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DECLARATION

I, Alejandra Soto Herrera, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

ACKNOWLEDGMENT

I want to thank all the people from Ibumila, Nundu, Itulike and Lunyaniwi villages in Njombe who collaborated in this research and to Pendo Wilfred and family who more than my interpreter, was a friend and support.

I would further like to thank my supervisor Dr. Jens Bernt Aune for his guidance, comments and invaluable help throughout this work. I also would like to thank the EPINAV program for helping me with the financial support while in the field and special thanks to Dr. Ndelilio A. Urio for his support and guidance while in the field.

I also want to show my gratitude to the people from Njombe district for assisting me and giving me the possibility of doing this research and especially to the extension officer for organizing the interviews and coordinating the transportation.

I thank my family and friends for their endless support, love and patience.

To “Toto”

ABSTRACT

This paper presents an assessment of Conservation agriculture (CA) practices in Njombe, Tanzania by using SWOT method as the analyzing tool. It outlines the main Strengths, Weaknesses, Opportunities and Threats farmers face when implementing CA practices in their villages. The four villages selected were in CA introductory phase. The main objective of the study was to investigate whether or not CA practices can be implemented and how farmers could best adopt these practices. To collect the necessary data mixed methods were used. Ninety-two interviews were made with individual households in order to discover their perceptions and their attitudes towards CA. After gathering the data, they were analyzed in two sections: Section 1 includes an initial SWOT analysis of farmers' current agricultural practices. Section 2 includes a second SWOT analysis based on the CA methods practiced in these villages. Results obtained from this analysis reveal that the main strengths are the current knowledge about soil conservation and the participation in livestock and agricultural groups. The main weaknesses, which farmers need to address is the lack of storage facilities. A constraint to adoption is also the limited follow-up from extension officers and village leaders after providing training and carrying out demonstration projects. New markets and more sources of income are important opportunities for farmers. Price fluctuation and climate change are being seen as threats. Additional practices such as agroforestry and the use of bio slurry as organic fertilizer should be assessed and promoted among farmers. These practices are considered beneficial in addition to what CA practices bring. Farmers already have the necessary knowledge, to continue using current practices and adopt new methods when needed. Feedback and efficient communication is a key factor for farmers to achieve their main goals, which are improving living standards and food security.

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ACRONYMS

CA: Conservation Agriculture

SWOT: Strength, Weaknesses, Opportunities, Threats

SPSS: Statistical Package for Social Sciences

DAP: Diammonium phosphate

CAN: Calcium Ammonium Nitrate

WFP: World Food Programme

SACCOs: Savings and Credits Cooperatives

SUA: Sokoine University of Agriculture

TDBP: Tanzania Domestic Biogas Program

1 Introduction

Conservation agriculture (CA) has been introduced in many countries around the world with the main objective to improve food security, increase profits from agriculture and minimize environmental damages caused by the practice of conventional agriculture. In Africa CA, practices have been successfully implemented in countries such as Tanzania, Kenya, Zambia and Zimbabwe. All these countries have agriculture as its main source of income. In this study, an analysis of current agricultural practices will be performed in Njombe region, Tanzania. The region was chosen since currently there are ongoing projects in its introductory stage of implementing CA. Thus, the main objective is to analyze the feasibility of CA implementation and how can farmers best adopt CA practices in four villages in Njombe.

The research was carried out using quantitative and qualitative methods to collect data. Household interviews and focus groups discussion were the main instruments used to gather the necessary data for analysis. The analysis was performed using SWOT method in order to evaluate the strengths, weaknesses, opportunities and threats of current farming practices in the region. The results obtained from this research can be foundation for future implementation of CA practices in the region. In addition, it will provide with areas of improvement, which need to be addressed in order for the implementation to be successful.

1.1 Problem statement

Conservation agriculture and its principles have as its main goal to make use of natural resources in a more efficient way, contribute to food security and increase profits to improve livelihoods standards. CA practices have been implemented in several countries in Africa with successful results. In Njombe, Tanzania, some villages have already started to practice CA. In other villages, proper research needs to be done before introducing and implementing CA practices. In the villages selected for this research, CA is in its introductory phase; therefore, this study will assess the constraints and opportunities for adopting CA.

1.2 Main objective

The general objective is to analyze the current agricultural practices in four villages in Njombe district. With this analysis, this study aims to evaluate whether it is feasible to implement CA practices and to find how farmers can best adopt CA practices.

1.3 Research question

What are the main strengths, weaknesses, opportunities and threats in current agricultural practices that can influence CA implementation?

- **Sub research questions**

-What are the main strengths in current agricultural practices?

-Explore weaknesses in current agricultural practices that can be considered as constraints when implementing CA practices.

-Identify potential opportunities to make CA implementation successful.

-Find out the main threats, which villagers face in their agricultural practices.

2 Literature review

2.1 Conservation agriculture

2.1.1 Concept and principles

Conservation agriculture (CA) is an approach, which seeks to improve food security, contribute to agricultural sustainability while managing natural resources and to increase profits without affecting the environment (Friedrich et al., 2012). In addition, CA addresses the damages caused by the use of conventional methods (i.e. the use of plough) mainly soil erosion (Aune et al., 2012), to control the environmental effects caused by agriculture, and to provide a more sustainable management for cultivating crops (Baudron et al., 2009). CA is based on three main principles: minimum soil disturbance (i.e. direct sowing and no tillage), permanent organic soil cover with crop residues and cover crops, and crop rotation utilizing varied crops such as legumes and perennial crops (FAO, 2014).

2.1.2 Positive aspects from practicing CA

The practice of CA brings a variety of benefits, such as soil improvement, reduction of weeds increase in yields and reduce labor workload. Soil improvement will be the result from an undisturbed soil. Soil is usually disturbed when using plough and hoe for land preparation and weeding. This is a general practice in conventional agriculture. When practicing CA, the soil is not disturbed and it conserves its plants nutrients. A fertile soil is the key to help crops grow healthy (Jat et al., 2013). Healthy crops is also the result of utilizing crop residues and cover crops as mulch to cover the soil. Cover crop usage will protect the soil preventing its degradation (ibis).

Soil degradation has been the cause for many losses in yields causing low or no income for farmers. Soil conservation can also be done through the third principle of CA; crop rotation. Crop rotation involving legumes helps to prevent pests and diseases, and improve soil quality due to its capacity of fixing large amount of nitrogen (Giller et al., 2009). The best way of conserving crop residues is by having a mix of crop and by rotating crops every season. This practice will not only benefit the yields, but also will minimize pests and weeds infestation and will also prevent this to multiply (Liebman & Dyck, 1993).

2.1.3 Negative aspects from practicing CA

When practicing and adopting CA methods, farmers face challenges, which can be considered as constraints or negative aspects. These can influence whether or not to implement and adopt CA practices. Among the main factors are the consequences and effects of utilization of crop residues for mulching, time in the increase of yields, cost of adopting new weeding methods, labor use and the lack of follow up from previous projects.

Using crop residues for mulching, and cover the soil is one pillars for CA. However, this practice can result in the reduction of crop residues available for other uses, such as fodder and construction of livestock sheds. If crop residues are not enough to use as fodder it will affect the amount of manure and milk production (Giller et al., 2009). Therefore, there is the need to assure that crop residues are in sufficient quantities to fulfill the principle of mulching and to feed livestock. The effect of CA may also not come immediately.

According to Giller et al. (2009) to see the benefits in yields when practicing CA can take longer than expected and therefore it will affect the perception that farmers have towards CA. For farmers it is important to see results in a short term in order for them to decide to use new methods. New methods also includes weeds control. Farmers spend a lot of time in weeding since it has to be done manually. Therefore, this system will not be attractive to farmers especially for small families who depend mainly on family member to perform this activity. In order to minimize time and labor, farmers have the option to utilize herbicides. However, this can represent a cost the beginning of the implementation and it can be a limitation for farmers who cannot afford it (Wall, 2007).

Lastly, farmers currently see the lack of follow up from previous training as a negative aspect when adopting CA practices. When providing training and demonstrations of new and improved methods, the institutions involved, do not provide follow up. Meaning they do not come back to ask for feedback or see the results. Farmers claimed that is the main reason why they are less likely to adopt new methods and new technologies. Nyanga (2012) confirmed that according to his findings, this is one of the main constraints which can affect CA adoption.

2.2 Conservation Agriculture as practiced in Africa

In Africa, the concept of CA has been adopted at a very low pace. Despite the efforts from several international development agencies and national programs to promote and help farmers to adopt these practices, Africa has the lowest area under CA among other continents (Jat et al.,

2013). The leading countries in Africa with the more land under CA are South Africa, Zambia, Mozambique and Zimbabwe (ibis).

Studies in these countries show some of the main causes for low CA adoption in this continent. Among the major causes are: (1) the conflict with free grazing increases since crop residues used to cover the soil are graze by livestock; (2) currently, there is lack of support for farmers when implementing and promoting CA practices; (3) there is a lack of incentives to encourage farmers to invest in CA practices; (4) the increase in income as a result from CA adoption will not be immediate (Corbeels et al., 2014).

However, CA methods are expanding, which shows the interest of farmers to adopt this system. Some of the main reason why CA adoption is expanding in this continent are: (1) improvement in the farm economy by reducing costs in expensive machinery and also by saving time farmers will spend operating this equipment, providing farmers with the opportunity of finding other supplementary sources of income; (2) fertilizer application, weed control and different methods for sowing, reducing the amount of labor; (3) increase in yields; (4) soil quality improvement and increase in nutrients and minerals which prevent water erosion (Friedrich et al., 2012).

3 Contextual background

3.1 Study area

3.1.1 Njombe region

Njombe region is located in the Southern Highlands of southwestern Tanzania. Njombe district used to be one of the seven districts from Iringa region. In 2012, it became its own region. There are four districts conforming this region: Njombe, Wanging`ombe, Makete and Ludewa. There are 6 divisions, 96 wards, 384 villages and 35 mitaa. According to 2012 census, the total population is 702,097 people. The region neighbors Mbeya, Iringa and Ruvuma. Njombe is characterized for having roads in good condition and easy access, especially with main cities as Dar es Salam (The United Republic of Tanzania, 2013). Njombe district covers 768,075 ha of cultivated and grazing land (Akarro & Mtweve, 2011). Its spatial location makes this region suitable for tropical and temperate crops due to its weather and soil types. The temperature in the region is normally below 15°C with rainfall from 1,000 – 1,600 mm per year. Rainfall period starts in November and ends in May. There is also a dry season, which is usually after the rain, from June until September.

3.1.2 Agriculture in Njombe

Agriculture is the main source of income in Njombe, contributing to 90% of the income for living. The main crops are Irish potatoes, beans, wheat and maize. In addition, a big proportion of land is under cultivation of cash crops, tea being the main cash crop in the region. Njombe is ideal for fruit production such as pineapple and bananas. Irrigation systems are common in flower and tea farms. Livestock keeping is a common activity in this region. The main breed is indigenous Zebu. Livestock also includes pigs. Off-farm activities include forestry and beekeeping. These two are potential sectors for increasing and continuous development (The United Republic of Tanzania, 2013).

3.2 Literature review on SWOT analysis

SWOT is a strategic planning tool used in many projects. It requires a decision-making, either to improve the actual project or carry out a new one. It analyzes the strengths, weaknesses, opportunities and threats of that specific project (Hay & Castilla, 2006). The terms strengths and weaknesses refer to internal attributes. Internal attributes can be controlled and addressed by

the actors involved. Strengths are to be follow and reinforced, while the weaknesses are to be eliminate or minimize. Weaknesses need to be especially understood to decide which areas need improvement and which one are inherent to the purposes of a project. The other two terms opportunities and threats are external attributes, which are beyond the control of any actor involved. Actors involved can take advantage of the opportunities and try to avoid threats that might be constraints in order to achieve certain goals (Suh & Emtage, 2005).

4 Methodology

4.1 Methodology

4.1.1 Mixed Methods

Mixed methods were used in this study. This means that I use qualitative and quantitative research methods. Mixed methods seek to include both types of research within the same project (Bryman, 2008). In despite some authors suggest that the use of mixed methods is not feasible in every research, for my study, it was necessary and it was the best option to collect the required data. This research involves perceptions, opinions, experiences and observations, which is data that cannot be quantified by using quantitative research. At the same time, it contains percentage, specific quantities and numbers, which cannot be, analyze by using a qualitative method.

4.1.2 Study area

This study was performed in four villages Nundu, Ibumila, Itulike and Lunyanywi. These villages are located in Njombe District, Tanzania. In this region, there is currently a Conservation Agriculture Project, led by Sokoine university of Agriculture (SUA). This project seeks to introduce CA practices in this region. CA practices have been introduced already in some villages and some others are still in research. Research consist in finding out if CA is feasible, before start introducing these methods. The characteristics of the villages selected for this research are mainly that CA introduction is in its initial stage and awaiting for proper research in order for the project to continue.

4.1.3 Study population

For this research, I chose to interview households with cultivated land and households with crop-livestock farmers, meaning farmers who own livestock besides having cultivated land. This decision was made after conducting a pre-test in Ibumila village with two farmers. Their responses about time spending in certain activities and the way they distribute their working day were different. In addition, according to the key informant, there were only certain amount of farmers with livestock. Therefore, there was not enough data for this study to be representative if I included only crop-livestock farmers.

4.1.4 Sample size

For this study, I conducted 100 household interviews and one interview with the main key informant. Two focus groups were conducted in two of the villages. When planning the sample design it is necessary to be precise in order to get a sample that can represent a population (Berg & Lune, 2012). Thus, with this amount of interviews, it was possible to get a representative sample. Sample size will influence the accuracy of results (Fowler, 2014).

These household were distributed among the four villages, 25 households for each village. From these 25 households, 13 were crop producers and 12 were crop-livestock farmers. The focus groups included four farmers in one village and seven in the second village. The research was conducted during land preparation period; therefore, the majority of the farmers were working the entire day in their land, limiting their possibilities of participating in the interviews.

For the selection of farmers, I use purposive sampling. Together with the extension officer and village leader, a list of possible farmers was elaborated. These farmers were chose because they were part of certain group in the village, such as livestock keeping group. In addition, some of these farmers selected were participant in previous trainings. Trainings included, gardening, storage processes, how to plant the correct type of seeds, etc. The list did not specify if the head of households were females or males but it included if it was crop producer or crop-livestock farmer. For the focus groups, a convenience sampling was used. This was adequate type of sampling since I could only depend on farmers who were available to participate (Berg & Lune, 2012). The extension officer together with the village leader, coordinate the farmers who could assist to these interviews. A purposive sample was used for the key informants; in this case, it was only for the Livestock and Agricultural officer.

4.2 Data collection

4.2.1 Field observations

During the first week in the field, before starting collecting data, I started with some field observations. Observations in how farmers distribute their day, how they were preparing their land and what were the typical behavior of farmers. These observations gave me an impression of how farmers distribute their farming activities annually. In addition to the first week, I keep observing farmers during the entire data collection. Field observations as Kothari (2004), suggests, help to eliminate subjective biases and helps to control validity and reliability of the

data. As an example of the importance of this method was the attitudes toward an ongoing project conducted in the same villages at the time of this research.

4.2.2 Household and key informant interviews

Semi standardized interviews were conducted to the head of households, focus groups and village leaders. In order for the interview to have a sequence, I divided the questions into six categories. Each category included certain amount of questions related to a different topic (i.e. Section A “Demographic information”) (See Appendix 1). The questions were intended for both groups, crop producers and those with animal husbandry. The pre-test previously conducted provided an opportunity to take time of the interview and/or modify and rephrase questions.

Crop producer farmers interviews took 30 minutes and crop-livestock keeping farmers’ groups, took 40. Some of the questions were modified in order to save time without missing any important data. In addition, time also depended on the fact that every question needed to be translated from English to Swahili and vice versa when farmers responded.

At the beginning of every interview, it was necessary to build rapport between farmers, the interpreter and myself. According to one of the 10 commandment to conduct a good interview by Berg and Lune (2012), it is important to start an informal conversation before performing the interview and to get familiar with the environment to make respondents feel warm. Farmers in this region are very skeptical of the information they provide. Farmers might be afraid of the responses, since the questions involve participation and assistance of extension officer and village leaders. Therefore, it was essential for farmers to feel comfortable and even though interviews had to be during certain minimum time, I tried not to make famers feel in a rush.

An interview was done with the Livestock and Agricultural district officer. It took place at his office and with the presence of the interpreter. Here there was no need for any translation, since the Officer spoke English. The questions for this interview were more clarification questions and detailed processes. Other questions included what was the hierarchy at district level and what were the main tasks for each of the authorities including village leaders and extension officers. This interview lasted approximate 1 hour 30 minutes. At the end of this interview, many of the unclear responses from farmers were clarified and some others were corroborated.

4.2.3 Focus group discussion

Two focus groups discussions were performed in two villages, one at Itulike and one at Ibumila. The main objective with focus groups was to confirm previous information from the interviews and as a complement for the research. I used some of the questions from the interview made to households but with some additional comments added. The groups included both woman and men and the participants were farmers with cultivated land and livestock keepers. With the help and advice of the Livestock and Agricultural District officer, we agreed that no more than eight members would be enough to gather the required data. Both focus groups were different due to the lack of availability of farmers. In Ibumila village, only four people participate.

All of the participants belonged to farmers with cultivated land and all of them were males. Therefore, the responses among them were very similar. Contrary to the focus groups in Itulike, seven people participate and they were from both categories and both genders. In these groups, the answers varied and there were more additional information useful for this research. The time for both focus groups were 40 minutes for the first and 1 hour for the second group.

4.2.4 Secondary data

To collect secondary data, I used mainly reports and scientific papers about CA project done in the same area, Njombe, and similar regions. Thesis, reports and previous researches made about CA were also included.

4.2.5 Data analysis

After all interviews were completed, I started to review all the interviews to make sure I had the necessary information before leaving the field. All interviews were made on paper, therefore all data was entered to an Excel sheet in order to have all data in a drive. Thereafter the data was coded and entered in a specific statistical program. Focus groups and key informant interviews were transcribed into Word file. In order to start analyzing my data I proceed to enter all information from interviews in the Statistical Package for Social Sciences (SPSS) program. I decided to choose this program since it is one of the most common programs in social sciences research and I was already familiar with the tools and commands needed.

4.2.6 Validity and reliability

To make sure the interviews were tailored to the objectives of the research, a pre-test was conducted. Even though this test was made only with two farmers. After these two interviews, together with the Livestock and Agricultural District officer we made modification and re-structured some question based on the expertise of this officer. He has been in charge for many years of the Livestock District department. He is also the main key informant for the projects in Njombe and had worked together with SUA in other CA projects. According to the CA project leader, he stated that he was the most reliable and trustworthy person for my research.

4.2.7 Study limitations and ethical considerations

The number of farmers interviewed was reduced to 92 at the end of the research due to the difficulties to find sufficient number of farmers. Also the interviews had to be modify in order to save time and to make the interviews shorter but with the information needed. The lack of time was because farmers were in their most important activity of the season, which was land preparation. They needed to prepare their land in order to be ready to plant on time. The majority of farmers were interview early in the morning before they use to go to the field. Thus, I just have few hours to make interviews. The rest of interviews were conducted at any time farmers had an opportunity to meet with me. Other farmers use to tell me that they will be able to carry out the interview in their break time. The time when the research was conducted was not the most appropriate time to perform the interviews. If the period would have been during August/September, I would have had more time to perform the sufficient number of interviews and farmers would have been more willing to respond. The majority of farmers agreed to perform the interview but they use to ask about the time it would take.

Regarding the sampling method, I depended on the extension officer choices. During the day, all famers were out working on their fields. Therefore, the extension officer used the phone numbers of farmers who previously participated in previous training to contact them and make sure they would be at their house at the time of the interview. It would have been better to choose randomly so the responses would have been different. As an example, the majority of the famers knew about CA practices. In addition, they were familiar with some concepts, such as crop rotation, ridges and contours. These terms they had learned in previous training. Responses from randomly selected farmers could have been different since not all of farmers in these villages have been part of training and demonstration projects.

Gender was another factor influencing the answers of the focus groups. I could corroborate that when there was the presence of only one gender, the responses were the same, but during the focus groups with both genders, the answers varied between them. It would have been optimal to have two focus groups one with each gender. However, due to the season it would have not been possible.

Regarding ethical considerations, all farmers were previously informed before conducting the interview. This was to make sure farmers agreed voluntarily to participate. Before every interview, I introduced my interpreter and myself. The presentation included where I was coming from and whom I was working with. This gave confidence to farmers since they were already familiar with SUA and people coming from Norway to do researches. In addition, farmers were explained the purpose of the research and what their responses and contribution would be used in the future. In order to provide privacy and make farmers feel comfortable, only the interpreter and I were participating in the interview. In some villages it is common for farmers to feel intimidated if leaders or extension officer are present. They might fear about consequence of their responses.

5 Results and Discussion

This chapter will be divided in two parts; part one consists in a description of household characteristics and current agricultural practices in the four villages selected. This first part will consist of three sections. Section 1 will include a description of household's characteristics and a description of the farming systems. Section 2 will describe the farmer's current agricultural practices, different methods, technologies, and inputs they are currently using. In addition, section 3 will include a description of the current practices under CA label in Njombe.

Part 2 will provide a SWOT analysis of the current agricultural practices and a second SWOT analysis focusing on CA.

Part I

5.1 Household characteristics and farming systems

All households' characteristics are similar among the four villages selected for this research. The most important characteristics is that all farmers depend on agriculture for their subsistence. The percentage of farmers in Table 1 shows that in Nundu and Ibumila village the main source of income is crop production and in Itulike and Lunyaniwi is Livestock keeping. In addition, the main occupation in the four villages is crop production and livestock keeping. Besides agricultural activities, a small percentage of farmers have an additional source of income, such as forestry, bee keeping, handicrafts and brewery. The percentage of farmers with off-farm activities is similar in the four villages.

Livestock keeping and crop production are farmer's main sources of labor. While farmers work on their own land, every season they also have the opportunity to find jobs in other farms, producing an additional source of income. Thus, household members play an important role when working on daily agricultural activities. Mainly, family members who are capable of performing the different tasks, do these activities.

Farmers reduce their labor expenses since the majority do not need to pay additional labor, unless they require additional workers. However, usually, family members are able to carry out all tasks. Table 1 shows that the highest percentage of head of households are females. The highest percentage in the four villages are married couples. However, a small but significant percent, 28% and 10% are widows especially in Nundu and Lunyaniwi village. This can be due

to the age of households' heads. In these two villages, the highest percentage is from 41 to 55 years old. In contrast with the other two villages, Itulike and Ibumila, the head of households is from 26 to 40 years old. The average of household members is 4 to 7. The percentages are similar in the four villages and only few families, have more than eight members. The members include mother and father. These members own their land; therefore, they do not have a rent expense. Regarding the sizes of land farmers own, it varies among villages. The majority owns from 1 to 3 hectares and a small, but significant percent, owns bigger plots of more than 8 Ha. This small percentage is only in Nundu and Ibumila village, on the other two villages the percentage of bigger acres is very low. (See Table 1)

Table 1. Household general characteristics presented for each village.

	NUNDU VILLAGE		IBUMILA VILLAGE		ITULIKE VILLAGE		LUNYANIWI VILLAGE	
Gender of farmers	♦Females	68%	♦Females	60%	♦Females	58%	♦Females	58%
	♦Males	32%	♦Males	40%	♦Males	42%	♦Males	42%
Age of farmers (years old)	♦41 to 55	52%	♦26 to 40	44%	♦26 to 40	57%	♦ 41 to 55	65%
	♦26 to 40	36%	♦41 to 55	40%	♦41 to 55	43%	♦26 to 40	25%
	♦56 to 70	12%	♦56 to 70	16%			♦56 to 70	10%
Number of household members	♦4 to 7	60%	♦4 to 7	76%	♦4 to 7	90%	♦4 to 7	74%
	♦1 to 3	24%	♦1 to 3	16%	♦1 to 3	5%	♦1 to 3	22%
	♦more than 8	16%	♦more than 8	8%	♦more than 8	5%	♦more than 8	4%
Marital status	♦Married	68%	♦Married	96%	♦Married	86%	♦Married	85%
	♦Widow	28%	♦Separated	4%	♦Separated	8%	♦Widow	10%
	♦Separated	4%			♦Widow	6%	♦Separated	5%
Main occupation	♦Crop production and livestock keeping	60%	♦Crop production and livestock keeping	56%	♦Crop production and livestock keeping	91%	♦Crop production and livestock keeping	80%
	♦Crop production	40%	♦Crop production	44%	♦Crop production	9%	♦Crop production	20%
Main income generating activity	♦Crop production	44%	♦Crop production	56%	♦Livestock keeping	57%	♦Livestock keeping	38%
	♦Crop production and livestock keeping	32%	♦Crop production and livestock keeping	20%	♦Crop production	24%	♦Crop production and livestock keeping	31%
	♦Livestock (Milk production, ox hiring)	24%	♦Crop production and livestock keeping		♦Crop production and livestock keeping	19%	♦Crop production	26%
			♦Others (Off-farm activity)	20%			♦Others (Off-farm activity)	5%
Main crops	♦Maize and Irish potatoes	52%	♦Maize and Irish potatoes	92%	♦Maize and Irish potatoes	96%	♦Maize and Irish potatoes	85%
	♦Maize	48%	♦Maize	8%	♦Maize	4%	♦Maize	15%
Size of land in Hectares	♦1 to 3	52%	♦1 to 3	44%	♦1 to 3	76%	♦1 to 3	58%
	♦4 to 7	36%	♦4 to 7	40%	♦4 to 7	20%	♦4 to 7	36%
	♦more than 8	12%	♦more than 8	16%	♦more than 8	4%	♦more than 8	6%
Off-farm activities	♦None	84%	♦None	72%	♦None	72%	♦None	74%
	♦Others (Forestry, Beekeeping, own business)	16%	♦Others	28%	♦Others	28%	♦Other	26%

Farmers distribute their land in different ways. Figure 1 shows a description how farmers divide their land for their crops. This way will depend if they only work with crop production or with livestock as well. Farmers with only crop production distribute their land between Irish potatoes and maize as shown in Figure 1. They also use a small piece of land to grow cereals, vegetables and fruits, which is usually located next to the grasses, which they grow as fodder.

Few farmers utilize a small piece of land to plant small perennial trees, such as bamboo, shrubs and pines. The crop production and livestock keeping group, besides designate some of their land for crop production, they also use some of their land to keep livestock. Figure 1 shows how they also use their land when they include livestock keeping.

Figure 1. Description of a farming system and flow distribution in a village.



Figure 1 shows a distribution of how farmers utilize their fertilizer in crops and which the main purpose of all what they produce. Farmers sell their crops to the local market and they save some for own consumption. Vegetable and fruits are mainly for own consumption but a small amount of vegetables are going to the local market. The income farmers obtain is to buy inputs for the different agricultural activities and for household expenses. Livestock, especially cattle, is mainly for milk production and manure.

Livestock sheds are small sheds, usually made out of wood and covered by metal sheets or dry straw as shown in Figure 2. Farmers designed these sheds in order for them to collect manure in a more effective way. In addition, the sheds have a container, which farmers use to deposit and store the manure. Figure 2, shows how the containers look like in the villages. Most of the time these are made from cement and according to farmers, it is the best material to preserve

manure to use it later for their land as fertilizer. Farmers utilize the fertilizer mainly in crops (maize and potatoes), grasses, fruits and vegetables.

Figure 2. Cattle sheds and manure cement container.



Livestock keeping farmers also utilize a small piece of land to grow grasses for livestock. The main type of grasses they grow is Guatemala, Elephant, Rhodes and Setaria, being Guatemala grass the most common. (See Figure 3)

Figure 3. Guatemala grass in Itulike village, Njombe.



5.2 Farming practices

Along the year, farmers undertake a series of activities in order to get their final production. Part of the income farmers get for this production is to cover all households' expenses, the other part, the highest, is to purchase the inputs farmers need for each activity. Table 2 provides a

description of the inputs most farmers need. These inputs vary among farmers since not all farmers utilize the same.

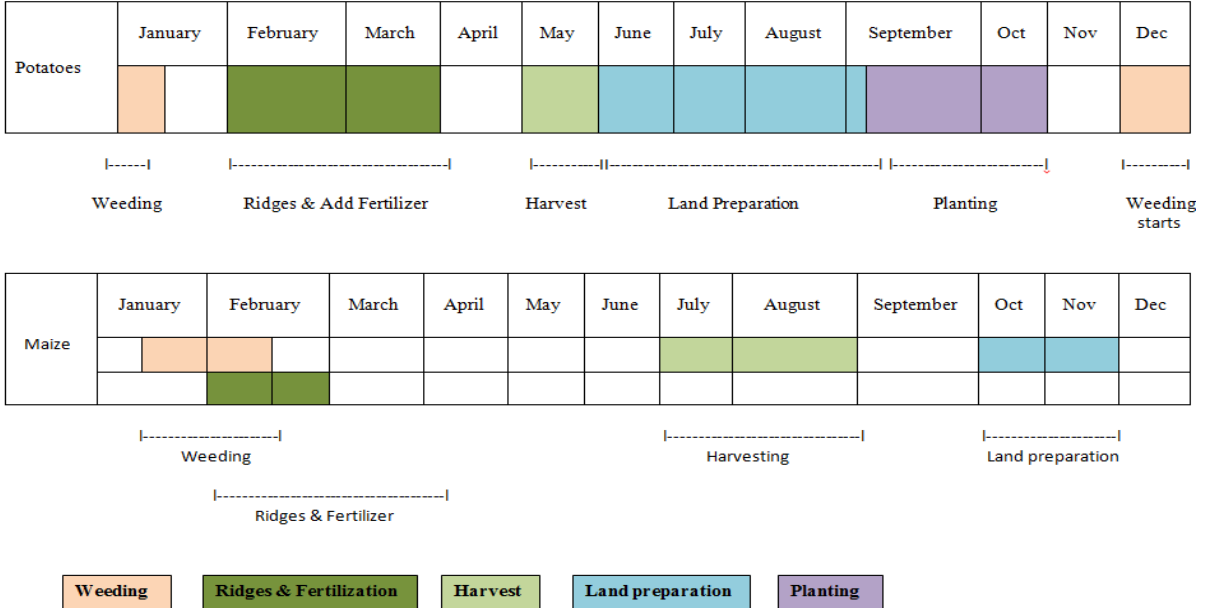
Table 2. Description of inputs required for each agricultural activity.

ACTIVITY	INPUTS
Land preparation	<ul style="list-style-type: none"> • Hire ox (if needed) • Weeding labor (if needed) • Herbicide
Planting	<ul style="list-style-type: none"> • Seeds • Fertilizer • Additional labor (if needed) • Fungicide/Insecticide
Harvesting	<ul style="list-style-type: none"> • Buying sacks • Hiring transport to carry production • Insecticide/Pesticide
Livestock keeping	<ul style="list-style-type: none"> • Veterinary services • Concentrate and salt

The main activities farmers carry out are land preparation, planting, harvesting and livestock keeping. Each of these activities involves different tasks, which in turn require different amount of time and different amount and type of inputs.

During the year farmers do these activities. The season starts in a different month for the different crops. Table 3 shows the season for Irish potatoes starts in June, and for maize, the season starts in October.

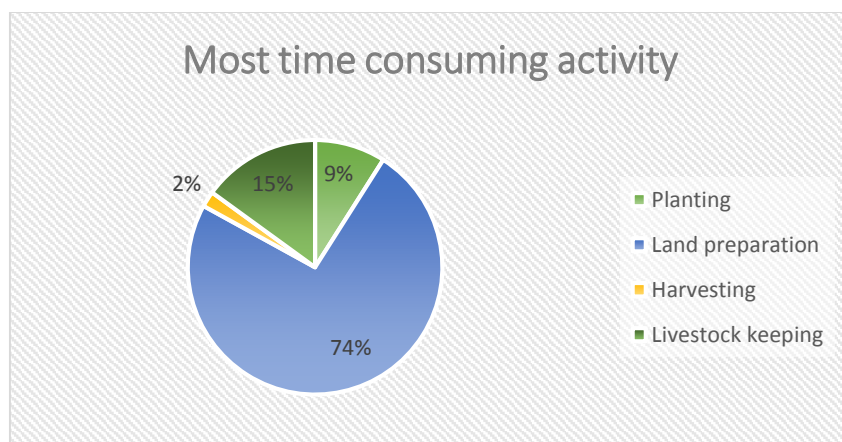
Table 3. Calendar of agricultural activities during the year.



- **Land preparation**

Land preparation is the most time consuming activity compared with planting and harvesting and it is the first activity of the season. Figure 4 provides a description in percentages of the amount of time farmers spend in each activity. The amount of time farmers will use in this activity will depend on the crop. As shown in Table 3, the period for land preparation is from June until the first week of September. For maize, is from October until the third week of November.

Figure 4. Most time consuming activities.



Two major tasks need to be perform when preparing the land. An initial weeding and soil preparation. For Irish potatoes, the initial weeding starts in June and for maize in October. During that period, farmers spend the entire working day doing exclusively this task. They usually spend from two to three weeks.

When this time is not enough, farmers hire additional labor in order to finish on time. However, among family members and friends, they are able to complete this task. Weeding is mainly done by hand or with the help of a hoe.

A very small percentage, 7%, of farmers use herbicide as an additional method. The main reason given by farmers is lack of knowledge and that they have never used these products before. Table 4 shows in percentages the main reasons for not using herbicide.

Table 4. Farmers' reasons for not using herbicide in weeding.

Reason for not using herbicide	Percent
Lack of knowledge	52%
High price	14%
Will cause damages in soil	7%
Not used to herbicides	20%
Total	93%

Even though farmers stated they spend an entire working day in weeding, they also stated that it is possible to work in other farms that might need additional workers. Therefore, weeding period is also considered as a source of additional income. According to the 7% of farmers who use herbicide, they save money from not hiring labor.

After completing the weeks of weeding, farmers start preparing the soil. By this time, farmers already selected the size of land designated for each crop. Farmers proceed to remove all crop residues and weeds to clear the land. Some farmers, burn the crop residues, while others, collect them and take it to the house to feed their livestock. Farmers, who burn the residues, do this only in long distance plots because it is easier than to carry them. In addition, it takes more time and people to carry the residues to the house.

After clearing the land, some farmers start making contours and ridges. These methods will help to reduce fertilizer leaching, to help conserve rainwater and to prevent soil erosion. The tools farmers use for this activity is mainly hoes and just few farmers use ox. Ox method is only common among farmers who can afford to hire it or the ones who have their own.

Finally, farmers applied fertilizer. According to farmers, the application of fertilizer at this time will help them to improve and increase yields. The highest percentage of farmers 79%, use both fertilizers, organic and chemical. Farmers use chemical fertilizer mainly in long distance plots. As stated by farmers, it is easier to carry compared to organic fertilizer.

The most common chemical fertilizers used are DAP, UREA and CAN. Farmers are able to find this in local market, therefore they do not have to travel long distances to get it. The price they pay is considerable in comparison of the price they will have to pay for transportation of organic manure.

They usually need to pay additional transportation and the farmers who do not have livestock, need to buy manure from other farmers. Since the majority of farmers used both fertilizers, they are able to see the differences in quantity and quality of yields.

Furthermore, manure is not the only organic fertilizer farmers utilize. Bio slurry is a new and innovative type of fertilizer. Its use may reduce the use of chemical fertilizer. The use of this fertilizer is in its introductory stage and it is part of the Tanzanian Biogas Program. Therefore, the majority of farmers does not have yet the appropriate knowledge and the availability of biogas plants are limited in the village.

After the application of fertilizer, land is ready for planting. The time to finish with this activity differs between crops. For Irish potatoes, land needs to be ready by the second or third week of September and for maize it needs to be ready by the last week of November. (See Table 3) By this time, farmers already have the inputs needed for planting season.

- **Planting**

Planting season starts at different time depending on the crops. For maize, planting starts immediately after the first rainfall, which is usually at the beginning of November. By this time, farmers need to have the necessary amount of seeds and enough people to be able to finish planting on time. For Irish potatoes, planting season is from early September to end of October.

The main input farmers require during planting season is the seeds. The majority of the farmers use improved seeds. According to farmers, even though the cost is more, it is worthy to spend more money on this type of seeds. This investment results in higher and better quality yields compared to the use of regular seeds. Farmers use improved seeds for both crops and for vegetables, fruits and grasses.

Before starting with the sowing process, farmers proceed to make contours. This is the most common procedure for the initial planting, and they use it in all villages. Secondly, they proceed to sow the exact amount of seeds using a stick to dig the hole. Thereafter they cover the seeds with soil. According to farmers, in the past, they did not know the correct amount of seeds, but after they got training from their extension officer, they know.

Depending on each crop, they will undertake a second weeding. For maize, farmers spend 1-2 weeks and for potatoes 2-3. This secondary weeding varies among villages. In some villages, farmers stated that they do not have many problems with weeds; thus, the time they spend in this activity is less. Another activity during planting season is spraying. Fungicides are only applied in Irish potatoes. The product farmers apply is Rodomil, its active ingredient is MEFENOXAM, it is usually applied 2.5Kg/Hectare, and they can buy this in the local market. After planting and doing a second weeding, farmers will be ready for harvesting.

- **Harvesting**

Harvesting is the final activity. Even though is last activity before obtaining the final production, it requires the same attention and organization as the previous activities. It is in this stage when farmers need to plan to whom and where they will sell their production, if it will be the local market or private buyers will come directly to buy their production.

In addition, farmers need to establish the amount of production they will save for own consumption and if they will be able to store any amount for next season. Inputs require for this activity includes cost of transportation, materials to collect production (such as sacks) and additional labor, if required.

The time of the year for harvesting varies between crops. For Irish potatoes the time is May and for maize from July until August. Farmers start packing in sacks their products and prepare for selling and/or storage. The products destined for selling, are transported by motorcycle or by truck. Farmers also use bike to transport their agricultural products.

Farmers, who sell their production to private buyers, have to carry their production to their shops and wait for buyers. These farmers have a better chance to make a good deal regarding the price. Private buyers come mainly from Dar es Salaam and when they do not come for any reason, farmers are not be able to sell or store their production. This creates a dependence on private buyers for some farmers.

Storage availability is not an option in every village. When the storage option is not possible, farmers will try to sell all their production in the local market. The local market is located approximately 15 to 18 km. from the villages. This distance is difficult for farmers transporting their production by bicycle. Even though the roads are in good condition, most of the time they are not able to carry all the production at once. Therefore, the opportunity of selling all their production decreases and consequently they will have to sell their products at any price regardless if it is very low.

To avoid this loss, farmers try to spend some money by paying private trucks or they take local buses to carry their production. According to farmers, sometimes it is better to pay extra for private transportation but you can guarantee that you will carry all your harvest at once and safe. Additionally to the transportation to the market, farmers face the price issue. Farmers consider price a main issue because it is unstable most of the time. However, farmers do not have an alternative but to deal with this instability since the local market is their only option to sell their products.

- **Livestock keeping**

Even though livestock keeping is another agricultural activity, it differs to others since farmers take care of livestock every day, including Saturday and Sundays and along the whole year. In these villages, not all farmers have livestock. Livestock involves additional costs and sometimes not all farmers can afford to have and take proper care of their livestock. In this region, livestock consists mainly of cattle and pigs.

The average number of cattle is from 5-7 cows. Cows' main purpose is milk production and manure. The average number of pigs is from 3-5, and their main purpose is for selling and only some farmers utilize its manure as fertilizer. Milk production is an important income for farmers, but mainly, is essential for their own consumption as part of their nutrition, especially on children. Milk production for selling has a specific market. This market is the only factory in town, CEFA, which buys the milk from farmers. There are two ways of taking the milk production to the factory. Either farmers can bring the milk directly to the factory or they take it to the collection point. Thereafter, people from the dairy come in trucks to pick the milk. Figure 5 shows the collection point outside a village and the containers farmers use to transport the milk.

Figure 5. Milk collection point outside the villages.



If farmers are not in time, for any reason, they will lose their opportunity to sell their milk, unless they take it directly to the factory. Taking the milk directly to the factory will imply additional transportation costs and additional time to transport the milk by bicycle. Transporting by bicycle is a hard task for farmers with high milk production.

The average of milk obtained every day is between 12 – 15 liters per cow. This production will depend in the age of the cows producing milk, time in lactation period, the quality of fodder and the breeds. The dominant breed is indigenous, which according to farmers, is one of the best breeds and they have had good results. Farmers feed their cattle 2-3 times per day. Feeding time is important since it directly affects the milk production between 5:30 – 6:00 in the morning. Women are responsible for milking and they are also in charge of taking the daily production to either the collection point, or directly to the factory. When women does not have enough time to do feed cattle at the right time, they teach other household members like daughters or sons to do this instead. Women in the villages are usually busy taking children to school, cooking or doing other activity.

Farmers have as an advantage that plenty of good grasses grow in this area. The main type, as mention before is Guatemala grass. This grass has the characteristic that it grows fast and is of good quality. Nowadays farmers are also utilizing bio slurry as fertilizer for this and other type of grasses, which according to them; it has increase the quality and quantity of grasses. Therefore, they are able to dry and store enough fodder for dry season when the availability of grasses is limited and/or the quality is poor. Figure 6, shows how they store and pack the dry grasses. Another advantage of using fertilizer in grasses is that they can sell grasses to other farmers. This represents and additional source of income.

Figure 6. Stored dry grasses around households.



5.3 Conservation Agriculture in Njombe

In Njombe, the concept of Conservation Agriculture is not a common term among farmers. What is common is the term soil conservation. Soil conservation for farmers is more than taking care of their land. It is also a way of leaving, since for the majority, agriculture is their only source of income. Therefore, farmers make daily efforts to improve and learn different ways of having a productive land. Throughout seminars, demonstration programs and projects, farmers have developed several methods, which are within CA principles and they have been implementing other practices, which in this specific district are considered as an innovation.

To prepare their land, farmers have learned to use different techniques years ago. According to farmers' testimonies, initially they used to prepare their land and remove weeds by using oxen. Oxen was not available for every farmer, since only few had livestock. Therefore, it was not available for all at the beginning of the season. The rest of farmers without oxen used only hoe tillage. Following the reduce tillage principle, after getting training, farmers started to use hand hoe and the ripping to minimize soil disturbance. After clearing the land from crop residues, farmers proceed to measure their plot. Currently farmers have not receive training to manage crop residues. Alternatively, they proceed to remove them for livestock. Other, they burn them. Thereafter, farmers proceed to measure their plots. Figure 7 (a) shows how farmers using a rope and a stick. After measuring the plot, they proceed to make rows, by measuring these with rope and a stick (Figure 7 (b)). Lastly, farmers start to rip only the measured rows with a hoe to open the furrows, this will leave the soil in between the rows undisturbed, see Figure 7 (c). Farmers currently use these techniques instead of using plough.

Figure 3. Tillage process in Itulike village.



Land preparation also include weeding. Weeding is the hardest work demanding activity for farmers. According to them, they used to remove weeds manually and with the help of a hoe. This practice was work demanding and sometimes labor was not enough. Consequently, they were late for planting. Late weeding have serious effects on productivity. To reduce the workload, some farmers started using herbicides. However, there has not been proper training on the use of herbicides.

Farmers' testimonies confirmed the lack of knowledge of these products. Furthermore, even though farmers have continued to weed manually and using a hoe, the workload has minimize since the amount of weeds is less. They attributed this to a series of practices, they have learned with time.

The major methods practiced under the CA label in Njombe include improve tillage methods, the use of improved seeds, build water catchment methods (contours and ridges) and crop rotation. Rotation is with legumes and shrubs. The use of contours and ridges is also practiced

and they contribute to water harvesting. Additional practices have been implemented in this region. These practices include agroforestry, the use of manure, bio slurry and compost. The utilization of manure has increase after experiencing the positive effect it has on crops productivity. Crop productivity has also been improved by the use of bio slurry. Bio slurry is an innovative farming practice, which is expected to be adopted by the majority of famers in this region. Institutions such as TBDP, has introduced the use of bio gas plants and therefore the use of bio slurry. Bio slurry and manure are applied directly to crops as fertilizer and as a method to reduce weeds. Figure 8 (a) and (b) shows some of the vegetables that has grown using bio slurry as fertilizer.

Figure 8. (a) and (b) Vegetables production with the use of bio slurry as fertilizer.



(a)Vegetable production in Ibumila village with use of bio slurry as fertilizer.



(b)Vegetable production in Ibumila village with the use of bio slurry as fertilizer.

Farmers also started to practice agroforestry after getting training and they have seen the benefits that this practice has brought to crop productivity and soil quality. In Njombe, they currently plant banana trees and other perennial trees. According to famers, this not only prevents soil erosion, but these types of trees retain water. They also plant grasses in steep slopes to prevent soil erosion and use grasses as fodder for livestock. Currently, grass production have been improving after the use of bio slurry. All these practices have been consistent. However, farmers have faced many challenges due to lack of communication between them and their extension officers.

Part II

5.4 SWOT analysis from current agricultural activities

5.4.1 Strengths

The following section will describe and list the main strengths found in current agricultural activities. This will provide an overview of the positive and outstanding factors, which are contributing to a more efficient use of resources and better outcomes for farmers.

- **Soil conservation knowledge**

Currently, farmers have knowledge about soil conservation. “Soil conservation is the key of the future agriculture”, these are words from farmers when asked what they know or think about soil conservation. Farmers not only know some of the consequences of a bad soil management but also the benefits of conserving it. This knowledge favors farmers and contribute positively to their current practices.

Farmers have implemented techniques and methods, such as contours and ridges. These methods prevent rainfall to wash away fertilizer and seeds. In addition, farmers stated that these methods work also as water catchments, which is important during dry season.

Farmers directly associate soil erosion with loss of nutrients and minerals, which consequently affect the final yields of the current season and affects next year’s production. Farmers have had big losses of crops and production in previous years when they did not use contours and ridges. Consequently, farmers stated that the following season was very difficult to work on the soil and the amount of weeds were elevated. In addition, farmers plant trees and grasses in steep slopes also to prevent soil erosion. Other studies show that these practices have been successful in soil conservation purposes (Biamah et al., 2000) and soil management through agroforestry which farmers are already practicing by planting fruit trees like bananas in order to retain water and to provide additional nutrients and minerals to near crops.

They have also implemented other techniques that they know can help to conserve the soil such as crop rotation, fallowing and less use of chemical fertilizer. The positive and negative results due to the good or bad soil management has been an experience for farmers.

Farmers already have initial knowledge about CA principles. This can be consider as one of the main key element when introducing other CA practices. Wall (2007), suggests that the success of CA depends more on what farmers know than on the inputs they use. Therefore, in these villages farmers have an advantage of knowing already some of the CA concepts. The implementation and adoption of new methods and practices will be more feasible.

- **Crop rotation practices**

According to farmers’ testimonies, the use of crop rotation technique has brought many benefits to crop production such as better quality and higher amount. They state that previously they did not use this technique, but they got some training from their Agricultural officer. As part of the training, farmers where taught about benefits of crop rotation and which type of trees to plant.

They stated they taught them to plant “water friendly” trees such as banana trees and to plant grasses. Farmers are aware that during dry season these fruits trees retain water, which is beneficial for other crops.

After this training, they have also noticed that amount of weeds have decreased and they learned that soil could recover from previous seasons and get more nutrients. As part of this practice farmers can also start to use legumes, which not only provides an additional source of income, but also it is beneficial as part of their healthy diet (Nyanga, 2012).

- **Education**

In these villages, farmers give a big importance to the education of their family members. A proof of this is that they use a big part of their income to pay school fees on time. In addition, the head of household, whether is the mother or father, consider education of their children essential to the improvement of agricultural practices.

Currently, they get a lot of information about agricultural practices, techniques and good husbandry practices at schools. The majority of the household members have been in school at least until primary school and the majority of the young family members try to continue their education at institutions like “Uyole Agricultural Research Institute” (ARI-Uyole). This institution is located in Mbeya district, which is 2 1/2 hours away from Njombe district. This is the most accessible option for young family members to improve their knowledge in agriculture.

Furthermore, after attending this agricultural institute, young family members are ready to share and spread their knowledge among family, neighbors and friends among their village. Villagers usually depend on others testimonies and others experiences before applying any new method, new technology or new products, which at the same time can provide positive effects in their crops and livestock. This type of sharing information is the primary source of getting new concepts and new knowledge (Wall, 2007). Therefore, the more family member who have the opportunity get education and learn new things, the better will be for the community and other farmers who does not have this access to education.

- **Age of farmers**

Age contribute positively in current practices. Table 1 shows that the biggest percentage of farmers are younger than 55 years old. Nyanga (2012) suggesting that older farmers are more used to conventional agriculture. Therefore, it is less likely that they want to adopt or change

methods and practices they have been doing for a long time. In these villages, only few farmers older than 55 years were interviewed and none of them was currently practicing conventional agriculture.

- **Organic fertilizer use**

The use of fertilizer has been a common method in these villages. In the past, farmers used to apply only chemical fertilizer. This was because only few farmers own livestock and they did not know about the different benefits and/or the proper way to apply manure.

Nowadays they use both, chemical and organic, and after the successful results from using organic fertilizer, they stated they would like to shift to use only organic fertilizer. Organic fertilizer provides better yields and better quality of crops, farmers stated. They have also experienced a big difference when preparing the soil for next season. The soil becomes more workable and the amount of weed is low every season. According to farmers, when using chemical fertilizer, the nutrients and minerals from the soil are less. Therefore, this can be one of the causes for low yields. However, the use of chemical fertilizer is still essential for long distance plots. In addition, since the demand of organic fertilizer is increasing, manure is sometimes not enough to cover all the cultivating plots, therefore they have to complement with chemical fertilizer.

Farmers are aware of the benefits of manure and consequences of chemical fertilizer use. They have been looking for alternatives to reduce the amount of chemical fertilizer and to find solutions for transportation and for availability of manure. With these efforts, they will be able to improve food security through the improvement of crop production.

- **Infrastructure**

Infrastructure plays an important role in the benefits and advantages these villages have. Even though inside the village the roads are dirt roads, the access for every type of transportation is possible. Farmers are able to carry their products, food and any other inputs by any means (i.e. Small car, bicycle, motorcycle and bus).

This provides an easy access to town center and mainly the local market. The roads connecting to and from Njombe district are in good condition, which also facilitates the transportation of their products to important markets such as Dar es Salaam market. This also increases the possibilities of increasing the amount of private buyers and market opportunities so farmers can sell all their products.

- **Internal organization**

Each village have their own Agricultural and livestock extension officer. According to the Agriculture and Livestock District Council representative, one of his main targets is to make sure every village have an extension officer. Therefore, the villages are have already this asset and it is with these extension officers that farmers can get organized in groups. According to farmers, they have heard that in other villages, that there are small groups who are in charge of going to meetings and focus groups with livestock and agricultural officers. This is why they are conforming internal groups for their own benefit. In these meetings, they get updates about new products, about new seeds, coming seminars and other new small businesses opportunities. These groups also involves village leaders who are the contact between farmers and group leaders, so the information can get to farmers in an efficient way.

Farmers see internal organization as one of the main solutions for important issues, such as price fluctuation. They stated that if all agree and they are organized to sell their product at one price, buyers will not have other option but to buy the products at an establish price, not at their price, which usually very low. Belonging to agricultural and livestock groups as well as participating in trainings, expands the possibility of a better adoption of CA (Nyanga, 2012).

- **Eagerness and open to new ideas**

At the end of every interviewed, I asked farmers about their perceptions and thoughts about innovative methods and adopting new skills as well as their willingness to participate in new programs. All farmers interviewed agreed that more seminars and demonstration programs will help them too improve and to learn new practices that will improve their incomes. This positive attitude is essential when either adopting or improving current practices.

As a good example, while doing my research, there was a demonstration program about bio slurry. The leader of the program asked participants to do certain tasks required for this program. I was able to witness how farmers started the exact day they had to start with this trial and with a lot of expectation and enthusiasm. Farmers put the same effort as if they were working on their land. They were positive about the results, therefore this eagerness is always required when implanting and adopting new methods, in not only current agricultural practices, but also when starting something new, as the bio slurry use.

Other new activities farmers are willing to develop is the opportunity for new businesses. Small business such as the increase of the plots destined for vegetables in order to get more income

in local and other markets. While using bio slurry, TDBP show how the amount and quality of vegetables can increase. This give a potential monetary value when trying to expand to other markets. They showed the same with grasses. Grasses have increased in amount and quality. Currently, some farmers are utilizing grasses as cash crops, since they learned to use bio slurry. It is not only the use of bio slurry, which provides good results, but the attitude of farmers toward taking the chance to try new methods.

5.4.2 Weaknesses

The following weakness are factors, which can be, consider as constraints and that affecting current agricultural practices. Weaknesses are also causing a negative impact on farmers and their products. These factors need to be address and be controlled by farmers and people involved.

- **Crop residues management**

Crop residues management is an activity, which requires improvement and additional knowledge. Knowledge about other uses besides using them for livestock feeding is lacking. Farmers in these villages mainly collect crop residues for livestock feeding purposes and the residues from long distance plots are burned.

The majority of farmers know that burning crop residues have consequences to the soil. However, they use this method because it is easier than to carry the crop residues to the household. To carry them they need additional transportation, which implies additional workload. Which at the same time implies the use of valuable time during the day. Figure 9a shows how farmers pick the crop residues and place them in sacks. Figure 9b show the residues after burning practice.

Furthermore, farmers have not experienced the effects and benefits of using crop residues to cover the soil. Therefore, they might be skeptical before starting with this practice. Few farmers commented that agricultural officers together with Caritas, provided with some demonstrations about use of crop residues. However, the project was never completed. Therefore, farmers did not have the opportunity of put in practice what they learned and they could not see any benefits for it. As mentioned previously, farmers in these villages depend a lot in others experiences. So far, in these villages, no one is utilizing crop residues to cover the soil. Farmers prefer others to try first and prove that it worked, before they decide to try themselves.

Figure 9. Collection of crop residues in near plots and burned residues in long distance plots.



a.

b.

- **Cost and availability of inputs**

Every agricultural activity requires different amount of inputs. Inputs are usually available in the local market or sometimes in local stores located in the village (i.e. manure, additional fodder). To purchase some of these inputs, farmers currently are entitle to get a “voucher” of 90,000.00TZS (52.00USD).

Farmers can exchange this when they go to buy inputs, such as seeds, chemical fertilizer, fungicides and herbicide. As stated by farmers, this voucher is not beneficial for them since the inputs are not available when the season starts. Therefore, if they do not have the inputs on time, they might delay their agricultural activities, (i.e. planting). Delayed in planting will directly affect yields. In other regions, the causes for delayed planting are different. In Zambia, the delay is due to lack of oxen availability (Aune et al., 2012).

Farmers in Njombe depend strictly on the availability of inputs in order to plant on time. Therefore, this dependency increases the importance of having inputs available. When inputs are not available, farmers missed the chance to redeem their voucher. In addition, they need to use more time to look somewhere else for their inputs. Some farmers stated that sometime they have to travel to other town, such as Mbeya, to buy get their inputs. This not only represents more valuable time, but also it can negatively affect their final yields. Unavailability of inputs also affect the consequent practices such as harvesting on time, which as a final result farmers

are not able to sell their production. Therefore, this implies only a loss instead of getting any profit from their crops.

Crops inputs are not the only inputs farmers need to spend money on. Livestock keepers also need inputs for cattle. Farmers stated that vaccination of livestock, and veterinary services are very expensive. This implies that when they are not able to buy products for their livestock, milk production and the amount of manure decreases. Milk production does not only represent an additional income for farmers, but it is essential for the children's daily diet. In addition, when manure production is low they will have to buy more mineral fertilizer.

- **Lack of external help and monitoring (District level)**

As an effort to reduce inputs availability issues and other livestock keeping concerns, livestock keeping groups together with livestock agricultural officers have been introducing different programs (i.e. annual vaccination program). This program seeks to help farmers with the vaccination expenses and they have been implementing veterinary supervision and monitoring to help prevent diseases.

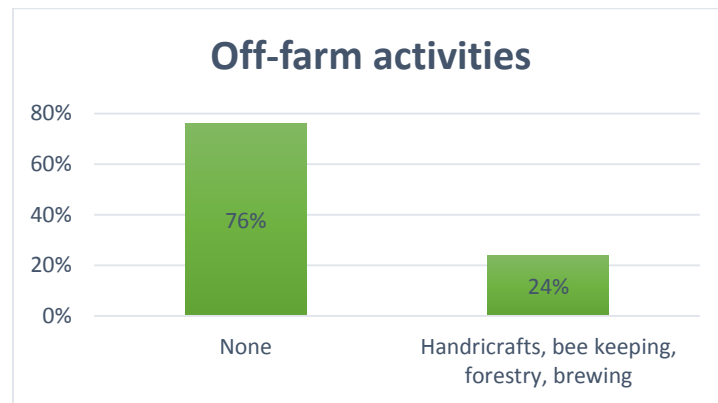
The main constraint with this and other programs are the lack of transportation available, the monitoring, supervision and follow up with these programs. According to the Agriculture and Livestock District Council representative, usually there is not enough trucks and/or cars to be able to go and visit the villages to provide effective supervision and monitoring. Besides, they currently have shortage of staff. Therefore, there is not enough people to take care of this supervision. Livestock keepers stated that they could not wait for staff (i.e. livestock officer and/or veterinary) to get to the village, because sometimes they never come. Therefore, they are putting in risk their livestock to get diseases due to lack of supervision and proper treatment. Adequate treatment as well as advices about livestock sheds are important to prevent disease.

To improve livestock practices farmers ask for more seminars and demonstration about good husbandry practices. Farmers stated that usually when there are seminars, not all livestock keepers are invited or included, only few of them. Therefore, they do not get new information and farmers who usually go; sometimes they do not share what they learned. Farmers attribute this to the lack of organization. This could be improve if there were more monitoring from Livestock and Agricultural officers.

- **Lack of alternative sources of income**

Farmers' main source of income is agriculture. Besides, only a small percentage have an additional income such as bee keeping, forestry, selling eggs, vegetables and managing their own small business. Other small businesses are mainly handicrafts, bee keeping, forestry and brewing. Figure 10 shows the high percentage, 76%, of farmers who only depend on crop production and livestock keeping for their subsistence.

Figure 10. Off-farm activities farmers practice.



This dependency almost only in agriculture can affect farmers because of various factors. Firstly, if they cannot hire enough labor to work, plant and/or harvest, they will not be able to get any income from their crops. Secondly, they depend on rainfall in order to obtain their products. In the future if rainfall decreases or any external event such as drought or extreme rainfall occurs, they will not be able to harvest. Lastly, farmers depend on the market to sell their products; if the price decreases radically, they will not be able to cover the production expenses. Furthermore, they will have debts and loss of money.

- **Lack of storage facilities**

Currently, only one of the four villages has a storage option, (Ibumila). The village leader is in charge of managing and supervising the storage place. Usually farmers need to pay a certain fee to store their production. This production will be saved either for own consumption if needed or for selling when better prices can be achieved. The surplus is what farmers usually store. However, according to farmers, nowadays storage is one of the main challenges they are facing to increase their production. Some farmers stated that even though their crops have increased they have to sell them at low prices in order to avoid any loss. In addition, farmers know that they could get a better price in low season if a storage facility exists in their village.

This lack of assistance with storage facilities has a negative impact when trying to encourage farmers to adopt methods, which will help them to increase their production.

5.4.3 Opportunities

Opportunities are external factors that are beneficial for farmers and their sector. This can contribute to the improvement and success of current practices.

- **External training**

External help from different institutions, mainly SUA (Sokoine University of Agriculture) is one of the most important opportunities for farmers in Njombe. SUA, in collaboration with other organizations such as TDBP (Tanzanian Domestic Biogas Program), provide practical demonstrations to farmers. These demonstrations show how to use biogas products, such as bio slurry, the benefits and the results. They also provide constant assessment and they work directly in selected farmers' land; therefore, farmers can really see the results. Afterwards they can choose to use these products or not. According to observations made during bio slurry demonstration, the majority of farmers decide to use this product as fertilizer and insecticide. Farmers show their excitement about these projects and welcomed institutions that can go to their village and teach them new agricultural methods for their benefit and the environment.

Other institutions collaborating in demonstrating and introducing better agricultural practices are Heifer International, WFP and CARITAS. These institutions organize seminars, demonstrations and provide assessment in new technologies and methods in order for farmers to improve their current agricultural practices. These groups can also teach them crop residues management and storage techniques for their crops. These and other training will cause a positive impact in CA adoption methods. According to, farmers who have been part in trainings before, are more likely to adopt new practices and methods. Since farmers had participate with these institutions, the opportunity to expand and introduce new practices are feasible.

- **External economic support “Inputs voucher”**

In order to support farmers and help them with some of the input expenses, the government has assigned a “voucher” to cover some of these. However, most of the time this voucher does not help farmers because inputs are not available when they need them. The demand of inputs is high when the season starts.

Extensions officer have the opportunity to make sure the inputs needed are available so they can successfully make use of this voucher. Thus, farmers can have access to what they need for a successful planting and harvesting. Especially to perform these activities on time. Also farmers will save time looking for inputs in other places. Even though this “voucher” does not cover all the inputs for every season, farmers stated that it is a small but significant support and they can save some money. Wall (2007) coincides with the above by stating that in order for CA to be successful the accessibility and affordability of inputs for farmers need to be addressed.

- **Market availability**

Market can be seen as a great opportunity to sell all farmers production. Even though price varies and sometimes does not cover all the expenses, farmers can guarantee to sell all their products. Their products can be collected from private buyers who come from long distances (i.e. Dar es Salaam) and take the entire production. The rest of farmers are able to go to the local market and sell their production.

As with crop market, the same is for milk production. CEFA is in charge of taking the milk produced by all farmers. Farmers are able to take the milk directly to the factory, or they have the facility of taking it to the collection points. When farmers are not able to sell their milk, is not because of lack of market, but for other reasons. These reasons can be, they did not bring the milk of the day on time, the milk was contaminated or because the production was not high enough, so they decide to keep it for own consumption.

- **Storage availability**

When production is high and farmers have surplus, they store certain amount to sell it when the availability of certain product is not available. Currently there is only one village, from the four in the research, which counts with a storage place. This place has the capacity to store the amount of production farmers need for storage, usually their surplus. Even though farmers have to pay an additional fee of TZS5,000.00 (3.00USD), when time to sell their production comes, they see the profit after selling what they stored at higher price. This is a good opportunity to encourage people, not only to learn the benefits of storing some of their production, but also to encourage them to increase their production. With storage option, farmers are able to make more profit since in low season the price increases (Aune et al., 2012).

- **Savings and credit co-operative organizations**

Currently saving and credit co-operatives are an important asset for farmers. In these villages SACCOs provides farmers with credit to buy their inputs and they provide the savings service. This is a good opportunity for farmers to save their profit and to have it available for next season. In addition, farmers stated that when the time to pay school fees comes, sometimes they have to make use of their savings, since they do not have enough money from their harvest yet.

SACCOs also provide facilities of payments so farmers can loan money to buy their inputs on time and a certain amount every month. This loan can be used next season when the time to plan and buy the required inputs arrive. Having access to credit, facilitate any agricultural practices for farmers.

5.4.4 Threats

- **Climate change**

Farmers in this region stated that one of the consequences due to climate change is that they do not know when the first rainfall will come. In the past, they knew at least the week for the first rainfall so they use to be ready with the preparation of land. In other similar regions, such as Zambia, farmers experience same weather changes. Changes with not only late rainfall but also, the rainy season stopped before expected (Nyanga et al., 2011). Consequently, farmers in Njombe do not know when it is going to rain and if it will actually be enough rain to have a good harvest. Livestock is also affected, since in rainy season, livestock is more prone to suffer disease.

Nyanga et al. (2011), report that in Zambia threats to livestock diseases is one of the three causes in agriculture due to climate change. Currently, farmers from all the villages are experiencing and increase in livestock diseases such as mastitis and East Coast fever. Yet, farmers do not attribute this to climate change, but to lack of adequate treatment and prevention methods. Threats to the security and health of farmers is other consequence of variation in climate. As an example, farmers stated that when rainfall is very strong, the only way to transport products and to get to local market is by truck. Normal cars, bicycles and motorcycles are very dangerous to use. Some farmers have suffered accidents while trying to carry their milk, for example. They do not only suffer personal injuries, but also they lose their production.

- **Price fluctuation**

As mentioned before, market is consider an important opportunity for farmers to sell their production. However, price is a threat for farmers. While there is a market to sell products, sometimes the price is low that farmers are forced to sell their production even though the price will not cover their production costs. For the majority of the farmers, selling their products does not represent any profit. According to Livestock and Agricultural officer, buyers can change their price at their convenience. The lack of intervention from the Agricultural department and the lack or organization among farmers is considered as the main cause for this instability. The same price instability applies also for milk production. In addition, there is only one option for farmers to sell their milk, CEFA. Therefore, they do not have any other option, other than accept the price established for this factory.

Figure 11. SWOT Analysis matrix of current agricultural practices

	Positive	Negative
Internal	<p>Strengths</p> <ul style="list-style-type: none"> *Soil conservation practices *Crop rotation practices *Education *Age of farmers *Organic fertilizer use *Infrastructure *Internal organization *Eagerness and willingness 	<p>Weaknesses</p> <ul style="list-style-type: none"> *Crop residues management *High costs and low availability of inputs. *Lack of external help and monitoring (District level) *Lack of alternatives as sources of income besides livestock and crop production. *Lack of storage facilities
External	<p>Opportunities</p> <ul style="list-style-type: none"> *Availability of external training *Market existence *External economic support “inputs voucher” system. *Storage availability *Co-operative organizations. 	<p>Threats</p> <ul style="list-style-type: none"> *Climate change *Price fluctuation

5.5 SWOT Analysis on Conservation Agriculture

5.5.1 Strengths

- **Soil quality improvement**

Soil quality in these villages have improved since they started with Conservation Agricultural practices. Farmers are able to compare how the soil has been affected due to the bad management and bad practices. Major problems according to farmers are lack of nutrients, low yields and bad quality of crops. Since they started using ridges, contours and utilizing manure and bio slurry, they can see the difference and benefit from this. They also have experienced the positive impact or the ridges as water catchments. A study done in Zimbabwe by Biamah et al. (2000), also suggest ridges as a practice for water conservation. In addition to better and higher yields, farmers have noticed that land preparation is less hard which helps to save effort and time.

- **Increase in yields**

The increase in yields is one of the best results from using organic fertilizer and the use of soil management techniques such as contours, ridges, and crop rotation. The shift to organic fertilizer from chemical fertilizer have almost doubled the production to some farmers. The amount produced for 1 acre is about 10 sacks of maize, but when they use manure and/or bio slurry, they produce from 15 to 20 bags per acre. In addition, grass, vegetables and milk production has also increased. Currently, there is not enough farmers utilizing bio slurry. This is because in these villages, the demonstration project was still in its introductory phase and the amount of households with bio gas plants is currently limited. However, farmers stated that they were looking forward to start using this after experiencing the results in other villages. In addition, while having some conversation from TDBP, they stated that the implementation in other areas as Kenya and other villages in Njombe, has been successful and they were positive to get the same results in these villages.

- **Increase in quality of crops**

Quality of crops has increase since farmers started to use manure and practice CA in soil management. According to farmers, since they started to use bio slurry, the quality of grasses have improved positively. Because of this, there are farmers who are using grasses as cash crops. These farmers state that sometimes they cannot supply all farmers' requests for grasses.

Therefore, he stated that he is planning to invest in land only to grow grasses as his main source of income. Grass production has a promising future when farmer increase their amount of livestock in the village. The increase of livestock will require an increase of grasses production to be enough to use it as fodder and for mulching. Giller et al. (2009) suggests that the lack of fodder is seen as a constraint to fulfill the soil cover principle. This is where the increase of grasses production takes its importance. Besides grasses, the demand for vegetables due to the good quality is increasing. With good quality of crops, farmers can sell products at a higher price and create new sources of income.

- **Increase in income for farmers**

Quality and quantity of production positively influence farmers. They can increase the price and therefore meet their needs. Even though, some farmers are not able to cover their input expenses, others not only have increased their income, but also they have found new ways of income. As previously stated they are starting to sell vegetables, grasses and grasses seeds, which in return provides additional income. Increase of income also provides farmers to invest in livestock and new plots.

- **Weeds reduction**

Weeds have been a main issue for farmers. Farmers not only need additional labor or to buy herbicide to get rid of them, but weeds also affect their yields. As a solution, farmers have seen positive results in weeds after using bio slurry. The amount has decrease very noticeable and therefore farmers reduce their amount of labor to do this task. In addition, the fewer farmers who use herbicide, so not have to spend money in this input, since it is no longer necessary in some plots. The amount and type of weeds vary among villages. However, it is common the positive effect in weeds reduction.

- **Education and livelihood improvement opportunities**

Education is a key element for the success of yields with consequently brings livelihood improvements. In these villages, there is more opportunity for family member to get education instead of staying working on their land. According to The United Republic of Tanzania (2013) Njombe region have private and Governmental primary, secondary and high schools. In

addition, there are three universities college branches, Iringa University, St. Joseph and Open University (ibis). There are plans to construct new schools and colleges. Therefore, the possibilities of education are increasing for farmers in this region. Parents give a big importance to education because it is the way to succeed and find good jobs, which will help to improve their livelihoods. Farmers are already improving their livelihoods because of higher income. They are able to have better houses and they are able to improve livestock sheds. They have noticed that having an adequate and clean shed, prevents livestock from getting diseases.

5.5.2 Weaknesses

- **Lack of internal supervision (Livestock and Agricultural extension officer)**

Livestock and Agricultural officer supervision is important to make sure villagers are getting the proper and adequate assistance from extension officer and village leaders. Farmers stated they spend long time without anyone visiting and supervising them. Therefore, they do not have assistance and someone to answer their concerns and issues. When interviewing Livestock and Agricultural officer, he stated that it is very difficult to get to every livestock-keeping farmers. This is because they do not have enough and proper transportation and they do not have enough budget to cover expenses such as fuel. Therefore, they try to organize livestock keeping groups and they assign an extension officer to coordinate this. Unfortunately one extension officer is not enough to reach every farmer.

- **Lack of training from Livestock and Agricultural extension officers**

According to Livestock District officer, as part of the tasks of the extension officer is to provide constant training and reinforce all agricultural and livestock keeping practices. In addition, extension officers play an important role, being the direct contact with farmers. Farmers stated that they seldom receive training and when they form groups, they only select some livestock-keeping farmers. Unfortunately they always choose the same people and these people do not share the knowledge. Consequently, this creates a negative perception of the extension officer causing miscommunication and frustration, which directly affects livestock and crop production.

Negative attitudes and lack of interest are also common among farmers who experienced lack of communication from extension officers. Biamah et al. (2000) report, shows that farmers can lose interest in participating in new project due to the failure and lack of follow up from previous

projects. This becomes a big challenge from extension officer in order to build confidence and trust with farmers.

- **Lack of agronomic knowledge from extension officers**

In order for farmers to have assistance from the Livestock office, they seldom send an extension officer to supervise and monitor livestock keeping farmers. According to livestock keeping farmers, sometimes the extension officers do not have the knowledge about crop needs. Farmers expect them to help them with this information besides livestock keeping needs because they do not have an agricultural officer. Unfortunately most of the time they only respond to livestock issues. Therefore, they need to get knowledge from farmers from other villages.

Livestock and Agricultural District officer stated that there was supposed to be two-extension officer one for livestock keeping and another one for agricultural practices. Nowadays, they only have one extension officer, who is in charge of both things, but his experience is mainly with livestock keeping. However, the extension officer stated it is hard to cover and respond to every farmer with concerns in the village. He stated they will need more personnel and more support from District office.

- **Time, facilities to transport manure and availability of manure**

Most farmers apply manure as organic fertilizer to their crops. The results have been positive. However, a high percent still use chemical fertilizer in their long-distance plots. Long-distance plots require an additional mean of transportation to carry manure. Currently, villagers do not have a system or availability of any transport to do this task. This lack of transportation and also additional labor to apply manure in long distance plots are the main limitations when utilizing organic manure (Jackson & Mtengeti, 2005).

Therefore, their only and easier option is to continue using chemical fertilizer, since it is easy to carry and does not require a big amount of labor. Even though farmers know about the consequences and low yields, they stated it is the only option. However, they are willing to find a way in order to stop using chemical fertilizer. They are aware of the negative consequences; therefore, they are open for a solution. Farmers stated that during livestock keeping group meeting, they asked extension officer to help them addressing this issue in the best way.

Manure scarcity is also a challenge for farmers in order for them to stop or/and reduce the use of chemical fertilizer. This also affects farmers who sell manure to others. In the village, two farmers sell manure to others. According to these farmers, they sell manure, since they have eight heads of cattle and they utilize chemical fertilizer. Therefore, they can afford to sell manure to others and get an additional income. According to an assessment conducted by Jackson and Mtengeti (2005) in order for farmers to be able to cover with manure 2 Ha. of their land, they should be able to have at least eight head of local cattle. In the villages in this study, the majority of farmers (69.2%) have from one to three heads of cattle and the size of land of the majority (57.5%) is from one to three Ha. Therefore, this corroborates farmers' testimonies that the current manure they are producing is not enough.

5.5.3 Opportunities

- **Labor opportunities**

Labor opportunities will arise since, every season the required labor for agricultural activities such as weeding; will be less due to CA practices implementation. Therefore, farmers and other family members have the opportunity of working either in other lands, or find other sources of employment in the local town or nearby. In addition, farmers have the option of using herbicide as an alternative to reduce workload. The amount of farmers when using herbicide can be reduced from 50 – 70 persons to 10 – 20 persons-day per hectare (Haggblade & Tembo, 2003). Few farmers are already using herbicide and they expressed that in fact, it reduces workload, but it will require additional training on the correct doses, appropriate product, required equipment and correct use of it in order for this method to be successful (Nyanga et al., 2012).

- **New marketing opportunities**

The opportunity of new markets will be present with higher quality and amount of agricultural products. Farmers now have the opportunity to start with a new market for vegetables. It is a fact that with the use of bio slurry, vegetables have a quality that can be sold at a higher price, due to the demand of good products especially in big cities such as Dar es Salam.

Other marketing opportunity is through the co-operative called Agricultural Marketing Cooperative Society (AMCOs). This co-operative buys all the production from the farmers who are members and they are in charge of selling them in the local market or to private buyers. The advantage is that members can be sure to sell all their production. According to farmers, the

only disadvantage that they see is that in order to be a member you need to pay an initial fee 5,000 TZS (3.00USD). However, other members stated that even though they have to pay, there is a risk they will not get any income. In addition, this co-operative is inside the village; therefore, the transportation of the agricultural products is not an issue.

- **External help and programs**

Pilot programs from different institutions, such as SUA, CARITAS, TDBP and Heifer International are a good opportunity for farmers to continue improving their agricultural practices and to reinforce the good practices they currently have. According to the Livestock and Agricultural District officer, when such institutions come to the villages with a new project they bring everything they may need. For example, they bring transportation, enough personnel, tools (i.e. notebooks, pens, posters, and brochures), and expertise in the subject. Besides, they cover all costs. Therefore, the villagers and the extension officers have the facility of supporting and collaborate directly with these institutions.

When institutions come to the village to show or introduce new technologies or methods, it is important for farmers to be introduced by their extension officer and village leader. Otherwise, they will be skeptical and not open about adopting and learning new methods. Farmers had shown that they are willing to learn and to participate in any pilot program that will be useful and will make them adopt better practices. While doing the research, TDBP was teaching how to use bio slurry and it was noticeable the good attitude from farmers towards learning and practicing this method.

- **Better veterinary services**

With CA practices, the amount of income will increase; therefore, more opportunities to acquire livestock will arise. Aune et al. (2012) report that in other studies, CA adoption has allowed farmers to increase livestock, which represents many benefits for farmers. However, it also represents additional expenses, and some of them have high costs. Currently farmers have the option of calling a veterinary to assist them in some villages. However, when diseases increase, this veterinary is not able to assist all farmers. Therefore, livestock, especially cattle, get sick. This causes low milk production, low manure production and a big loss for farmers. With the opportunity of vaccination campaign farmer will be able to benefit from this.

5.5.4 Threats

- **Availability of inputs in the future**

Availability of inputs in the market is an issue for all farmers. They depend on the inputs for every season. Even though they are getting a voucher, which covers some of the expenses for the inputs they need, most of the time they are not available. The late acquisition of inputs results in delay of planting, which affects their final production and consequently farmers' income. During group meetings with livestock and agricultural extension officer, this is one of the main topics to address. However, despite all efforts to address this issue, there have not been any solution yet. Instead, there is no assurance that this problem can be solve.

- **Climate change**

Climate change is considered a threat to farmers since this region is prone to be affected by climate change in the future. Nowadays they have seen consequences of extreme rainfall. Some farmers have lost all their production due to soil erosion in regions where they never planted any trees to prevent. In addition, they stated that maize breaks when there is strong wind and therefore the production is very low. Since they cannot prevent extreme weather to happen, they are already implementing methods so they will be prepared in the future.

- **Price fluctuation**

Price in local market is unstable and it has been like this for long time. According to farmers, even though they have complaint about this to the extension officer this issue has never been solve. Most of the time in order for them to sell their products they have to agree, even though is not a fair price.

Figure 12. SWOT Analysis matrix on conservation agriculture

	Positive	Negative
Internal	<p>Strengths</p> <ul style="list-style-type: none"> *Increase in yields *Increase in income for farmers *Increase in quality of products *Soil quality improvement *Weeds reduction *Education opportunities *Livelihood improvements 	<p>Weaknesses</p> <ul style="list-style-type: none"> *Time, availability of manure and facilities to transport manure *Lack of internal supervision from Agricultural and Livestock officer *Lack of training from Agricultural and Livestock officer *Lack of agronomic knowledge from livestock keeping officer.
External	<p>Opportunities</p> <ul style="list-style-type: none"> *Cost of labor (more opportunity during weeding season) *Market (new market opportunities), new connections, new buyers, better price. *More seminar and pilot program opportunities. *Better veterinary services. 	<p>Threats</p> <ul style="list-style-type: none"> *Availability of inputs in the future *Climate change *Price fluctuation

6 Conclusions

The SWOT results made in this study, show that knowledge and participating in different agricultural and livestock groups are the key factors to be pursued in the adoption and implementation of CA practices. For farmers in Njombe CA practices are not new methods, and they have responded positively to trainings involving CA. However in order to improve and keep performing their current activities, internal organization and supervision needs to be reinforced. Encouraging farmers to become members of agricultural and livestock groups is the best mean of communication knowledge and new methods implementation.

When introducing and teaching farmers about crop residues management, it has to be considered that farmers are using crop residues for other uses, such as fodder, fuel and for construction materials, (i.e. livestock sheds). In this study, there is no evidence that farmers are having problems with lack of crop residues. Farmers in these villages actually burn crop residues because it is the easiest way to get rid of them instead of carry them for livestock. This is only the case in long distance plots. Therefore, this can be taken as proof that currently they have enough to feed livestock and they could use the crop residues that they burned to cover the soil. In addition, they are currently increasing the amount of grasses and quality of grasses, which gives farmers more opportunity to practice this CA principle. With the introduction and the implementation of cover crops, will also help and assure there is enough crop residues to fulfill the cover soil principal without affecting livestock and farmers.

The utilization of manure is increasing in these villages. Currently more farmers have already experienced the positive results of applying manure and lately bio slurry as a second option for organic fertilizer. This has increased the interest in farmers to acquire livestock in order to produce enough fertilizer for them and with the probability to sell to others. However, the issue of transportation and additional labor for long distance plots needs to be addressed. Besides, the availability of livestock inputs should be a concern for extension officer and livestock keeping group leaders. Farmers see the benefit of having livestock but at the same time, they know there are challenges that might affect them in a long term. Weak veterinary services and no supervision and monitoring are considered as the main problems with livestock issues, such as the availability and access to veterinary services.

When adopting CA practices, farmers will improve their living standards. Firstly, they will get better nutrition by planting more legumes and by increasing the amount of milk production. Secondly, they will have more access to education, since the amount of time they spend in some agricultural activities like weeding will be reduced. Thirdly, their housing will improve and their livestock sheds. Lastly, but no less important, the environmental effects will be reduced since the soil will be less prone to soil erosion. Soil will conserve its nutrient and mineral, providing more and better crops for farmers.

References

- Akarro, R. R., & Mtweve, N. A. (2011). Poverty and its association with child labor in Njombe District in Tanzania: the case of Igima Ward. *Current Research Journal of Social Sciences*, 3(3), 199-206.
- Aune, J. B., Nyanga, P., & Johnsen, F. H. (2012). A Monitoring and Evaluation Report of the Conservation Agriculture Project 1 (CAP1) in Zambia (N. Department of International Environment and Development Studies, Trans.). Norway: Norwegian University of Life Sciences.
- Baudron, F., Corbeels, M., Monicat, F., & Giller, K. E. (2009). Cotton expansion and biodiversity loss in African savannahs, opportunities and challenges for conservation agriculture: a review paper based on two case studies. *Biodiversity and Conservation*, 18(10), 2625-2644.
- Berg, B. L., & Lune, H. (2012). *Qualitative research methods for the social sciences* (8th. ed. Vol. 5). Boston: Pearson Boston. pp. 50
- Biamah, E. K., Rockstöm, J., & Okwach, G. E. (2000). Conservation Tillage for Dryland Farming: Technological options and experiences in Eastern and Southern Africa. Nairobi, Kenya.
- Bryman, A. (2008). *Social Research Methods* (Third ed.). Oxford: Oxford University Press. pp. 603
- Corbeels, M., de Graaff, J., Ndah, T. H., Penot, E., Baudron, F., Naudin, K., . . . Adolwa, I. S. (2014). Understanding the impact and adoption of conservation agriculture in Africa: A multi-scale analysis. *Agriculture, Ecosystems & Environment*, 187(0), 155-170. doi: <http://dx.doi.org/10.1016/j.agee.2013.10.011>
- FAO. (2014). What is conservation agriculture. Retrieved November 4, 2014, from <http://www.fao.org/ag/ca/1a.html>
- Fowler, F. J. (2014). *Survey research methods* (Vol. 1): Sage publicationspp.
- Friedrich, T., Derpsch, R., & Kassam, A. (2012). Overview of the global spread of conservation agriculture. *Field Actions Science Reports. The journal of field actions*. (Special Issue 6).
- 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), 23-34. doi: <http://dx.doi.org/10.1016/j.fcr.2009.06.017>
- Haggblade, S., & Tembo, G. (2003). *Development, Diffusion, and Impact of Conservation Farming in Zambia: Food Security Research Project*
- Hay, G., & Castilla, G. (2006). *Object-based image analysis: strengths, weaknesses, opportunities and threats (SWOT)*. Paper presented at the Proc. 1st Int. Conf. OBIA.
- Jackson, H., & Mtengeti, E. (2005). Assessment of animal manure production, management and utilization in Southern Highlands of Tanzania. *Livestock Research for Rural Development*, 17(10).
- Jat, R. A., Sahrawat, K. L., Kassam, A. H., & Friedrich, T. (2013). Conservation Agriculture for Sustainable and Resilient Agriculture: Global Status, Prospects and Challenges. In R. A. Jat, K. L. Sahrawat & A. Kassam (Eds.), *Conservation Agriculture: Global Prospects and Challenges*. Rome: CABI International.
- Kothari, C. R. (2004). *Research methodology: methods and techniques* (Second ed.). New Delhi: New Age International pp. 96
- Liebman, M., & Dyck, E. (1993). Crop Rotation and Intercropping Strategies for Weed Management. *Ecological applications*, 3(1), 92-122. doi: 10.2307/1941795

- Nyanga, P. H. (2012). Factors influencing adoption and area under conservation agriculture: a mixed methods approach. *Sustainable Agriculture Research*, 1(2), p27.
- Nyanga, P. H., Johnsen, F. H., & Aune, J. B. (2011). Smallholder farmers' perceptions of climate change and conservation agriculture: evidence from Zambia.
- Nyanga, P. H., Johnsen, F. H., & Kalinda, T. H. (2012). Gendered impacts of conservation agriculture and paradox of herbicide use among smallholder farmers.
- Suh, J., & Emtage, N. F. (2005). *Identification of strengths, weaknesses, opportunities and threats of the community-based forest management program*. Paper presented at the ACIAR Smallholder Forestry Project ASEM/2000/088 Redevelopment.
- The United Republic of Tanzania, P. M. O. (2013). *Njombe Region Investment Profile*.
- 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.

Appendix 1: Households Interviews

SWOT ANALYSIS

A. DEMOGRAPHIC INFORMATION

Village:	Questionnaire number:
Name of interviewer:	Date of interview:
Start time:	End time:

B. HOUSEHOLD INFORMATION

1. Household gender: 1=male 2=female
2. Age of respondent: _____ years.
3. Marital status: 1=single, 2=married, 3=divorced, 4=separated, 5=Widow, 6=Cohabitant
4. Main occupation: 1=crop production (agriculture), 2=livestock keeping, 3=crop production & livestock keeping, 4=forestry (timber, charcoal making), 5=others (specify) _____
5. What is your main income generating activity: _____
6. What are your main crops: _____
7. Do you have any off-farm activities: 1=handicrafts, 2=carpentry, 3=making bricks, 4=other (specify) _____
8. Number of family members: _____
9. Do you own land: 1=yes, 2=no
10. If yes, size of land use by household: _____ Ha.

C. LAND USE PRACTICES

11. What is your most time-consuming activities: 1=planting, 2=preparation of land (digging, clearing land from residues), 3=weeding, 4=harvesting, 5=livestock keeping (feeding, cleaning, milking, veterinary care) 6=others (specify) _____
12. How many hours do you spend on the each activity:

Activity	Time (hours per day)	Duration (days/months)
Planting		
Preparation of land		
Weeding		
Harvesting		
Livestock keeping		
Other (specify)		

13. In what the farming (livestock, crop production) activities you spend more money on:

Activity	Tick	How (things you spend money, inputs)
Planting		
Preparation of land		
Weeding		
Harvesting		
Livestock keeping		
Other (specify)		

14. What are the main inputs you utilize:

15. Do you use fertilizer: 1=yes, 2=no

If NOT, go directly to question 20

16. Which type of fertilizer: 1=organic, 2=chemical 3=both

17. If ORGANIC, have you always used organic: 1=yes, 2=no

18. If NOT, have you seen any difference since you decided to change to ORGANIC:
1=yes, 2=no

19. How?

20. Why did you decide to change?

21. How did you learn to use manure (organic fertilizer):

22. If CHEMICAL, have you always used chemical: 1=yes, 2=no

23. If NOT, would you be interested in trying to use organic (manure) fertilizer: 1=yes, 2=no

24. Why yes or no? _____

25. Is the fertilizer you are currently using, enough? 1=yes, 2=no

26. If NOT, why?

27. Do you use herbicide? 1=yes, 2=no

28. Why?

29. Would you be interested in starting using herbicide? 1=yes, 2=no

30. Why?

D. LIVESTOCK KEEPING

31. Do you have livestock: 1=yes, 2=no

32. Which type of livestock, how many, what type of feed and for what purpose do you use your livestock:

Livestock type	Quantity (How many)	Type of feed (If grasses, which type)	Purpose of livestock (milk, manure, meat, etc.)
Cattle			
Sheep			
Pig			
Goat			
Poultry			
Others (specify)			

33. If cattle,

How many litters you produce per day?

Is it for your own consumption, selling or both? 1=own consumption, 2=selling, 3=both

If selling, how to you transport your milk to the market?

What are the main constraints in selling the milk production, if any?

34. Is manure enough for your field use: 1=yes, 2=no

35. Do you sell manure to others? 1=yes, 2=no

E. PEOPLE AWARENESS ON SOIL CONSERVATION

36. Do you know anything about soil and water conservation: 1=yes, 2=no

37. What can you tell us about soil conservation:

38. Do you practice anything to conserve soil: 1=yes, 2=no

39. Which practices:

40. Do you know about soil erosion: 1=yes, 2=no

41. What can you tell us about soil erosion: 1=yes, 2=no

42. Has your production being affected by soil erosion: 1=yes, 2=no

F. PRODUCTION MARKET

43. Do you set the price when it comes to sell your production to the market: 1=yes, 2=no

44. If NOT, who sets it:

45. Do you agree with the price established: 1=yes, 2=no

46. Do you think the price could be better: 1=yes, 2=no

47. How do you think the price could be better:

48. Do you get to sell all your production: 1=yes, 2=no

49. If NOT, why?

G. RESPONDANT INVOLVENT IN ORGANIZATION

50. Do you receive any type of training regarding agriculture and livestock? 1=yes, 2=no

51. Which type and from whom you got the training?

52. Is there any current organization (i.e. NGOs, etc.) introducing and showing CA practices? 1=yes, 2=no

53. If YES, which organizations?

54. Have you heard about any workshop/demonstration or pilot projects where you can learn new practices or CA techniques? 1=yes, 2=no

55. Have you ever participated in any of these workshops: 1=yes, 2=no

56. What was the workshop about?

57. Did you apply what you learn? 1=yes, 2=no

58. If NOT, why?

59. Would you be interested in participating in any workshop? 1=yes, 2=no

60. If NOT why?

61. Do you face any challenges or constraints in your current practices (farming activities, livestock keeping and others), overall?



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