starter only in the first year. The trainings of Foundations for Farming cost 1,500 kwacha per day. This is not expensive, but it gives people a sense of ownership. Project coordinator Beckett states: "*The technology should be promoted, not inputs. When the focus is on the inputs, the principles are forgotten and people will abandon the technology when the inputs stop*". Of course farmers will like the project because their fields will look good (with hybrid seeds and fertiliser that smallholder farmers could never afford without the input support). But it is not realistic nor sustainable. It can be stated that the performance of CA is highly dependent on input use, illustrated by the following example. NGO Find Your Feed promotes CA in Mzimba district. The farmers in the

project are trained in the CA principles and are given hybrid maize and fertiliser. When visiting two farmers who are in the project, it was observed that at least half an acre was converted to CA, as requirement for the input support. The rest of the field is still under conventional agriculture, with ridges. Since the farmers received enough hybrid seeds and fertiliser for their whole farm, they used the inputs on both their conventional and CA plot. No difference was seen in crop stand. An enormous difference was seen compared to a neighbouring CA field. The owner had recycled OPV seed from few years ago and had not applied fertiliser to the field, because it was too expensive. In this case the inputs caused the difference in crop stand and yields, not necessarily the technique of CA. Government Extension Worker states: "*Many NGOs who promote CA encourage farmers to use hybrid seeds. The farmers favour them, but the seeds are expensive. If farmers are not in a project or targeted for the FISP, they have not the slightest option to purchase the seeds themselves".* Although organisations say they do not encourage any input support, in reality it is not abandoned. Also it is not clear for farmers what to expect.

The farmers in the CA project of SOLDEV were informed during an introduction meeting that no input support would been given. However it was found that farmers still expected to get things for free. This became clear when 34 from the 120 farmers dropped out the project after the first year. The farmers that stayed in the project were mainly interested in the principles of CA. One farmer explained: "*Of course I will accept every gift such as a bag of fertiliser. But my crops might still die during the dry spell*". He explained that the knowledge he gained through the demonstrations (especially on how to mulch the field to prevent soil run-offs and increase soil moisture) will help him in the long-run. In contrast, many farmers explained they like the principles of CA and FGW since it increases the yields. However, after one or more years their plot under CA or FGW is still the same size (three times 20x20m). This indicates that they might not be telling the truth, and practice CA or FGW due to input support. It was found that mainly male farmers dropped out, because they expected input support. Most female farmers stayed, they primarily joined the project to gain knowledge to support their families. According to the project staff female farmers are more serious with CA than male farmers, this gender issue will be elaborated in paragraph 4.5. Interviews with farmers that are still in the CA project showed that they still hope to get some inputs, or at least do not have to return the seeds to the seed banks, since last year's harvest was bad. Additionally, it was found that the annual award given to the best performing farmer is an incentive for people to apply all principles, and to gain more knowledge on CA. The award contains a wheelbarrow, hoe and some more farming tools.

The statement that input support is still a significant incentive for people to practice CA is illustrated in the observations of an evaluation meeting of SOLDEV in Mpata. The CA project will phase out next year, but the donor is willing to extent the project. The project staff agrees but decides to ask the involved farmers their opinion. They got this response: *"Yes the project should be extended otherwise we are doomed. We will need another water source* [SOLDEV already drilled two boreholes] *because making compost manure is impossible without water. Also, can we get more seed, since 1kg is not enough if we want to expand our plots. Moreover, you introduced chinadanga* [type of compost manure] *to us, which requires small amounts of fertiliser. So if the project extends we should get fertiliser, right*?" The project staff disagreed and told the farmers that extension of the project will mean extra training and support, but no material help. It is evident that the expectations of the farmers conflicts with the project staff.

As stated before, FfF discourages the use of input support. However, when FfF gives out training in collaboration with a donor organisation, trainings are paid for and material support is given. The following example visibly indicates the role of input support in the adoption of FGW. A local trainer, who has been to the FfF training is employed by a donor to train FGW in his home village. The donor supported him with funds for a motor bike in order for him to be more mobile. Within this village twenty farmers picked up the FGW principles. These farmers received fertiliser and hybrid seeds. According to the donor, this input support is only meant as a kick-starter, no inputs will be given the next years. Eighteen of the twenty farmers did not apply the principles of Farming God's Way. They did abandon the ridges (which was a requirement for the support) but apart from that less to none of the principles were seen in the fields. While walking through the village one of the farmers approaches the local trainer, asking: *"I am waiting for the next batch of fertiliser, when can I expect it?".* This indicates that input support is a motivation for farmers to start FGW. Moreover, other farmers from the village also told they want to join the project, but they wait till the donor comes back to select them for the input support. Without support they see no reason to start. See also textbox B for another example of the relation between input support and adoption.

B. Input support and adoption

During a field day of Tiyeni (NGO that promotes sustainable farming methods in northern Malawi) a sketch was performed to encourage fellow farmers to join. The message of the sketch can be summarised in the following statement: "*Why wouldn't you join, since you get many things for free, such as a hoe and a pig*". A few weeks later the farmers that joined Tiyeni were visited again, and they acknowledged: "*If Tiyeni leaves this village we will stop making the deep beds straight away, since it is too much work".* They agreed that they needed Tiyeni for the inputs. The farmers expect a bumper harvest this year, which is not surprising with the amounts of fertiliser they got and hybrid seeds.

The statement that free inputs are an incentive for farmers to join CA projects are confirmed by literature. According to Andersson and D'Souza (2014) incentives in the form of input packages, credit or subsidies have become a significant feature of CA promotion projects in Malawi. Input support does not only influences the uptake CA but also the sustainability of such uptake. Marongwe et al. (2011) agree that CA promotion often involves the supply of input packages (fertiliser and seed) to farmers, mainly due to the inaccessibility of inputs by smallholder farmers. Nevertheless, they state: "Although this approach may be seen as discouraging adoption, many other farmers have adopted the technology despite the absence of input support" (p. 156). In contrast, Giller et al. (2009) found that most smallholder farmers practice CA for the sake of input support. They cite Haggblade and Tembo (2003) who estimated that 15,000 of the 75,000 farmers that practiced CA in 2002/03 in Zambia were spontaneous adopters, while the remaining 60,000 farmers practiced CA as a condition for receiving their input. More experiences are found in which adoption of CA was claimed during the course of active promotion, but did not lead to sustained change in agricultural practice. Giller et al. (2009) found that the apparent success of Sasakawa Global 2000 was largely due to its promotion of CA including inputs of fertiliser, pesticides and herbicides. After the project support stopped the farmers quickly reverted to their former farming practices.

2.2.2 INPUT SUPPORT FROM GOVERNMENT AND NGOS

The government targets 1,5 million vulnerable households with packages of subsidised seed and fertiliser, known as "vouchers", through their Farm Input Subsidy Programme (FISP). The FISP started in 2005 to improve national food security and to lift the productivity of smallholder farmers. In foregoing years beneficiaries were selected by the community. The Village Headman would register all farming families, and within an open forum the community would decide which families would receive the vouchers. Now the selection is done randomly in the headquarters of Lilongwe. The vouchers contain; NPK fertiliser (50kg), urea (50kg), hybrid maize seed (5kg) or OPV maize seed (8kg) and legume seeds (3kg), and costs 9,000 kwacha. This is almost nothing compared to the current input prices at agro-dealers, such as Farmer's World. Still, a number of vulnerable farmers selected for these vouchers will sell it, in order to get some cash. Extension workers have the task to prevent this but it is hard to control. In Karonga the ratio extension worker/farmer is 1:2000 currently.

The District Agriculture Development Office (DADO) under the Ministry of Agriculture calls for coordinated effort from government and collaborating partners to facilitate sustainable agriculture in order to achieve food security (SOLDEV, 2013). CA and FGW is promoted not solely by the government, SOLDEV and Foundations for Farming, also the NGOs Total Land Care, Tiyeni, Find Your Feed, Foundation Charity and Self Help Africa promote sustainable agriculture. The DADO decides where NGOs can carry out their project. The coordinator of the Agricultural Development Office explains: "*NGOs that come in our region are welcome, since they have inputs and budget which we as government lack. NGO's have to ask permission before entering a region. We brief the NGO's and introduce them to the chiefs since we know the area best*". NGOs are filling in the gaps and the lack of resources of the government. However, the projects of the different actors are sometimes complementary, at times overlapping and in some cases disturb each other.

A problem with different NGOs promoting sustainable agriculture is the fact that they promote different farming techniques and methods. Total Land Care, for example, promotes the use of herbicides in their CA trainings. These trainings are given in the same community as SOLDEV is active, but SOLDEV discourages farmers to use herbicides. These different approaches create confusion among farmers. Tiyeni promotes a type of sustainable agriculture in which farmers have to dig deep ditches between the ridges to collect rainwater. In contrast, Foundations for Farming gives training in the very same area telling people not to dig the soil at all. In the interviews, many farmers acknowledged they did not know exactly what the principles of CA or FGW were for, for example the meaning behind abandoning the ridges. Agricultural Extension Coordinator Mhango explains that farmers generally do not change soon, they rather stick to their known practices. Let alone when they hear conflicting messages.

Another problem related to different NGOs promoting sustainable agriculture in the same area is the incentive for farmers to become involved in as many projects as possible, for the sake of getting free inputs. This strategy called "project hopping" is very present in the north of Malawi. Most projects have some requirements before they give out input support to farmers; free fertiliser if the plots are mulched or a package of seed after attending a training. One respondent explained: "*Find Your Feed entered a neighbouring village, so I borrowed a small piece of land in that village from a relative and mulched the plot, which was a requirement to get two goats for free. I needed the manure of the goats to prove another NGO that I was involved in making compost manure, so I would get three kg*

of hybrid maize seed in return". This example shows that farmers try to take advantage of different NGOs that are present. Not to only gain knowledge and improve the yields, but to get free inputs, allowances when attending a training or free lunch during a field day. Farmers share information with each other, not on the content of the training, but on what inputs the different projects give out. This is a form of social learning (Stone 2007), people sharing information and are influenced by the decisions their peers make. Project hopping is a strategy of poor farmers who could otherwise not afford inputs and feed their families. It is easier to join several projects and receive seed, fertiliser or even goats, than to apply the principles of the technique to the field and achieve higher yields after some years. This issue of poverty and coping mechanisms, and farmers having a short-term vision has been elaborated in paragraph 4.1.

According to Cawood Simon, consultant on sustainable agriculture, the donors have taught people a culture of entitlement instead a culture of hard work. She states: "*People need to have a failed crop in order to get donor support. Some people even chops down trees to open up lands in order to grow maize they will never eat*". When farmers lack money for inputs, there is a change to get government vouchers or project inputs. After a bad harvest, the World Food Programme will support vulnerable households. This 'dependency-syndrome'; the belief that people cannot support themselves without outside help, is made worse by all foreign aid and projects. According to her the government and donors made Malawian farmers dependent. This, together with the findings from the previous paragraph that input support influences (non-sustainable) adoption, begs a wider discussion on whether CA and FGW need input support.

2.3 SYNTHESE

The Farming God's Way project of Foundations for Farming and the Conservation Agriculture project of SOLDEV have a different approach to beneficiary selection. SOLDEV targets interested farmers in a three year project in which they are supervised and get a starter input. Farmers who want to get a training in FGW from FfF have to pay for it. It has been found that involving an opinion leader, such as a Village Headman is of key importance in the spread and acceptance of CA and FGW. In villages where the VH is involved adoption is easier for community members. Literature confirms that community projects have a higher success rate if the Village Headman has been involved.

Both FfF and SOLDEV make implicitly use of the adoption and diffusion theory in order to spread CA and FGW. According to the adoption and diffusion theory of Rogers (2002) people evaluate innovations not only by themselves or on the basis of research, they rather talk to people and listen to personal evaluations of peers who have already adopted the innovation. For Rogers (2002) interaction is a way to spread knowledge. In contrast, Stone (2007) argues that knowledge is an effect of interaction. The assumption of SOLDEV and FfF is that farmers who are trained will spread this knowledge in their community. SOLDEV specifically works with a lead farmer approach. It can be concluded, though, that these knowledge dissemination strategies are not effective; farmers do not easily share information on the content of trainings with friends and relatives. CA and FGW do not spread as fast through communities as expected, which conflicts the theory of diffusion. It is analysed that farmers do not simply make a decision to adopt a technology or not, they rather refine their practices to what they hear and see. This is called agricultural skilling (Stone, 2007). It was found that farmers tell each other about the different projects of NGOs that give out input support (social learning). Many farmers want to join these projects as a strategy to gain inputs, not to acquire

agricultural skills and knowledge. Although input support has not been encouraged by SOLDEV and FfF, it can be concluded that it does play an important role. Input support does influence the adoption rates and the sustainability of such an uptake. Without input support farmers often drop out the project, or revert to their old farming practises when the project phases out. Next to SOLDEV and FfF the government and other NGOs actively promote sustainable agriculture. These projects are sometimes complementary, at times overlapping and in some cases disturbing, since they promote different types of sustainable agriculture, often in the same region. As concluded before, farmers take advantage of the different projects active in their area in order to get input support, and share this information with each other. This begs a wider discussion whether projects that promote CA and FGW require input support.

CHAPTER 3 – CA AND FGW IN RELATION TO FARMERS' ON-FARM ACTIVITIES

In this chapter the household characteristics of the smallholder farmers are described and related to the key principles of CA and FGW, which are; maintaining soil cover, minimising soil disturbance and implementing crop rotation and/or intercropping. The key principles involve changes in the on-farm activities of the smallholder farmers, for example in labour, and therefore influence adoption.

3.1 HOUSEHOLD CHARACTERISTICS

There is considerable variation over the 16 farm households that have been interviewed. The smallest unit was an elderly woman farming with her granddaughter. The largest unit contained 21 persons (man, three wives, 17 children). Farming is a family activity that requires the help of every man, woman and child who is old enough to work. Children usually help with planting, weeding, and harvesting, the younger girls mostly assist their mothers with the many chores around the home, such as fetching water, cooking, cleaning, and taking care of children (Mealer & Kamkwamba, 2009).

Maize is the predominant staple food crop among farmers. Next to maize, some farmers grow tobacco and cotton as cash crops. As additional food crops the following crops were grown; pumpkins, groundnuts, pigeon pea, cassava, tomatoes, cowpeas, beans, soya and potatoes. These food crops are mainly meant for household consumption. Only when there is a bumper harvest, vegetables are sold on the market.

Many farmers use a hoe to work on the field, for weeding and to make planting stations or ridges. Animal traction for ploughing is rarely used, because most households do not own oxen, and renting oxen is too expensive. It has been found that the farmers who have cattle are relatively richer farmers, and can use cattle to plough their fields (except for one farmer who only owns a calf). For these farmers, shifting towards CA or FGW and abandoning ploughing is not time-saving and therefore less attractive, which is described in paragraph 3.5.

Animals present on the farm are mostly chicken, sometimes goats, cattle and pigs. The more wealthy farmers have more livestock than the poorer farmers. It has been observed that the farmers with cattle also have more land. The average landholding size is 2 á 3 acres (around 1 ha) per farming family, but the richer farmers own up to six acres of land. Most of the farmers did not hire extra labour, apart from two richer farmers. The majority of farmers had extra jobs, such as piece work or businesses as coping mechanisms in times of food insecurity. Farming is not the only source of income nor the only occupation that requires time and labour. Especially piece work influence CA and FGW adoption, since the piece work are in the planting and weeding season, therefore farmers have less time to cultivate their own fields. This is worked out in paragraph 4.1. Some farmers grow cash crops (cotton and tobacco) for the auction floor, to complement their income. See figure 3 for the details of the interviewed farming households.

Due to CA and FGW, the tasks and labour throughout the farming season differ. This factor influencing adoption will be described in the next paragraph.

Name	Household (members)	Land (acres)	Animals	Food crop (excl. maize)	Cash crops	Coping mechanisms	Extra labour
Mbosi	4	2	Chicken	Pumpkins Groundnuts Pigeon pea		Piece work	
Mbotwa	13	2		Pumpkins Tomatoes		Business	
Nyirenda	5	3	Chicken Goats Pigs	Pumpkins Groundnuts Pigeon pea Cassava	Tobacco		
Ngulube	9	1		Cowpeas		Piece work	
Kumwenda	5	2,5	Chicken Goats	Pumpkins Tomatoes	Cotton	Vendor	
Kabaghe	2	1	Chicken	Pumpkins		Piece work	
Marisawa	10	3	Chicken	Pumpkins Groundnuts Soya	Tobacco		
Efron	8	4	Chicken Cattle Goats Pigs	Groundnuts Pigeon pea Cassava Cowpeas		Gardener	
Ngunde	8	2	Chicken Cattle	Pumpkins Groundnuts Pigeon pea Tomatoes Beans		Watchmen	
Manda	3	2,5	Chicken Goats	Pumpkins Pigeon pea Cassava Potatoes		Business	
Djavula	3	6	Chicken Cattle	Pumpkins Groundnuts Beans	Tobacco		3 workers
Munthali	5	1,5		Cowpeas Tomatoes		Vendor	
Mkango	21	4	Chicken Pigs	Pumpkins Groundnuts	Tobacco		
Ngwira	9	4	Chicken Goats	Pumpkins Pigeon pea	Tobacco Cotton	Business	
Mpande	8	1.5		Pumpkins Groundnuts		Piece work	
Jevula	4	3	Chicken Cattle	Cassava Beans			1 worker

Figure 3. Details of the interviewed farming households.

3.2 LABOUR THROUGHOUT THE FARMING YEAR

Under conventional agriculture, work starts in July to clear the land from previous harvest in May. The dried maize stalks are collected, stacked into heaps and lined up into rows. They are set on fire, normally around July and August. Grasshoppers and mice that make their homes in the fields or stacks will be caught and eaten. From October on ridges will be dug. Since this is the dry season, the soil is hard and making ridges is difficult. Normally the first rains arrive in December and continue through March or April. The first effective rains (normally in November) are the sign to start planting maize. Two weeks after the seedlings appeared the first round of fertiliser will be applied. Another round of fertiliser will be applied after some extra weeks, and the field will be weeded several times. The maize can be harvested in May normally. The maize is left to dry on the vine, and then brought home or pulled and plucked in the field (Mealer and Kamkwamba, 2009).

Under CA or FGW the work is year-round. In July and August people are encouraged to protect their mulched plots against fires. The planting stations should be dug in August and September, and fertiliser or compost manure should be added to the planting stations in October (NB: It has been observed that not all farmers apply fertiliser in the planting stations, many wait with applying expensive fertiliser until they see the maize plants have germinated). After the first rains, normally in November, the maize should be planted in the planting stations and covered. When the plants appear they will be thinned. A round of top dressing will be added in both December and February. The plot will be weeded and mulched throughout the year. In the rainy season compost making is encouraged. The maize will be harvested in May, the cobs are brought home and the crop residues serve as mulch layer on the field.

From the above it can be concluded that the farming year under conventional farming and CA differs. Under conventional farming the field is left alone for long parts of the year. CA requires farmers to visit their fields regularly. Farmers who adopted CA complained that there is always something to do, whether it is collecting mulch, making compost manure or think about green manure cover crops and intercropping. The returning issues, the need to grow cover crops in the dry season, make compost manure and to weed and mulch the plot year round, lead to an increase in labour. Mulching is needed in the same time as farmers need to weed their plots, this additional work in an already busy season leads to a labour peak. The overall higher labour burden of CA and FGW might be compensated partly, because there is no need to plough and make ridges any more. However, this does not prevent the labour peak during the weeding season. Also, this is not beneficial for farmers with cattle, since ploughing with cattle is the easiest and fastest option to prepare the land. Malawian farmers are used to visiting friends and relatives in the dry season, but project staff discourages to abandon the field for a long time. This causes friction. It has been found that farmers in the CA and FGW project therefore apply the principles partly and sometimes abandon the whole technique.

It is difficult to conclude whether CA and FGW lead to an overall increase in labour, because different experiences have been heard and observed. For example, some farmers noticed a decrease in weed pressure due to the mulch layer, while other farmers complained about an increase in weed pressure because of abandoning tillage. Also, because the farmers in both projects try the principles on such small plots, they did not complain about extreme peak moments in the farming year. Most farmers, though, acknowledged they would not expand their plot under CA or FGW, for the reasons of an

increase in labour burden. In paragraph 3.5 it will be discussed that ploughing the field and making ridges is more work than making planting stations, particularly for farmers without cattle. However, since people are used to the ridges they do not see it as hard work anymore. For them, the principles of CA and FGW lead to an increase in labour, which discourages adoption. Next to that, making ridges can be done when farmers have time for it, while planting stations should be made early in the farm year (August and September) according to CA and FGW project staff. This does not match with farmers' other activities, such as visiting friends and relatives in the dry season, and also discourages adoption.

In the next paragraphs the three key principles of CA and FGW (mulching, no-tillage, crop rotation and/or intercropping), effecting adoption, will be analysed in relation to farmers' activities and labour. Already from the household characteristics and elaboration on labour, it becomes clear that the principles might not be suitable for every type (relatively poorer or richer) household.

3.3 MULCHING

3.3.1 COLLECTING MULCH

Mulch needs to be collected year-round to keep the soil covered and prevent soil erosion. According to the project staff the soil should be covered well (SOLDEV promote a 100% mulch cover with 3 cm depth). Many farmers complain about the amount of mulch that is needed for the fields, especially because the decomposition of mulch on the fields is fast. Project staff of SOLDEV and FfF encourage the use of crop residues as mulch, but this is not always possible. The relative rich farmers need to feed crop residues to their cattle (more in paragraph 3.3.4), while the relative poor farmers lack enough crop residues due to poor productivity. Also, most farmers burn crop residues to catch mice (more in paragraph 3.3.3) which is a Malawian delicacy. Alternative strategies are to collect crop residues from neighbouring farmers or go into the bush to collect mulch material, which is very labour intensive. A farmer mentioned that collecting mulch is not impossible, but just hard work. He states: "*It takes a lot of time, I need to go to the bush all the time to collect grasses and leaves. Even in the dry season there is some mulch available, but this is far from the farm and is hard work to collect, especially walking up and down the hills*".

Many farmers mentioned the increase in labour, due to mulching. According to farmers (especially those with cattle) the labour burden is more intense under CA and FGW compared to conventional agriculture which has a labour peak at the start of the planting season, even before the rains, when the ridges are made. As shown in the previous chapter, farmers in the project of SOLDEV only have to mulch three plots of 20x20m. The plots of the farmers who adopted FGW do not have a fixed size, but are on average small as well. Even on these small size plots, farmers did not manage to find enough mulch. It has been observed that some farmers stick to the plot size, but many of them abandon parts of the plots, simply because of the increased labour burden. These farmers that abandon CA principles are often the poorer farmers, busy with other jobs such as piece work or a job as gardener or watchman. Only a few farmers (with and without cattle) expanded their plots. The farmers who expanded their plots gave as reason that they saw the benefits of CA or FGW by themselves, which is a form of environmental learning. They wanted to invest time and labour in the technique, for example to collect mulch. It can be concluded that CA and FGW are not suitable for all

farmers due to an increased labour burden, this is especially the case for poorer farmers with other jobs.

Some farmers are used to harvest whole maize stalks and bring them to the homestead, where they then take off the maize cobs. The farmers with cattle store the maize stalks to feed cattle throughout the dry season. The farmers without cattle, who adopted CA or FGW, now need to return the stalks to the field again. It was observed that the CA and FGW fields are sometimes close to the homestead, but sometimes further away from the homesteads. One farmer stated: "*I need to rent oxen to bring back the maize stalks to the field, this costs time and money".* The suggestion to harvest only maize cobs, and to leave the stalks in the field is not accepted by many farmers, since they are afraid of roaming animals (see paragraph 3.3.4) and afterwards fires (see paragraph 3.3.3).

3.3.2 DISAPPEARING MULCH: TERMITES

Termites eat dead plant material and can decompose a hundred percent mulch cover within a month or two. Termites are especially active in March and April. If there is no dry material available, termites will attack the crops. It was found that the farmers in Karonga did not have any problems with termites. In contrast, farmers in Mzuzu complained about termites eating both mulch and crops. A farmer stated: "*the mulch cover attracts termites, if the dead material is eaten they will continue with my crops*". In contrast, another farmer said: "*I started applying the principles of FGW some years ago and I have never had any troubles with termites eating my crops. They prefer the mulch layer of dead material, and decompose it for me. This creates organic matter*". The effects of mulch on termites are not straight forward.

However, project staff and Government Extension workers promote the use of mulch, to prevent destructive effects of termites. Project staff of Foundations for Farming explains that decomposition by termites is a natural process, and will enrich the soil. Government Extension Officer points at the benefits of a mulch cover: "*Termites can be very destructive, especially on plots that are not mulched. A farmer can visit his plot every day and discover half of his crops are gone overnight. The termites do not eat the crops, but cut down the roots. A mulch layer can prevent this disaster*". The promotion of FGW is focused solely on the positive effects of a mulch cover in relation to termites, but a mulch cover can also attract termites that eventually eat the crops. Andersson and Giller (2012) state:

> Termites can have positive benefits – in West Africa it was found that particular soil dwelling termites (*Odontotermes* and *Macrotermes*) improve nutrient release and crop performance on crusted soils (Mando 1998). These species are responsible for the formation of macropores in *Zaï* pits (Mando et al. 2006) which improves infiltration and capture of rainfall into the soil. However farmers in Zimbabwe complain that leaving maize residue as mulch attracts termites that, especially in drier areas or during dry spells, feed on the next crop causing lodging and yield loss" (p. 38).

During a farm visit, it has been observed that roots of crops (both maize and groundnuts) were cut down by termites, on plots that were mulched. This farmer decided to abandon the mulching, because she was afraid to lose her crops due to the termites. Since the effects of termites on the mulch layer and crops are not clear, project staff should be cautious not to tell a single story.

3.3.3 DISAPPEARING MULCH: BURNING

In Malawi many farmers, under conventional agriculture, are used to burn the fields some months after harvest. After harvest, in June and July, livestock can graze freely in all fields to eat crop residues. Everything that is left will be burned in August, not only to clear the field but also to catch mice. Mice stay underground, and can be caught easily when they run out their holes when the field is on fire. For farmers, burning the field to clear the land is important. If you don't, neighbours and community members will tell you the field is dirty. This issue of group conformity is described in paragraph 4.6.1. Farmers who own livestock often collect the crop residues, mainly maize stalks, at their homestead. Sometimes they still burn the field in August, to clear the land from the left-over residues or weeds.

Farmers, without livestock, who have adopted CA or FGW find it difficult to stop burning, because it is something people do together, and roasted mice are a Malawian delicacy. In Karonga, a set of bylaws has been introduced. One of the bylaws prevents people from burning the fields. Often if someone burns his field, the neighbouring fields are set on fire as well, not always on purpose. One farmer, Jeremiah, who practices FGW said: "*Last year my neighbours burned their fields, and the fire went to my field as well. All my crop residues were gone, while I needed them as mulch cover*". He explained that the neighbour knew about him wanting to save the crop residues, but did not care. A lady farmer in Karonga experienced the same. The bylaws, that should prevent people from burning the fields, are not obeyed. Farmers who did not adopt CA or FGW complained that the new techniques disturb Malawian traditions. Burning is something which has been done for generations, and it has been found that farmers will not easily stop this practice, even though the bylaws are established. Also some farmers who adopted CA or FGW still burn their fields, either because they do not want to stop this custom, or because of community members pushing them to clear the fields. The lady farmer, whose field has been burned down, explained she did not dare to go to the chief to report the burning, since she was afraid of being bewitched. More on witchcraft in paragraph 4.6.2.

3.3.4 DISAPPEARING MULCH: LIVESTOCK

For smallholder farmers who have mixed crop-livestock systems, animals are extremely important. They contribute to the food security of the household, provide for system diversification, generate cash, spread risk, recycle nutrients, provide draught power and transportation (De Haan et al., 1997). Next to that, they are a symbol of social status and for example used for bride dowries. A farmer explained: "*Livestock, especially cattle, is important for us, Malawians. We will make sure that they are well fed*". Farmers often prioritise feeding their livestock with crop residues before mulching the plots. Sometimes farmers store the crop residues at their homesteads, and use it as fodder throughout the dry season. One farmer stated: "*Mulching my plot is a challenge, in the rainy season there are enough green materials for my livestock to eat and enough palm leafs to mulch the plot. In the dry area everything is brown and yellow and no fresh grasses and plants are available as fodder. Therefore, I collect the maize stalks after harvest to feed my cattle. If there are anything left, I use it as mulch".* This reasoning was common for farmers with cattle. However, some farmers found solutions to be able to both feed livestock and mulch their fields. They let their livestock graze in the bush, tethered or free, or choose to feed cattle with other grasses and plants than crop residues. One farmer said: "*I send my children to the bush every morning before they go to school, to collect fodder*".

In Karonga district there are high livestock densities while in Mzuzu there is not much livestock. As can be observed from the characteristics of the interviewed farmers (see paragraph 3.1), not many smallholder farmers own livestock. But also for farmers who do not own livestock themselves, the presence of livestock around influences CA and FGW uptake. This has to do with the free range grazing system in which animals graze freely after harvest, since not much crops are grown in the dry season. Farmers who have mulched their fields complain about livestock eating their mulch cover. Some farmers tried to protect their field against roaming animals. One strategy is to fence off their fields, but this is difficult due to the size and the required materials and/or money. Another strategy to overcome problems of roaming animals is to protect the fields during the dry season. Farmers who had to protect their fields complained about the increased workload, especially if the fields are further away from the homestead. This leads to a more or less negative association with CA.

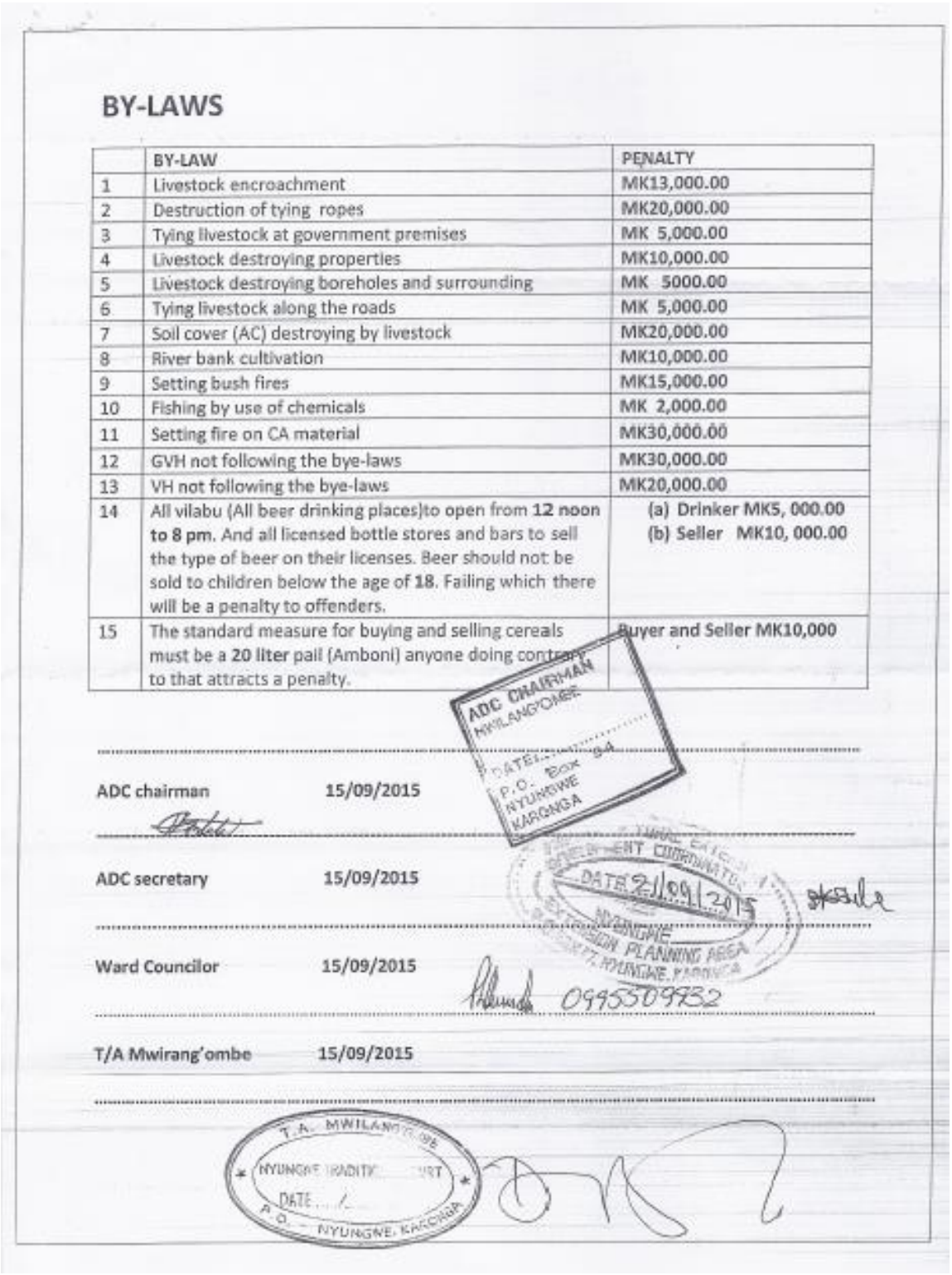
In Karonga, a set of bylaws has been introduced to prevent cattle from grazing freely after harvest. The bylaws and fines can be found in figure 4. The bylaws are formulated by the Area Development Committee (ADC) to avoid difficulties in sustainable agriculture production. The by-laws should also assist to mitigate effects of climate change. After the by-laws were agreed upon at ADC the farmers were informed. To give an example of the first by-law; if someone's livestock is roaming freely after harvest time –and before the first rains- and destroys crops or crop residues in a field, the fine for the owner of the livestock will be 13,000 kwacha. The fine is party paid to the owner of the field that has been destroyed (10,000 kwacha) and partly to the police (3,000 kwacha). The owner of the field or the police should first approach the owner of the livestock. The case will be discussed with the Village Headman if he or she is not willing to pay directly. The reason for giving the police a part of the fine is to give them an incentive to keep an eye on regulating livestock.

According to Agricultural Extension Coordinator (AEC) mister Nundwe, the bylaws are an incentive for people to adopt CA. He states: "*CA is now spreading in Nyungwe at a fast rate due to the implementation of the bylaws"*. In contrast, many farmers mentioned that the by-laws are often not obeyed, for example when people do not want to report cases to the Village Headman, because they are afraid they will be bewitched (more information on witchcraft in paragraph 4.6.2). Also social relations do play a role. Many cases of livestock encroachment are never reported, because the livestock belonged to a friend or relative, and people do not want to disturb social relations. People who own livestock are not in favour of the by-laws at all, because it is an enormous increase in labour to keep livestock in stables and feed it, or ty livestock to different places. These farmers have protested against the formulation of the by-laws and do not obey the implementation, hoping they can get away with it.

As a strategy to overcome problems of roaming animals, when the by-laws are not obeyed or in places in which the by-laws are not present, farmers stock maize stalks at their farm until the rains start and animals are tethered again. Therefore, from May till November or December the land is bare. According to the District's Agricultural Development Officer (DADO): "*Problems with roaming animals affect efforts to prevent soil erosion, retain soil moisture and improve soil fertility*".

Giller et al. (2009) describe that land-use rights can be an obstacle to mulching for farmers. The free range grazing system relies on communal use of the land and traditional grazing patterns. They state: "Individual farmers cannot restrict grazing even on their own land without challenging the traditional

rights of others in the community" (p. 30). This is not the case for farmers in Karonga who want to prevent roaming animals. They have the bylaws on their side. However, due to social relations, people being afraid of witchcraft, and farmers who are in conflict with the by-laws, the implementation is problematic. Many farmers still stock their crop residues at their homestead till the first rains.



BY-LAWS

	BY-LAW	PENALTY
1	Livestock encroachment	MK13,000.00
2	Destruction of tying ropes	MK20,000.00
3	Tying livestock at government premises	MK 5,000.00
4	Livestock destroying properties	MK10,000.00
5	Livestock destroying boreholes and surrounding	MK 5000.00
6	Tying livestock along the roads	MK 5,000.00
7	Soil cover (AC) destroying by livestock	MK20,000.00
8	River bank cultivation	MK10,000.00
9	Setting bush fires	MK15,000.00
10	Fishing by use of chemicals	MK 2,000.00
11	Setting fire on CA material	MK30,000.00
12	GVH not following the bye-laws	MK30,000.00
13	VH not following the bye-laws	MK20,000.00
14	All vilabu (All beer drinking places)to open from **12 noon to 8 pm**. And all licensed bottle stores and bars to sell the type of beer on their licenses. Beer should not be sold to children below the age of **18**. Failing which there will be a penalty to offenders.	(a) Drinker MK5, 000.00 (b) Seller MK10, 000.00
15	The standard measure for buying and selling cereals must be a **20 liter** pail (Amboni) anyone doing contrary to that attracts a penalty.	Buyer and Seller MK10,000

ADC chairman 15/09/2015

ADC secretary 15/09/2015

Ward Councilor 15/09/2015

T/A Mwirang'ombe 15/09/2015

Figure 4. By-laws of Mwilang'ombe ADC (Area Development Committee) in Karonga

3.3.5 EFFECTS OF MULCHING

Keeping the soil covered with a mulch layer can increase soil moisture and prevent soil erosion. Soil erosion is a big problem for Malawian farmers. The fields of the smallholder farmers in Karonga are predominately flat or at moderate slopes. The area is hit by dry spells almost every year. Karonga has mostly dry, heavily silted riverbeds that are prone to flooding during heavy rains. Currently dry spells and drought has been imminent in most areas in Karonga including Nyungwe Extension Planning Area, in which the CA project of SOLDEV is present (SOLDEV, 2015). Mzuzu district has more regular rains, but the from time to time heavy rains cause floods and erosion. Mzuzu area is predominantly hilly and many smallholder farmers farm on steep slopes, sometimes over 30%. Run-off is a big problem. One farmer complained that about half of his field, grown conventionally, was washed away. Farmers doing CA and FGW who have mulched the plots see the difference in times of heavy rains, since more water infiltrates in the soil and less soil is being washed away. This is especially the case with farmers farming on moderate till steep slopes. One farmer stated: "*there is too much erosion on the slopes, we have to keep the little amount of water that God gives us in the soil. I have seen that mulch helps, this encourages me*". Many farmers have a few plots of land, which are not always close to each other. Some of their fields might be flat while others are on slopes. It was found that the principles of CA were mainly applied to a small plot, either close to the homestead (these plots were often at a flat land, or moderate slope) or to a piece of land that had not been in use, often further away from the homestead (these plots were very diverse).

Farmers, especially the ones with lower situated fields, had negative experiences with mulching. In both Mzuzu and Karonga, some farmers in the lower areas deal with water logging. During and after heavy rains big puddles of water cause rot among the plants, especially if the field is mulched. Crops that are grown on ridges have less or no problems. It has been found that CA and FGW are not suitable for every type of field. Ntare, Government Extension Officer in Nyungwe states: "*CA is not suitable for flat lands. The mulch cover will rot. I myself have this type of land and cannot practice CA. My maize grows on ridges. It is difficult for me to teach farmers on CA while I cannot do it myself".* Also project staff from SOLDEV and Foundations for Farming discourage farmers in these conditions to mulch field, and tell them to grow on ridges.

Rusinamhodzi et al. (2011) and Chikowo (2011) agree that mulch cover may lead to lower yields due to water logging, especially in years of high rainfall. Baudron et al. (2012), in contrast, state that CA reduces water infiltration during wetter years. This water shedding effect during wet years was perceived to be an advantage by farmers, but had more to do with no-tillage than the presence of mulch. They state: "the increased water runoff in the absence of ploughing was said to be an advantage during wet years, as it would prevent waterlogging" (p. 11). However, the type of soil and the slope are determining factors that decide whether CA or FGW will lead to water logging or not.

3.4 CROP ROTATION AND INTERCROPPING

The project staff of SOLDEV and FfF encourages farmers to rotate crops and/or intercrop maize with legumes. Also green manure cover crops (gmcc) are introduced to farmers. SOLDEV provides maize seeds, a legume seed of choice and lablab as gmcc and food crop to all farmers that participate in the project. These farmers set aside three plots under CA; pure maize, maize intercropped with a legume and pure stand legume. The legume and maize plot are supposed to shift each year.

The farmers in Karonga did not have problems with crop rotation and intercropping on the three small plots, that are a requirement for the project, and seemed to understand and experience the advantages. A farmer explained: "*I used to grow solely maize, apart from some pumpkins on the edges of my field. Now intercropped with the cow peas and lablab I know I am improving the soil and at the same time growing more food for my family*". A relatively wealthy farmer, who adopted FGW, intercrops maize with pigeon peas, cowpeas and pumpkins. He explains that pigeon pea and cow pea fix nitrogen in the soil. The big leaves of the pumpkins cover up the soil and suppress weeds. All three crops are food crops and complement his family's diet. It was found that this is a condition for farmers to start intercropping. An experiment of SOLDEV to give farmers seeds of legumes and gmcc, which are inedible, failed. Both richer and poorer farmers did not want to set aside a piece of land only for the sake of soil fertility. Project staff explained: "*We want farmers to improve soil fertility, but we learned that farmers won't grow crops only to improve the soil*".

Although intercropping was adopted quite often to larger parts of the farm, most farmers did not apply crop rotation to the rest of the farm. Especially the poorer farmers mentioned that they would never grow legumes instead of maize because growing maize had priority, there should be enough maize to eat nsima year-round. The argument that legumes should not compete with necessary food crop is related to risk-aversion of farmers (described in paragraph 4.2). A farmer, with only 1,5 acre and 6 children to feed, explained: "*My priority is to grow enough maize to give my children nsima whole year. Growing more legumes and rotate the plots is not an option"*. In contrast, a relatively wealthy farmer showed in his farm planning that the plot with pure stand cow peas will be rotated with the plot under pure maize stand next year. Since he has enough land and finances, he is able to experiment with crop rotation, to improve soil fertility. Another constrain for farmers to crop rotation is that the vast majority of the land is planted with maize. It is therefore difficult to rotate this with a few other crops that have much smaller plots. Government Agricultural Extension Officer explained: "*Crop rotation is difficult because of the small landholding size of the farmers, they grow mainly maize and some pumpkins, legumes, groundnuts and tomatoes next to it. For the sake of soil fertility and pest control they should rotate, even if it is not fully possible".*

Literature confirms that in many smallholder farming systems rotation with legumes has remained limited. Andersson and D'Souza (2014) explain that farm level constraints limit crop rotation, because farmers do not grow a large variety of crops. Also, higher labour demands and a preference for staple food crop production cause legume areas to be small (Thierfelder et al 2013, Giller et al., 2011). In southern Malawi it is a common practice for farmers to intercrop maize with pigeon pea (Andersson & D'Souza, 2014). This is mainly due to the small landholdings. In northern Malawi the landholding sizes are not as small as in the southern part (respectively 0.4 ha compared to 0.2 ha on average) but intercropping is gaining ground. This might be because different agricultural NGOs are promoting it. Most NGOs give out free seeds (both maize and legume seeds), which is an incentive for farmers to start intercropping. More on input support has been described in paragraph 2.2.

3.5 TO PLOUGH OR NOT TO PLOUGH

Malawian smallholder farmers are used to plough their fields and make ridges. For farmers with cattle, ploughing is the easiest option to loosen the soil and get rid of weeds. According to Agricultural Extension Coordinator, the adoption rates of CA are higher in Mzuzu district than

Karonga district; "*Mainly because there is less cattle in Mzuzu for ploughing, animal fodder and free grazing system. Cattle is a way of showing off. More cattle present in an area hinders CA and FGW adoption*". Four out of sixteen interviewed farmers have cattle. These four are the richer farmers. For them, the CA and FGW principle of no-tilling is not beneficial. Ngunde is one of these farmers with cattle, who adopted CA on a small plot. She explains that she is curious about the effects of no-tilling, but she only experiments with CA on a plot of 20x20m. She acknowledges that it is not likely she will increase the plot under CA, since she owns cattle that can easily plough the fields. She explains: "*I used to plough the field with my two cows. I still do it on my conventional plot, but the CA plot will not be ploughed any more. I make planting stations instead, but because the soil is hard this is tough*". Apart from being curious about the effects of no-tilling Ngunde might have adopted CA because of the involvement in a project and the related input support. For smallholder farmers without cattle the principle of no-tilling is beneficial in theory. Making ridges with a hoe is labour intensive, and hiring some cattle to plough the field is expensive.

However, it was found that many smallholder farmers preferred the ridges instead of no-tilling and planting stations. One farmer said: "*Although the soil is hard, and making ridges is difficult, we are used to it. It is in our blood. We know when to start and how to make them, all boys in the family help. Our parents and grandparents taught us this*". Some farmers who dropped out the CA project of SOLDEV explained they were busy during the dry season and did not have time for the technology. A farmer said: "*I travelled to Chtipa just before the rains started and returned late. I did not have enough time to make planting stations, so I ploughed the soil with oxen and made ridges. All my children helped*". This is linked to the promotion of CA and FGW, since SOLDEV and FfF tell farmers to start early with the planting stations. The stations should be dug in August and September already. In October the planting stations should be ready, filled with some compost manure and covered up with a little soil, for planting. The farmers should plant early, with the first rains. However, many farmers are used to visiting friends and family in the dry season or have other jobs, and cannot meet these requirements for CA and FGW. They therefore decide to plough the field and make ridges although it is more work. Farmers, at least, know what to do and when to start. Although it is wise to start early with the ridges (some farmers spend much of September through November digging ridges), many farmers start late or wait for the first rains that make it easier to dig the soil. It can be concluded that the time-specific actions required for CA and FGW constrain adoption. Additionally, although digging planting stations is less work than ploughing the soil and making ridges for farmers without cattle, farmers do not easily shift towards CA or FGW. Government extension worker explained: "*It is hard for farmers to change mind set, they are used to the ridges and think CA is a hell of a work, although that is not the case*".

It was found that when people see the benefits of CA with their own eyes –such as an improved crop stand during dry spells- the shift from conventional agriculture to Conservation Agriculture is faster. But it is not as simple as that. One farmer experienced that making planting stations was less labour intensive than ploughing the field and making ridges, enabling him to increase his field under CA. Nevertheless, due to huge weed pressure and a lack of mulch he did not manage to maintain the field throughout the season, and abandoned part of the field. The problem of weed pressure was mentioned more often, and is a factor hindering adoption. In contrast, a farmer who converted almost one acre to FGW and made planting stations instead of ridges, got many reactions from his friends and neighbours. They thought he was being lazy, not making ridges anymore. In Malawi,

making ridges is a men's job. The ridges should be firm and straight, people are considered lazy if the ridges are small and uneven. Farmers not making ridges anymore are almost a shame to their family. However, this particular farmer had abandoned the ridges, made planting stations, mulched a part of the plot and grew gmcc. His crops performed better than his crops on the conventional plot – with the same type of seed and no fertiliser on both plots. His friends and neighbours did not complain about him being lazy anymore. Although some of them pressured him to return back to the ridges, others were interested in the techniques and wanted to know more about the training he got.

In literature it is suggested that farmers generally undergo a change in mind-set relatively quickly when they experience, or are exposed to, the benefits of CA (Wall, 2007). This is in line with some observations in Mzuzu and Karonga. However, this does not suggest that CA and FGW are always suitable for the on-farm activities of smallholder farmers. The time-specific actions CA and FGW require constrain adoption, for example. Other downsides of the no-till principle are an increase in weed pressure, and weeding is constrained with a mulch layer on the field. Baudron et al. (2012) states that especially on more fertile soils in hot areas, weed pressure can lead farmers to abandon up to a third of the planted area. Giller et al. (2009) describes that the labour burden for women may increase under no-till farming, since weeding is done primarily by women. This is elaborated in paragraph 4.5.

3.6 SYNTHESE

There is great variety in the households characteristics of the farmers in northern Malawi, when it comes to household size, available labour, amount of animals and land. The farmers can be divided into relatively richer and poorer farmers. The richer farmers have several fields, own cattle and sometimes employ people to work on their fields. The poorer farmers have little land, do not own cattle, and are often occupied with other jobs. They for example work on someone else's field, which requires time and labour. CA and FGW, being labour intensive technologies, are more suitable for farmers with extra labour. Next to the labour issue, the key principles of CA and FGW –mulching, no-tilling and crop rotation or intercropping– influence largely for which households the technology is suitable.

SOLDEV and FfF promote a full mulch cover, to protect the soil surface, increase microbial activity, increase water infiltration and to control weeds. The principle of mulching conflicts with the traditional free range grazing system. People used to let their cattle graze freely and eat crop residues in the dry season. The implemented bylaws in Karonga should prevent this, but are not always obeyed, and especially richer farmers with cattle are not in favour of the bylaws. Controlling livestock and/or protecting fields against roaming animals lead to an increase in labour, and a more or less negative association with CA and FGW. Mulching also influences the traditional burning of the fields, to clear the land and to catch mice. Additionally, a mulch layer can possibly attract termites. Mulching can prevent soil erosion and lead to better yields (especially during dry spells) in the uplands, but is not suitable for farmers with lower situated fields due to water logging.

The principle of intercropping is gaining ground in northern Malawi. Green manure cover crops are only interesting for both poorer and richer farmers if they are edible. Crop rotation is difficult, due to the large portion of the land planted with maize, and a marginal part planted with other crops. Crop

rotation is especially not attractive for poor farmers. They cannot set aside a field for legumes solely, because legumes should not compete with the necessary food crops. Richer farmers are more likely to grow legumes, because they have more fields.

The no-till principle of CA and FGW especially hinders adoption among richer farmers that own cattle and are used to plough fields. It was found that both poorer and richer smallholder farmers are used to making ridges, and will not change this practice overnight. SOLDEV and FfF tell farmers to make planting stations early, way before the rains start. This time-specific action that is required hinders adoption, since many farmers start too late and therefore make ridges, since this is something that can be done any time. The no-till principle also leads to an increase in weed pressure generally, increasing the workload of farmers and hindering adoption.

Giller et al. (2009) state: “It cannot be automatically assumed that CA will bring benefits to the farming system and rural livelihood as a whole simply because benefits are shown at the plot level”. It was found that whether CA and FGW practices can fit in the on-farm activities of smallholder farmers largely depends on their households characteristics, especially the labour that is available in the household, the presence of cattle, and the amount and geographical position of the fields. According to Sigaut (1994), CA is not just a set of operations which a farmer needs to adopt. Instead, the new activities related to the key principles of CA are part of the on-farm activities and organisation (path) of farmers and their relations (network). The on-farm activities and organisation of farmers have been work out in this chapter. The focus of the following chapter will be on the network in which farmers operate, influencing adoption.

CHAPTER 4 – CA AND FGW EMBEDDED IN SMALLHOLDER FARMERS' NETWORKS

Not only the on-farm activities of farmers influences adoption. The decisions farmers make are likewise influenced by the networks in which they operate. The Actor Network Theory (ANT) describes that farmers are no autonomous actors, their activities are formed by the heterogeneous networks they are part of. Farmers, for example, may decide to conform to the group instead of trying something new, which implies repositioning themselves and other actors in the network or leave things as they are. When they change their farming strategy because they are targeted for the Farm Input Subsidy programme (FISP) of the government, or they decide to join a project to either improve their farm skills or for the sake of free inputs all will have an effect on other parts of the network. Some specific connections that shape farmers' position in networks and how CA adoption affects this are described in this chapter, starting with the poverty and coping mechanisms of smallholder farmers, followed by a notion on risk-aversion, an elaboration of farmer's knowledge on the key principles of CA and FGW, farmer's attitude towards smallholder farming and an explanation of gender issues. Then, an insight in the rural communities is given, including a description of group conformity, witchcraft and 'Africa Tax'. At last, the land tenure system is elaborated.

4.1 POVERTY AND COPING MECHANISMS

Non-human components of farmers' networks are seeds and fertiliser, which are necessary to realise a harvest. In November and December people must buy fertiliser and seed. This is expensive and often exhaust their savings. Agro-dealers are present in every town, there is no lack of input-markets. Farm inputs are considered expensive, 24,000 kwacha for a 50kg bag of fertiliser, around 4,000 kwacha for 5kg OPV seeds and 6,500 kwacha for 5kg hybrid seeds. Next to farm inputs, smallholder farmers need money for school fees, medicines, funeral costs, and household essentials such as sugar, soap and salt. Often farmers are indebted, because they borrowed money during the hungry season for household needs. They have to sell maize straight after harvest to pay off their debts. They are 'hungry for money', see textbox C for the example of Zikomo.

C. Hungry for money

Zikomo borrowed money for fertiliser, for his father's tomb stone, for his children's school fees and for traveling to family up north. Borrowing has become part of his lifestyle. His debt has slowly increased to a point where someone he owed money came and forcefully took his bike from him in front of his wife and children. The other debt collectors became very persistent too, knocking at his door on a regular basis. He feels trapped in a vicious circle, in which he is forced to sell the bulk of his maize at harvest times at low prices, and borrows money later in the year to purchase maize at double or triple the price.

During harvest time there is much supply of maize so the prices go down. Farmers might receive 50kw/kg maize. However, five months later –when their own maize is finished- they will need to purchase maize on the market. At that time there is less supply and lots of demand, so prices go up. The maize these days costs 200kw/kg maize. A farmer explained: "*Straight after harvest vendors came to my farm, to buy the maize. I got 800 kwacha per 20kg. Months later my maize finished and I had to buy it at the market from the same vendor, he asked 4,000 kwacha for a bucket of 20kg".* Next to individual households being 'hungry for money', society demands that people share their

resources. A farmer explained: "*It is always my wish to wait for selling part of the harvest when the prices go up. I never succeed, although I have enough maize and cash for my own family. The issue is my extended family. They will come to me for money or maize and I cannot refuse"*. Many farmers reported higher yields due to CA and FGW. However, they do not always benefit from it themselves, because society dictates that people should share surpluses, described in paragraph 4.6.3.

Due to the poor last year's harvest, most of the interviewed farmers (13 out of 16) did not have enough money this year to purchase maize seeds and fertiliser on the market. Some of them have been targeted by the vouchers of the government or got inputs from NGOs. Especially this last one is a strategy to reduce cost, many farmers try to be involved in projects from NGOs for the sake of input support. This strategy is called 'project hopping', also described in paragraph 2.2. Joining a project and receiving free seeds, fertiliser, or even goats is attractive and less risky than adopting an agricultural technique, from which people might benefit after some years. Farmers make decisions on the basis of their changing environment, they adjust their practices to what works, for example if project hopping is more rewarding than growing crops under CA and FGW technologies.

Other strategies, or coping mechanisms, to overcome food security during the hungry months are growing cash crops, setting up businesses and working as a watchman or gardener. The most practiced coping strategy is piece work or ganyu labour; working for wages or food on an occasional basis. Piece works are most important during the hungry season, when a number of poorer farmers are willing to postpone their own farm work for the price of a meal or some small cash. Postponing own farm work during the planting and weeding time is problematic and can hinder CA and FGW adoption. Farmers' own fields are planted too late, which leads to another poor harvest, and the need to do piece works again next season. Due to piece works smallholder farmers have less time to cultivate their own fields. Moreover, CA generally leads to an increase in weed pressure. This increase in labour during an already busy period when farmers also have other jobs is problematic. A poor farmer clarified: "*Weeds are taking over my field, but I am too busy with ganyu. At first I went to look for food for a month, then a week, and now it's all about tomorrow*". Next to that, farmers mentioned they rather practice principles they know and are used to than trying out a new strategy which involves more knowledge and time. Farmers complained about CA and FGW being very involving. Farmers need to spend time attending trainings, trying out intercropping or green manure cover crops, experimenting with different types of mulch et cetera. Besides the increased labour burden due to weed pressure, the way CA and FGW are promoted influences adoption. Additionally, the possible benefits of CA and FGW will be shown in the long-run. Smallholder farmers generally do not think about the long-run, their priority is to feed their family currently. This factor influencing adoption is described in the following paragraph.

4.2 RISK-AVERSION IN RELATION TO CA AND FGW

Farmers do not only listen to actors in their heterogeneous networks promoting CA and FGW, such as project staff and extension workers from the government, they also listen to their family who expect from the farmer to provide for food. Several farmers doubt whether the principles of CA and FGW will really work. They have to support their families, therefore, there is no space for experimenting or freestyling. One farmer said: "*I only have one acre. On this acre I need to grow maize for my family* [6 members] *for the whole year. Decisions I make, related to the field, are a matter of life and death"*.

Many smallholder farmers live around the poverty line, which means they have no buffer. Trying out a new agricultural principles, with the possibility to fail, is too risky.

Ridges make sense to Malawian farmers. They won't change this overnight. Kaweche, project member of SOLDEV, states: "*We cannot tell farmers to convert their whole farm into CA or FGW, it is a gradual process. We encourage farmers to start small*". Smallholder farmers' decisions are determined by their position in their networks. It was found that poorer farmers predominantly think about short-term issues, like how to feed the family today. CA and FGW are agricultural techniques that can improve the soil in the long-run, which will take several years. Many smallholder farmers do not have such a long-term vision, which is hindering adoption.

By observing the CA plots of the farmers in Nyungwe it has been discovered that some smallholder farmers assigned their most poor and stony fields to the project. Some of these fields have never been used for farming, because they are too far from the farm, or due to the poor soils and extreme weed pressure. The results from practising CA on these plots were not impressive. Smallholder farmers acknowledged they prioritised their conventional agriculture on ridges. They were afraid that the yields of the CA plot would be disappointing and wouldn't take the risk. In contrast, another farmer stated: "*Being a relatively wealthy farmer, I do not have to worry about what to eat today and next week. I have possibilities to try out new principles. There is plenty of land, and resources. I wouldn't be ruined if a new principle wouldn't work*". This farmer has a different position in his network, which makes him more likely to adopt CA or FGW.

Maize is the dominant staple food crop in Malawi. However, being dependent on maize only is problematic, especially with the dry spells, and climate change exacerbating this. Efforts of extension workers or project staff to promote other crops are not very effective. Growing maize and eating nsima, is part of Malawian practice, see textbox D. Under CA and FGW crop rotation and intercropping (maize with leguminous crops) have been promoted, to increase both soil fertility and nutrient uptake of families. However, most farmers within the projects did not want to set aside a significant part of their field to legumes, which hinders further adoption. A farmer explained that his priority is to grow enough maize to feed his family the whole year. Growing more legumes means less land available for maize. Many farmers indicated they are not willing to do this. SOLDEV promote three plots of 20x20m under CA (maize pure stand, maize intercropped with a legume, and legume pure stand) and FfF also encourage farmers to start small. It was found that a significant number of farmers in the projects did not meet these requirements. Plots were either very small, or farmers tried to apply one principle to the whole field (such as abandoning the ridges and

D. Importance of maize

Malawians eat maize with every meal. Most families serve this in the form of a dough like porridge called nsima. Other food crops than maize are seen as snack, not as real food. Mealer and Kamkwamba (2009) state: "Nsima isn't just an important part of our diet—our bodies depend on it the same way fish need water. If a foreigner invites a Malawian to supper and serves him plates of steak and pasta and chocolate cake for dessert, but no nsima, he'll go home and tell his brothers and sisters 'there was no food there, only steak and pasta. I hope I can sleep tonight'" (p. 37). This illustrates the importance for Malawians of growing maize and eating nsima.

making planting stations), often in the hope to get input support. Farmers explained they wanted to try out the new principles on small plots but it should not interfere with nor replace existing practices, in case it might not work out. Farmers more or less doubt whether the principles of CA and FGW will work. Many farmers mentioned they first want to see it with their own eyes, before they will expand the plot.

The finding that poorer farmers are reluctant to adopt CA or FGW is confirmed by literature. Wall (2007) states that the adoption of any new technology implies an investment in acquiring new knowledge of a complex system, which might be too high for a poor smallholder farmer. Especially because the results of CA and FGW will be seen after some years. Interviewed farmers questioned why they should risk this year's harvest for a technology that will be beneficial in the long term. Ngwira et al. (2013) found that there is a short-term risk of lower production and therefore lower household consumption under CA. The reason for the lower production has been associated with learning curves producers face after adoption. This is an unattractive prospect for food insecure smallholder farmers. The concern of lower production and household consumption has been raised several times in interviews with smallholder farmers.

4.3 KNOWLEDGE ON THE KEY PRINCIPLES

Another factor influencing CA and FGW adoption are high illiteracy levels among smallholder farmers and related to this the lack of knowledge and understanding on the principles of CA and FGW. The majority of the farmers that are in the project of SOLDEV only went to primary school. A small percentage followed secondary school. According to an government official, illiteracy levels in Mzuzu district are high. He states that people who have been to school will grasp the principles of CA or FGW, because they know how to learn and process knowledge. It was found that some farmers only understood half of the information after a training from SOLDEV. Farmers that are higher educated perform better, because they understand how to apply the principles.

Extension coordinator, mister Nundwe, stated that illiteracy levels are the bottleneck for CA adoption. He states: "*Due to the fact that many farmers cannot read or write, the adoption is slow. People do not understand the reason why they need to rotate crops, mulch the plot and abandon the ridges. CA as a practice to prevent soil erosion and to deal with climate change is not straightforward*". And it has been confirmed in the interviews. Farmers that show initiative and have been to school are more likely to adopt CA or FGW. One farmer said: "*I spend as much time possible on the farm and make plans on how to rotate crops and which gmcc to grow*". He is eager to learn more, both from project staff and extension workers. Another educated farmer who adopted CA said*: FGW is an experiment for me. I never got anything from projects or the government, but I am curious and want to try out. I used to be a school teacher, and I like learning new things. I will continue with this method. It is wise to follow new practices, since we need to learn, especially because climate is changing".* In contrast, less educated farmers also noticed that the rainy season is less predictable and dry spells occur more often than before. They rather wait for the rain instead of changing their practices. This is illustrated by a farmer who explained he had prayed God for the rain. He was waiting for weeks already, in the meantime his crops withered. He had been to the training and heard about applying a mulch layer that can increase soil moisture and avoid water evaporation, but he indicated he would not change his farming methods. Besides that, his field was situated next

to a river and he did not take any initiative to work with that – acknowledging it might be difficult to irrigate a field by hand.

The link between education and adoption is not evident. Knowler and Bradshaw (2007) state: "Education, be it specific or general, commonly correlates positively with the adoption of Conservation Agriculture practices; however, some analyses have found education to be an insignificant factor, or even to negatively correlate with adoption" (p. 35). The positive correlation can be explained by the fact that certain practices (such as mulching to increase water infiltration and crop rotation to increase soil fertility and reduce pests) can be understood by more educated farmers. In contrast, Pannell et al. (2006) found that education can tend to reduce or delay adoption if the limitations of the practice are recognised by more-educated farmers.

4.4 ATTITUDE TOWARDS FARMING

Especially young Malawians want to escape life in the rural area and search for a 'white collar job' in the cities. Due to high unemployment rates and a lack of proper education they are often not successful. The only option to make a living is to go back to the village and cultivate a plot of land. Farming is seen as last possible option, not something to be proud off. This farming identity is network-constructed; people who participate in heterogeneous networks are influenced by what it means to be a farmer. The identity of smallholder farming as last possible option of people influences CA and FGW adoption. According to FfF project coordinator Beckett, one of the biggest struggles for adoption CA or FGW is the mind-set of the farmers. They take little responsibility for the fields and do want to invest or try out new practices. It has been observed that many fields were overgrown with weeds, especially the ones further away from the farms. A farmer openly said: "*We farmers are lazy, we do not care about the soil and only work in the field when really needed*". Another farmer, visibly annoyed, stated: "*My father taught me to be proud to be a farmer. He used to wake up 4 am every morning to work on the land. Nowadays people only go to the field a few hours in the morning and leave it the rest of the day, and won't go to their fields for months in the hot season. People have become lazy and dependent, they want the government to feed them. I believe that showing initiative and investing in new technologies has the future*". Many farmers agreed that they would not go to the fields for months in the period between this year's harvest and the start of the next growing season. They rather visit friends and family. CA and FGW training focus on the need to weed regularly, to take care of the land, also in the dry season by covering up the soil, make compost manure and already prepare planting stations. CA and FGW lead to a shift in farm tasks during the year. For farmers who have been less active or have other occupations these months of the year this is completely new, and not very attractive. This change in labour throughout the season and the consequences for CA and FGW adoption is elaborated in paragraph 3.2.

Some young respondents stated they were saving up to migrate to South Africa for wage employment. Others planned to travel to Mzuzu or Lilongwe to find an office job. Farming is seen as their last option. The negative perceptions towards small scale farming and increasing rates of youth migration to the cities for wage employment is a trend seen in many rural areas in Sub-Saharan Africa. These decisions of people –and first of all the knowledge needed to consider migration– are influenced by the wider network farmers operate in. This network also influences the association of smallholder farming. Smallholder farming is seen by many as backward, non-productive, subsistence agriculture (Kirsten & Van Zyl, 1998). Not something to be proud of. Olutayo (2013) state: "The

present generation of youths can no longer be expected to confine themselves narrowly to a vocation where the reward for hard work is so meager when compared with the glory and successes achieved in the city in comfort and style" (p. 28). Adopting CA or FGW is not attractive for people who have a particular negative attitude towards small-scale farming and want to escape rural life.

4.5 HOUSEHOLD DECISIONS AND GENDER

Men often make household decisions, such as what to plant and when to purchase inputs. If a project enters the village, the man will often be the one to decide whether the household will join or not. However, it has been found that women are more willing to learn and try out new principles. A female farmer explained: "*We women must make sure there is flower to make nsima. We need to have enough supply for tomorrow as well. If we find a way to increase the yields –and flower supply- we are keen to try*". The farmers in the CA project of SOLDEV are selected on the basis of their motivation and capability. More than half of the farmers in the project are women. According to project staff: "*Women are in charge of the food production, and eager to increase yields. They are more willing to try out new agricultural techniques than most men*". Government Agricultural Extension Officer states: "*I can definitely see the difference between male and female farmers. Female farmers and widows are hardworking. Male farmers often do not follow all principles or they drink a lot and do not show-up at meetings*". Therefore, women are more likely to adopt CA.

Cases have been found in which a man did not want to join the CA project of SOLDEV, while the woman saw potential in the project. In a village in Nyungwe a man allowed his wife to practice CA on a small area, next to the house. After the first year, the man decided he needed the plot for growing tobacco, so the woman dropped out the project. The maize on the CA plot performed better than the maize grown conventionally, but the man did not change his mind and his wife had no other choice than to drop out the project. In contrast, another lady went to an introduction meeting of SOLDEV and adopted CA. She explained: "*My husband did not want me to start, and said that I would be in trouble if I would do it without his permission. But I resisted his power and his words"*. Eventually he did not care anymore because the yields were good. She explained that she was the one doing all the farm work since her husband was a lazy man, playing bao (a traditional board game) with friends whole day. It is confirmed by Lubwama (1999) that in many small-holder farms the technology is mostly at the disposal of men whereas women contribute 70% of agricultural production.

CA and FGW lead to shift in labour, described in paragraph 3.2. Also, it leads to a shift in specific (gender) relations within the networks of farmers. Men are often in charge of ploughing the field and making ridges, while women predominately take care of the weeding. Since ploughing and making ridges is not needed any more, the labour burden of men decreases. In contrast, the labour burden of women increases, because adopting CA commonly results in increased weed pressure (Kayode and Ademiluyi, 2004). This has not been observed or mentioned in the projects of SOLDEV and FfF, because the plots of the smallholder farmers are generally small. Giller et al. (2009) state that: "Without a reallocation of the gender-division of these roles in agricultural production this may lead to an unacceptable increase in the burden of labour on women". This needs to be taken into account if the plots under CA and FGW expand.

4.6 RURAL COMMUNITIES IN NORTHERN MALAWI

4.6.1 GROUP CONFORMITY

An aspect of living in the rural communities in northern Malawi is the strong sense that people belong to a group and should conform to the rest. There is lots of jealously in Malawian culture, if you differ from the rest people laugh at you and mock you. Also, equity is very important. If a NGO comes in with a project and support some farmers, the rest will be jealous. Decisions should be taken with the whole community, and no-one should be better off that the rest. See textbox E for the folktale of "the two farmers and one cow" illustrating the issue of conformity and jealousy in Malawian culture. In case of positive deviance, if someone does better than the rest, others will not ask how he achieved this. Instead, he will be forced to conform to the rest of the group. For example, if some farmers are targeted for a training and realise higher yields than the rest of the community, these farmers are in trouble since they do not conform to the rest of the community. They will be laughed at, mocked or even expelled or threatened. This has implications for CA and FGW adoption.

E. The story of two farmers and one cow

Two poor farmers live in the rural areas, next to Lake Malawi. They struggle to survive. One farmer improves his farm. After some months he earned enough money to purchase a cow. The other farmer is extremely jealous. One day, a fairy visits him, saying: you can make a wish. You can wish anything in the whole world. The farmers ponders… and says: Please kill my neighbour's cow!

Expert in Malawian culture, Cawood Simon, explained that FGW adoption has been low due to the tall poppy syndrome. This can be described as the social phenomenon in which people are attacked, cut down or criticised because of their talents or achievements that distinguish them from their peers (Dediu, 2015). People do not want to stand out but rather conform to the group. One respondent explained he almost got expelled from the village after adopting CA and having higher yields. His crops did withstand last year's dry spell, while crops of his neighbours died. The neighbours threatened him, and eventually he went back to planting on ridges. Also, many rural Malawians are afraid of witchcraft if they distinguish from the rest. This will be described in paragraph 4.6.2. Project members in Nyungwe knew stories of farmers whose fields have been demolished after they adopted CA, probably by jealous neighbours. According to project staff in both Karonga and Mzuzu there is a change coming. Examples of farmers have been found who prioritise their family above the community and existing values of conformity. One farmer said: "*My neighbours and in-laws started mocking me when I mulched my field and abandoned the ridges. When my yields were good they accused me of being a wizard, using magical powers to increase the yields. I did not care at all since I want to feed my family*".

It should be acknowledged that group conformity works in two ways. If some people, especially opinion leaders, within a community adopt CA or FGW others are likely to follow. The issue of opinion leaders in relation to adoption has been described in paragraph 2.1.1. One respondent stated: "*Most of my friends are in the project, they convinced me to join as well. I did not want to be the first one to adopt*". People who resisted the power of the majority can eventually turn into role models. One example of a farmer was found, who was laughed at and threatened after adopting CA. Halfway through the rainy season there was a three week dry spell. The crops of the neighbours

withered, while his crops survived. The Village Headman visited him and asked questions on his techniques. Then, as a community it was decided that the technique was worth the try. It can be stated that early adopters have a key role in the adoption process, and it is clear that farmers' decisions are influenced by the networks in which they operate.

4.6.2 ROLE AND USE OF WITCHCRAFT

Beliefs in witchcraft are present in rural communities in the north of Malawi. People live in fear, they are afraid of becoming bewitched, which might lead to disease or even death. The beliefs in witchcraft have implication for CA and FGW adoption. For example, one farmer produced more than last year, four bags of 50kg instead of the two bags of last year, due to CA. She stated: "*I heard there were rumours in the community that I used magical powers to increase my yield*". This scared her off, because wizards in Malawi are often violently persecuted. According to Mgbako and Glenn (2012) this ranges from stigmatizations to banishment, torture and even death. The farmer told the project staff about her fears. A meeting was organised in which the farmer explained in detail the new farming techniques and use of compost manure, that led to the increased yields. According to her the rumours had stopped afterwards. In another example, a farmer was accused of witchcraft during a dry spell, because his crops looked better than average. People thought he had "stolen" the yields of neighbouring farmers, since they were poor and his fields looked good. A large part of his field has been demolished by angry community members. This farmer shifted back to conventional agriculture, because he could not deal with the stress and rather conformed to the group. This farmer was obviously influenced by the wider heterogeneous network he is part of.

SOLDEV and FfF encourage the use of compost manure over fertiliser in the CA and FGW promotion, since it is sustainable and at low-cost. However, there is a traditional belief that fertiliser prevents witchcraft on the fields. It is said that wizards can come to the field when the crops are small, and steal the harvest. These magical powers do not work on fields where fertiliser is applied. At harvest time, the yields without fertiliser will be lower than the fields with fertiliser, since wizards secretly collected parts of the harvest at an early stage. Obviously, farmers who make use of fertiliser will get better results than farmers without fertiliser.

In Nyungwe a set of bylaws are introduced to prevent cattle from grazing freely after harvest. For farmers that adopted CA and leave crop residues on the field, the bylaws are an advantage. However, witchcraft prevents people from reporting cases of roaming animals. One respondent said: "*If my cattle go into my neighbours field and my neighbour thinks I am a wizard, he or she will be afraid to discuss this issue with me or report it to the Village Headman. I might bewitch her*". This reasoning was found often, and shows that rural Malawians live in fear for witches. An elaboration of the influence of the bylaws on CA and FGW uptake can be found in paragraph 3.3.4.

4.6.3 AFRICA TAX

Another aspect of living in the rural communities in northern Malawi is the need to belong to the (extended) family and community, and the obligation to support each other. The concept of 'Africa Tax' is widely known in Malawi. One respondent explains it as follows: "*My whole extended family paid for my school fees, books, and even university. After graduating I found a job within the government, and earned a decent income. Now it's pay-back time. I am supposed to support my*

family. I get endless requests of support from friends and relatives, for maize, transport, school fees, funeral costs and so on". Africa Tax can be described as the custom in which you have to assist others when they have needs, and they will in return assist you when you run out of money or goods. Especially people who do better than the rest of their family or community are often asked for support.

Although family has key priority, there is a strong sense of belonging to the community. If someone asks you for support it is not-done to refuse. Society dictates that if someone has the means he should provide the help. If someone manages to accumulate a surplus, others will be sure to have immediate needs that require those resources. A respondent complained he has to sell part of the maize straight after harvest: "*Last year I had enough maize for my household, my extended family came over and expected maize. I could not refuse, but eventually I did not have enough maize for my own household so I had to buy extra maize on the market".*

Farmers know that if they improve their fields and yields they might not benefit from it themselves, since all extra maize or money will be gone for the 'Africa Tax'. Adopting new agricultural principles, such as CA or FGW, which involves time, energy and knowledge is not attractive if you know beforehand that you will not benefit from the extra work that is been put into it – assuming that CA provides benefits. One respondent stated: "*Half of the maize I produce is gone for the Africa Tax, I had just enough left to feed my family. Why should I try to produce more?*". Although CA is not just about improving yields, but also soil conservation, the example shows that the concept of 'Africa Tax' influences CA and FGW adoption. However, not all Malawians follow the accepted principles of sharing, but people who do not pay a high price. According to Maranz (2001) people who do not follow the social norms are shunned and marginalised by friends and relatives. In cities the threat of being shunned is not as serious as it is in traditional and rural communities, but the pressure to conform socially to the accepted mores continues (Maranz, 2001).

It should be noted that sharing becomes an issue if there is a surplus. Most smallholder farmers produce too little to feed their family year round. Improving the yields to increase food security is therefore attractive. The extra maize will be used for household consumption. One farmer explained: "*Previous years I only had enough flower to support my family till November, now I grow part of the maize under CA and I expect to produce enough till next year's harvest*". Still, many farmers indicated they did not want to grow more, because they would not be benefitting from it themselves. This is a clear example of how heterogeneous networks play a role in the decisions farmers make. The social elements of the network (social relations and obligations) influence the material elements (farming strategies).

4.7 LAND TYPES AND LAND TENURE

The different types of land tenure in Malawi are public land, private land and customary land. Public land, including government land is land occupied, used, acquired or held by the government in the public interest, such as national parks and historical areas. Between 15% and 20% of land in Malawi is classified as public land. Private land is owned, held or occupied under freehold title, lease or registered as private land under the Land Act of 1967. According to USAID (2010) between 10% and 15% of land in Malawi is classified as private land. Customary land is all land held, occupied or used

by community members. Between 65% and 75% of land in Malawi is customary land (Chirwa 2008; Niyoka 2003). See textbox F for the explanation of the patrilineal customs in northern Malawi.

The smallholder farmers in northern Malawi are under customary tenure. The National Land Policy states that the community retains an interest in the land, which means that land cannot be sold outside the community. The Village Headman can reclaim and even re-allocate land if it is abandoned. Land can be obtained and lost in different ways within the customary tenure. Land can be obtained from the parents (male lineage). Also, a chief can allow you to use a piece of land which has been abandoned for several years. Purchasing land is difficult, since objective witnesses are needed together with permission of the chief. Only progressive chiefs allow people to sell and purchase land. Land issues are discussed during a monthly meeting with the Village Headman. During observations of this meeting and further interviews it was found that land can be lost in many ways. For example if someone comes to your field, claims the land and can prove that he has the right to the land, since it belonged to his family for a long time. Or if a person borrowed a piece of land (whether it is at costs or free of charge), and the actual owner comes back to claim the land. Also, as stated before, widows are vulnerable to property-grabbing by their husband' relatives. If a husband dies, the land originally belongs to the man's family and they will take it, leaving the wife and children no choice than to go back to her family, unless there are sons old enough to take over the farm. Nowadays, respondents explain it is straight forward that the wife can stay on the land with the children, and the land will been given to the children (both sons and daughters) when they are old enough. Most families do allow the wife and children to stay on the land, but in other cases they are chased away since brothers or uncles of the husband will claim the land, saying it belonged to their grandfather. According to Agricultural Extension Coordinator Mhango this mostly happens within less educated families. In one case the family of the husband threatened the wife, saying: "*will you ever use this land again, I cannot forecast what will happen to you"*. These family members might use witchcraft to claim the property back and expel the wife and children. More information on witchcraft can be found in paragraph 4.6.2.

F. Patrilineal customs

The ethnic groups that live in the north have patrilineal customs, which means that the man's village becomes the marital home when a couple gets married, and the man has to pay a bride price to the family of the bride. Although Malawi's formal law states that both women and men have the right to own land, cultural biases often prevent women from enjoying equal access, control and ownership of the land. It has been found that women in the north often do not own land, and that only sons (no daughters) inherit property. Therefore, widows are vulnerable to property-grabbing by their husband' relatives (Takane 2007; Ngwira 2013). The government is currently discussing a law that allows daughters to inherit the land, this is not implemented yet.

Land rights are important in relation to Conservation Agriculture and Farming God's Way. The type of land holding people have sometimes influences adoption. For example, if a farmer cultivates a piece of land which does not officially belong to him, he can be kicked off the land any time. He has less incentive to improve soil fertility because he might not be the one benefitting from it. Even more extreme, it was found that some people who adopted CA and achieved higher yields were kicked of

the land because the actual owner or a family member was jealous. This is especially the case in when the land is rented, illustrated by the following examples.

During an interview with a drop-out farmer from the CA project of SOLDEV, it was found that uncertainty on the land was a reason for him to stop practising CA. This farmer originally comes from Mzimba and has no family nor land in the Karonga region. He rented a piece of land from a wealthy farmer, built a house on it and cultivated the land. He had been here for three years. Last year the owner came to his house to tell him to leave. It was December by that time and the first effective rains had started, so he had already planted the maize. The owner gave him extra time till harvest. The farmer now needs to search for a new piece of land, and acknowledges that this is no ideal situation. He said: "*I have been to all trainings on how to mulch the land, make compost manure and so on. CA is very involving, and I have not seen the benefits yet. The soil might be better now, but I am not able to profit from it. I will only start CA if I have more certainty on where to live and farm*". This farmer therefore dropped out the project. Another farmer explained: "*I borrowed a small piece of land from a rich farmer. The soils were very poor, but I improved it over the years by applying Farming God's Way principles. The owner monitored how I was progressing and came in to take the land away from me. He needed it for own use*". Staff members explain that Malawians often borrow or rent plots of land, or they cultivate abandoned plots of land. Only if a Village Headman reclaims and re-allocates abandoned land to people, they can be sure they can stay on the land. Government official Kupunda states: *"Land issues are not a problem when it comes to CA adoption. Land belongs to the traditional leader and is divided between community members. Once the land is given to you, it is hard to be expelled from it*". Without clear permission from the VH to utilise the land, it is unclear to whom the land actually belongs and people feel unsecure. According to project coordinator in Karonga this is not a discouragement for people to develop the land, but there are exceptions. One of the farmers in Karonga cultivated a piece of land for 15 years. He did not adopt CA since he was not sure on his entitlement to the land. One day the actual owner came back from town, claimed the land and got it. Although in theory land issues should not be a problem for adoption, the given examples show that insecure land tenure does hinder CA and FGW adoption in practise.

Another aspect influencing adoption is the communal grazing system. Farmers let their animals, predominately goats and cattle, graze in communal areas. This is done in the dry season, after the main crops have been harvested. The animals graze on crop residues. In the rainy season the animals are kept in stables, tethered to a stake or tree, or herded by small boys. Farmers that have adopted CA or FGW face difficulties with roaming animals eating the crop residues that are left on their field as mulch. This issue is elaborated thoroughly in paragraph 3.3.4.

4.8 SYNTHESE

Many poor smallholder farmers struggle to purchase inputs at the start of the growing season. An important strategy for smallholder farmers to overcome poverty and food insecurity is to do piece work, work on someone else's farm for food or cash. Due to these piece works –that are predominately in the hungry season- less time remains to prepare their own field. Also, there is less time for the knowledge-intense principles of CA and FGW, although CA and FGW claim to be less labour-intense. Another issue influencing adoption is the finding that smallholder farmers prioritise their conventional agriculture on ridges, because they are afraid that the yields of the CA plot will be

disappointing. Wealthy farmers who own more fields are more likely to adopt CA or FGW. Many young Malawians want to escape life in the rural area and search for a “white collar job” in the cities or abroad. Farming is seen as last possible option, not something to be proud off. It was found that many farmers do not feel responsible for their farm, and will abandon their fields for some months each year. Project staff from SOLDEV and FfF encourage farmers to be actively involved in all farm-tasks year-round which is not very attractive for many smallholders farmers.

Smallholder farmers in northern Malawi are under customary land tenure. It was found that land rights play a role in the CA and FGW adoption, since the type of land holding people have influences whether they want to invest in a technology that will benefit in the long-term. Poor farmers sometimes borrow or rent a piece of land. If they are insecure of their right to cultivate the land, there is no incentive for them to improve soil fertility. People living in the rural areas have a strong sense of belonging to the community. Group conformity is important in these communities. This sometimes hinders CA and FGW adoption, since people do not want to do something different than the rest, nevertheless some farmers do stand out. It was found that some farmers, having higher yields due to CA, were laughed at, mocked or almost expelled from the community. Sometimes witchcraft is used to scare people off. Cases were found in which people shifted back to conventional agriculture. They were accused of being a wizard, could not deal with the stress and rather conformed to the group. However, group conformity works in two ways, if people (especially opinion leaders) within a community adopt a new practice, others are likely to follow. The strong sense of belonging to a community also lead to sharing and supporting each other. Society dictates that farmers with a surplus are obliged to support extended family or community members. Adopting CA or FGW which requires an investment in time, energy and knowledge is less attractive if the benefits will be gone to others.

The adoption of CA or FGW is not limited to a farmer’s individual choice to adopt or not, as Rogers (1995) describes in his five steps of the adoption process. Nor will it simply spread in communities through the social process of diffusion. Although Stone (2007) complements to the understanding of how people learn (both socially and environmentally), it does not clarify whether CA and FGW are beneficial for smallholder farmers in northern Malawi. There are other factors and processes, that play a role in the adoption process and the question whether CA can fit in the networks of farmers, such as group culture, land tenure system and risk-aversion should be taken into account. A broader theory is provided by the Actor Network Theory (ANT). The ANT describes how social and local interactions effect an network, and how networks of farmers, experts and scientists interact with each other and spread a technology. Farmers are no autonomous actors, they are not as free to decide as assumed by Rogers (1995) and Stone (2007). Farmers make choices in the context in which they operate, their environmental, cognitive, social, economic, geographic and political structures affect decisions of farmers (Gray and Gibson, 2013). Farmers are shaped by their context, and make decisions influenced by the people they listen to, the prices of inputs, the need to conform to the group, and the rules of rural Malawian society. Latour (1999) describes that the focus of analysis in adoption processes should be on “notions such as norms, values, culture, structure and social context” (p. 16), and that is exactly what has been done in this chapter.

CHAPTER 5 – CONCLUSION AND DISCUSSION

In this chapter the conclusions of the research are identified, starting with an elaboration of the three sub questions. They together form the final answer to the central research question. In the discussion a reflection is given of the research design and methodology. Also, the theories from the conceptual framework together with the major findings are discussed, linked to the three key lessons described in the theoretical framework. At last, some recommendations are made.

5.1 ANSWER TO RESEARCH QUESTION

This research sought to answer the following central research question:

What social and technical factors do play a role in the adoption of Conservation Agriculture and Farming God's Way among smallholder farmers in northern Malawi?

The central question has been worked out in the following sub questions:

1. How are CA and FGW promoted and does it spread through communities?
2. How are CA and FGW related to the on-farm activities of smallholder farmers?
3. How are CA and FGW embedded in the networks of smallholder farmers?

5.1.1 PROMOTION

Both Foundations for Farming (FfF) and the Synod of Livingstonia Development Department (SOLDEV) make use of the adoption and diffusion theory in order to spread CA and FGW. It has been found that this strategy is not effective, because farmers do not easily share information and skills gained during an agricultural training. The involvement of an opinion leader, such as a Village Headman is of key importance in the spread and acceptance of CA and FGW. Input support influences the adoption rates, but the uptake is often not sustainable. Next to SOLDEV and FfF other NGOs and the government actively promoting sustainable agriculture. These projects are sometimes complementary, at times overlapping and in some cases disturbing, since they promote different types of sustainable agriculture and give out all kinds of input support. Farmers take advantage of the different projects active in their area in order to get input support.

5.1.2 ON-FARM ACTIVITIES

CA and FGW lead to a change in the on-farm activities of smallholder farmers. The principle of mulching conflicts with the traditional free range grazing system. Mulching also influences the traditional burning of the fields, can possibly attract termites and leads to water logging in lower situated fields. In the uplands, mulching prevents soil erosion and leads to better yields compared to conventional agriculture, especially in times of dry spells. Intercropping is gaining ground, but crop rotation is difficult for smallholder farmers, due to the large portion of the land planted with maize and a marginal part planted with other crops. Crop rotation is especially not attractive for poor farmers who own less land. The no-till principle of CA and FGW especially hinders adoption among richer farmers that own cattle and are used to plough fields. Further, time-specific actions required for CA and FGW hinder adoption. According to Sigaut (1994) CA is not just a set of operations which a farmer needs to adopt. Instead, the new activities related to the key principles of CA are part of the on-farm activities and organisation (path) of the farmers and their social relations (network).

5.1.3 NETWORK

Farmers are shaped by their context, they are part of heterogeneous networks that influence their decisions. People living in the rural areas have a strong sense of belonging to the community, hindering adoption, because people do not want to do something different than the rest. Sometimes witchcraft is used to scare people off and lead them back to conventional agriculture. Society dictates that farmers with a surplus share this to their extended family or community. Adopting CA or FGW which requires an investment in time, energy and knowledge is less attractive if the benefits will be gone to others. An important strategy for smallholder farmers to overcome poverty and food insecurity is to do piece work. This factor, combined with poorly educated farmers, who lack initiative and a long-term vision, discourages adoption. Wealthier farmers often have a more long-term vision which makes them more likely to adopt CA or FGW. Among Malawians, smallholder farming is not something to be proud off, which hinders adoption. It was found that land rights play a role in the CA and FGW adoption, since the type of land holding people have influences whether they want to invest in a technology that will benefit them in the long-term.

5.2 DISCUSSION

5.2.1 REFLECTION ON THE RESEARCH DESIGN

The first method that has been used in the fieldwork to collect data are in-depth interviews. Most respondents in Karonga have been found via simple random sampling, aiming to create a representative selection of farmers that were enrolled in the project of SOLDEV, and farmers that have been to the introduction meeting but decided not to join. Farmers that were outside the project were found with the help of key informants. These key informants (an Agricultural Extension Officer and an agricultural expert) helped to find and select farmers, and because they were well known in the communities they supported the farmers to participate and to be open during the interviews. The respondents in Mzuzu have been found via the use of a key informant.

This dependence on key informants is a potential weakness in the set-up of the research, because they might be biased (and for example exclude people whom they do not like or include only farmers in favour of CA and FGW). This issue has been discussed with the key informants, and they understood that the researcher aimed at selection of a representative group of farmers. The respondents have been representative in their relation to CA and FGW (both adopters and non-adopters have been interviewed) and their performance under the technology. It should be noted that more relatively poorer farmers have been interviewed than relatively richer farmers. During the analysis of the data it became clear that there is a division between the relatively richer and poorer farmers. Looking back, more data could have been collected when this was noticed during the fieldwork, so that a better comparison could have been made between different household categories. However, this division between poorer and richer farmers is typical for the area in which the research has taken place. Also, the field work of this thesis was limited to a period of three months. This study is therefore unable to encompass the entire farming year of smallholder farmers. Questions about peoples' on-farm activities throughout the year could not be verified.

5.2.2 FINDINGS RELATED TO THE THEORETICAL FRAMEWORK

The adoption and diffusion model of Rogers (1995) focuses on the social factors in the adoption process of an innovation. Rogers describes that innovations spread because farmers talk to each other and farmers look at others before adopting a new technology. The data from observations and interviews show that farmers do not easily share information on the content of the training, which conflicts with the theory of Rogers. The adoption and diffusion theory has been useful though, to be able to observe how projects promote CA and FGW, and how processes of adoption and diffusion are shaped in practice.

Stone (2007) emphasizes on agricultural skilling; to see farming as a performance that can be influenced by both social and environmental learning. This theory has been very helpful throughout the field research and in the data analysis. Farmers need to survive, and change their behaviour and practices when necessary. For example, it was found that they had developed a strategy called 'project hopping', in which they try to enrol in different projects for the sake of input support.

The Actor Network Theory of Latour (1999) describes that social and local interaction effect networks in which farmers operate. This theory can be linked to Sigaut (1994) who describes that technology is a 'science of human activities', these activities are embedded in people's networks. Both theories have been explicitly helpful in the understanding that people are influenced by their network, and therefore no individual, autonomous decision makers. For example, it has been found that farmers are part of a strong group culture which influences their decisions related to CA or FGW adoption, or traditional values that play a role and hinder adoption, such as burning crop residues and the free range grazing system. The statement that farmers are part of heterogeneous networks has been used to analyse processes around new technologies. Project staff and Government Agricultural Extension OFfficers for example frame poor productivity of farmers as a cause of climate change. These actors construct meaning to technologies. Farmers' participation in such a network shapes their practices, and requires them to do different with their fields, tools and resources (non-human actors).

5.2.3 RECOMMENDATIONS

One of the striking outcomes of the thesis is the finding that people do not automatically spread information. Both projects and much literature assumes people will spread knowledge and skills that are gained during a training. Only a few articles were found that question this statement. It is therefore recommended that future research should zoom in on the issue of knowledge dissemination. Another option for future research concerns the on-farm activities of smallholder farmers year-round. The field work for this thesis was limited to a period of three months during the rainy season. Answers of farmers what they do the rest of the year, and whether CA and FGW are certainly difficult to fit in their activities later in the year, could not be verified.

The issue of poor productivity, soil degradation and climate change becomes more relevant every day. It is important to either research how CA and FGW can fit in the on-farm activities and networks of farmers, or to research what alternative strategies can solve the problems that smallholder farmers face. In both cases, the views of smallholder farmers themselves, and their context (the social, technical, ecological and economical) should be taken into account.

REFERENCES

Andersson, J. A., & D'Souza, S. (2014). From adoption claims to understanding farmers and contexts: A literature review of Conservation Agriculture (CA) adoption among smallholder farmers in southern Africa. *Agriculture, Ecosystems & Environment*, *187*, 116-132.

Andersson, J. A., & Giller, K. E. (2012). On heretics and God's blanket salesmen: contested claims for Conservation Agriculture and the politics of its promotion in African smallholder farming. *Contested agronomy: agricultural research in a changing world. London*, 1-22.

Baudron, F., Tittonell, P., Corbeels, M., Letourmy, P., & Giller, K. E. (2012). Comparative performance of conservation agriculture and current smallholder farming practices in semi-arid Zimbabwe. *Field crops research*, *132*, 117-128.

Bolliger, A., Magid, J., Amando, T.J.C., Skorá Neto, F., Ribeiro, M.F.S., Calegaria, A., Ralisch, R. and Neergard, A. (2006). Taking stock of the Brazilian "zero-till revolution: A review of landmark research and farmer's practice. *Advances in Agronomy*, 91:49-110.

Bulte, E. (2016). Top-economie op dorpsniveau. *Resource*. Retrieved from: https://resource.wageningenur.nl/nl/organisatie/show/Wageningse-kopstukken - Topeconomie-op-dorpsniveau-.htm

Chikowo, R., 2011. Climatic Risk Analysis in Conservation Agriculture in Varied Biophysical and Socio-economic Settings of Southern Africa. FAO Regional Emergency Office for Southern Africa (REOSA), Johannesburg.

Chirwa, E. W., Kumwenda, I., Jumbe, C., Chilonda, P., & Minde, I. (2008). Agricultural growth and poverty reduction in Malawi: Past performance and recent trends. *ReSAKSS-SA Working Paper*, *8*.Derpsch et al. (2015)

Cressman, D. (2009). A brief overview of actor-network theory: Punctualization, heterogeneous engineering & translation.

Drechsel, P., Gyiele, L., Kunze, D., Cofie, O., 2001. Population density, soil nutrient depletion, and economic growth in sub-Saharan Africa: a Malthusian nexus? Ecol. Econ. 38, 251–258.

Erenstein, O., 2002. Crop residue mulching in tropical and semi-tropical countries: an evaluation of residue availability and other technological implications. Soil Till. Res. 67, 115–133.

Erenstein, O., Sayre, K., Wall, P., Dixon, J., & Hellin, J. (2008). Adapting no-tillage agriculture to the conditions of smallholder maize and wheat farmers in the tropics and sub-tropics. *No-till farming systems*, 253-278.

FAO (2009). UN Food and Agriculture Organisation: FAOSTAT. Retrieved from: http://faostat3.fao.org/index.html#DOWNLOAD on 14-12-2015

FAO (2016). Conservation Agriculture. Retrieved from: http://www.fao.org/ag/ca/1a.html

Foundations for Farming (2015). Retrieved from: http://www.foundationsforfarming.org/index.php/about-us/our-message on 10-5-2016

Friedrich, T., Kassam, A. H., & Shaxson, F. (2009). Conservation agriculture. *Agriculture for Developing Countries.* Science and Technology Options Assessment (STOA) Project.

García-Torres, L., Benites, J., Martínez-Vilela, A., & Holgado-Cabrera, A. (2003). Conservation agriculture: environment, farmers experiences, innovations, socio-economy, policy. Kluwer Academic Publishers.

Giller, K. E., Witter, E., Corbeels, M., & Tittonell, P. (2009). Conservation agriculture and smallholder farming in Africa: the heretics' view. Field crops research, 114(1), 23-3

Gray, B. J., & Gibson, J. W. (2013). Actor–networks, farmer decisions, and identity. *Culture, Agriculture, Food and Environment*, *35*(2), 82-101.

Harrigan, J. (2003). U-turns and full circles: two decades of agricultural reform in Malawi 1981–2000. *World Development*, *31*(5), 847-863.

Haudricourt, A. G. (1964). Nature et culture dans la civilisation de l'igname: l'origine des clones et des clans. L'homme, 93-104.

IFAD (2011). International Fund for Agricultural Development. Retrieved from: http://www.ifad.org/operations/projects/regions/Pf/factsheets/malawi.pdf on 4-12-2015

Kassam, A., Friedrich, T., Shaxson, F., & Pretty, J. (2009). The spread of conservation agriculture: justification, sustainability and uptake. *International journal of agricultural sustainability*, *7*(4), 292-320.

Kirsten, J. F., & Van Zyl, J. (1998). Defining small-scale farmers in the South African context. *Agrekon*, *37*(4), 551-562.

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food policy*, *32*(1), 25-48.

Kronen, M. (1994). Water harvesting and conservation techniques for smallholder crop production systems. Soil Till. Res. 32, 71–86.

Latour, B. (1996). On actor-network theory: a few clarifications. *Soziale welt*, 369-381.

Latour, B. (1999). On recalling ANT. *The Sociological Review*, *47*(S1), 15-25.

Latour, B. (2005). Reassembling the social: An introduction to actor-network-theory (Clarendon Lectures in Management Studies).

Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems practice*, *5*(4), 379-393.

Lubwama, F. B. (1999). Socio-economic and gender issues affecting the adoption of conservation tillage practices. *P. Kaumbutho., and T. Simalenga, Conservation Tillage with Animal Traction, Resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA): Harare, Zimbabwe*.

Malawi Government. Retrieved from http://www.malawi.gov.mw/ on 16-11-2015

Manda, L.Z. & Makowa, G. (2012). Country profile Malawi. New agriculturist.

Maranz, D. (2001). African friends and money matters: Observations from Africa. Publications in Ethnography, Vol. 37

Marongwe, L. S., Kwazira, K., Jenrich, M., Thierfelder, C., Kassam, A., & Friedrich, T. (2011). An African success: the case of conservation agriculture in Zimbabwe. *International journal of agricultural sustainability*, *9*(1), 153-161.

Marra, M., Pannell, D. J., & Ghadim, A. A. (2003). The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: where are we on the learning curve?. *Agricultural systems*, *75*(2), 215-234.

Martin, C., Castella, J.C., Hoang Lan, A., Eguienta, Y., Tran Trong, H. (2004). A participatory simulation to facilitate farmers' adoption of livestock feeding systems based on conservation agriculture.

McElreath, R. (2004). Social learning and the maintenance of cultural variation: An evolutionary model and data from East Africa. *American Anthropologist* 106:308–21.

Mealer, B & Kamkwamba, W. (2009). The boy who harnessed the wind: Creating currents of electricity and hope.

Mgbako, C. & Glenn, K. (2012). Witchcraft accusations and human rights: case studies from Malawi. George Washington International Law Review 43: 389

Ngwira, A. R., Thierfelder, C. and Lambert,D. M. (2013).Conservation agriculture systems for Malawian smallholder farmers: long-term effects on crop productivity, profitability and soil quality. Renewable Agriculture and Food Systems 28(04):350–363.

Olutayo, C. A. (2013). Of white collar jobs and the deconstruction of the peasant farmer in south-west Nigeria. Lund University, Sweden,

Payne, G., & Payne, J. (2004). *Key concepts in social research*. Sage.

Rogers, E.M. (1995). *Diffusion of Innovations*, 4th edn. New York: Free Press.

Rusinamhodzi, L., Corbeels, M., van Wijk, M.T., Rufino, M.C., Nyamangara, J., Giller,K.E., 2011. A meta-analysis of long-term effects of conservation agriculture onmaize grain yield under rain-fed conditions. Agronomy for Sustainable Devel-opment 31, 657–673.

Sanchez, P. A., Shepherd, K. D., Soule, M. J., Place, F. M., Buresh, R. J., Izac, A. M. N., ... & Woomer, P. L. (1997). Soil fertility replenishment in Africa: an investment in natural resource capital. *Replenishing soil fertility in Africa*, (replenishingsoi), 1-46.

Sargeant, J. (2012). Qualitative research part II: participants, analysis, and quality assurance. *Journal of graduate medical education*, *4*(1), 1-3.

Sayinzoga, A., Bulte, E. H. and Lensink, R. (2015), Financial Literacy and Financial Behaviour: Experimental Evidence from Rural Rwanda. The Economic Journal. doi: 10.1111/ecoj.12217

Schneider, F., Steiger, D., Ledermann, T., Fry, P., & Rist, S. (2012). No - tillage farming: co - creation of innovation through network building. *Land Degradation & Development*, *23*(3), 242-255.

SOLDEV. (2015). CCAP Synod of Livingstonia Development Department. Nyungwe Conservation Farming project.

Sigaut, F. (1987). Des idées pour observer. Techniques et culture.

Sigaut, F. (1994). Les millets en Eurasie, d'une fete populaire a des questions pour les chercheurs. Industries des Cereales. ENG: "Technology, introduction to a science of technics" p.420-459

Stone, G. D. (2007). Agricultural deskilling and the spread of genetically modified cotton in Warangal. *Current Anthropology*, *48*(1), 67-103.

Stoorvogel, J. J., & Smaling, E. M. A. (1998). Research on soil fertility decline in tropical environments: integration of spatial scales. In *Soil and Water Quality at Different Scales* (pp. 151-158). Springer Netherlands.

Takane, T. (2007). Customary Land Tenure, Inheritance Rules, and Smallholder Farmers in Malawi. Discussion Paper No. 104, Institute of Developing Economies

Thierfelder, C., Bunderson, W. T., Jere, Z. D., Mutenje, M., & Ngwira, A. (2015). Development of Conservation Agriculture (CA) systems in Malawi: Lessons learned from 2005 to 2014.*Experimental Agriculture*, 1-26.

Vanlauwe, B., & Giller, K. E. (2006). Popular myths around soil fertility management in sub-Saharan Africa. *Agriculture, ecosystems & environment*,*116*(1), 34-46.

Voors, M., Turley, T., Bulte, E., Kontoleaon, A., and List, J.A. (n.d.). Chief for a day: Elite capture and management performance in a field experiment in Sierra Leone. Not published yet.

Wall, P. C. (2007). Tailoring conservation agriculture to the needs of small farmers in developing countries: an analysis of issues. Journal of crop improvement, 19(1-2), 137-155.