

THE IMPACT OF CONSERVATION AGRICULTURE ON FOOD SECURITY AND LIVELIHOODS IN MANGWE DISTRICT

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ABSTRACT

This study assessed the impact of conservation agriculture (CA) on food security and livelihoods in Mangwe district. The paper is based on findings from a research conducted in three wards of Mangwe district. Data was collected through in-depth interviews, semi-structured questionnaires and focus group discussions. Findings show that the adoption of CA is widespread within the District. Key among the findings is that while CA does improve yields per acreage, the improvement does not necessarily translate to improved food security. This is mainly due to climatic factors, including the poor rainfall experienced in the District and the nature of the CA practised. In terms of the impact of CA on livelihoods the study unravelled that CA does extend the range of livelihoods albeit, on a limited scale, through improved yields and income. However, this is also dependent on rainfall levels. The study concluded that while CA holds promise for the food insecure households in Mangwe, the way in which it is currently being practised is too labour intensive and it is necessary to consider the adoption of much more efficient practices especially in the preparation of land.

Keywords: Food Security, Livelihoods, Conservation Agriculture, Mangwe, Conventional Farming

INTRODUCTION

This paper assesses the efficacy of conservation agriculture in improving the food security status and livelihoods of communities in Mangwe district of Matabeleland South Province in Zimbabwe. The paper was borne on the backdrop of a worrying trend where global food production has been outpacing global population growth yet indications have continually pointed to increasing global food insecurity (Clover, 2003). As a result of this misnomer, targets set at the 1996 World Food Summit of achieving food security for all and halving the number of undernourished people in the world by 2015 have not been met. For Sub-Saharan Africa, the situation is even much direr as agricultural production has been trailing population growth. "Between 1965 and 1990, agricultural production grew at an annual rate of 1.7 percent while there was annual population growth average of 2.8 percent" (Boon, n.d:4). An explanation for this trend could be the fact that Africa was not part of the Green revolution initiatives of the 1940s to 70s. It is thus not surprising that the proportion of malnourished people has worsened to within the 33-35% range in sub-Saharan Africa (Rosegrant, Cline, Li, Sulser & Valmonte-Santos: 2005). This cataclysmic situation is further compounded by the simmering adverse effects of climate change, with the region expected to experience a 20% crop loss by 2050 due to adverse temperatures and the region is projected to experience floods and droughts frequencies (Mazvimavi, 2011). Such projections are worrying given that 85-90% of agricultural activities in Sub-Saharan Africa are rain-fed (Boon, n.d.). Clover (2003:1) locates the pervasiveness of food insecurity and hunger at the doorstep of "faulty analysis and faulty actions" presumably of all the

stakeholders. In view of this, we ask whether the adoption of conservation agriculture in Mangwe district was not borne out of a faulty analysis of the situation in Mangwe and also if the practice of CA itself is not a faulty action to remedy food insecurity and livelihoods challenges experienced by the rural poor?

WHAT IS CONSERVATION AGRICULTURE?

Conservation agriculture has been defined in various ways by different authors (see Twomlow, Urolov, Oldrieve, 2008; Dumanski, Peiretti, Benetis, McGarry, and Pieri, 2006) though the most widely used definition is that of the Food and Agricultural Organisation (FAO, 2012:1) which says:

Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterized by three linked principles, namely:

- 1. Continuous minimum mechanical soil disturbance.*
- 2. Permanent organic soil cover.*
- 3. Diversification of crop species grown in sequences and/or associations.*

In view of this definition, our study sought to establish how the Mangwe community of farmers are following these principles and to what end? The first principle has seen CA being also called Zero Tillage as mechanical tillage of the soil is reduced to absolute minimum. The adoption of this principle in farming is indispensable to soil conservation as studies have shown that tillage of the soil increases the risk of water surface run-off and soil erosion. For example in a study carried by Munodawafa (2012: 4) in Makoholi area near Masvingo in Zimbabwe it was revealed that:

Soil losses under the bare fallow ranged from 9t/ha during the first year to 152t/ha during the 8th year giving an average of 64t/ha/yr over the nine-year period. Conventional tillage recorded the highest cumulative soil losses among the cropped treatments (and averaged about 15t/ha over the nine seasons).

It is thus clear that soil tillage through conventional farming can in the long term lead to soil degradation as soil organic matter which is crucial for supplying nutrients to crops is washed away due to unstable soil structure borne out of tillage. In Zimbabwe the most commonly practised type of CA is that of creating planting basins using hand hoes (Mazvimavi, 2011).

To counteract the negative effects of soil tillage, CA uses permanent organic cover. This is mostly done through the use of cover crops which are grown between annual crops. The purpose of these cover crops is to protect the soil from the damaging effects of heavy rainfall, sun and wind. These cover crops also provide nutrients and facilitate water infiltration by reducing soil compaction.

According to Dumanski *et al.* (2006) crop rotations and associations which constitute the third principle of CA can be in the form of relay cropping, mixed crops and crop sequences. These practices reduce the need for pesticides and herbicides whilst at the same time promoting biodiversity. Given these ecologically friendly principles of CA, studies

have shown that the adoption of CA tends to improve poor farmers' food security and livelihoods (Mazvimavi, 2011; FAO, 2012).

In this paper we examine the impacts of CA on aspects of food security. We further highlight that given the multidimensionality of the concept of food security, CA cannot be seen as a magic bullet that will wish away the food security challenges confronting poor small scale farmers in the developing world in general and Mangwe in particular.

THE DIMENSIONS OF FOOD SECURITY

Food security is a term that has been understood in a number of varied ways, though at the centre of these conceptualisations, two broad strands of concern stand out, namely, the supply side to satisfy demand on one hand and on the other improving entitlements to food. True to this tradition, the United States Agency for International Development (USAID, 1992:2) defines food security as a situation in which "all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life." This is a definition that resonates with the definition proffered by the World Bank where food security is defined as "access by all people at all times to enough food for an active and healthy life" (World Bank 1986:1). The question is whether CA improves food security from the supply or access side or both? To this end, the indicators of food security used in the study focused on these two pillars (supply and access) of the concept of food security. Earlier studies attest to a significant increase in yields with the adoption of CA (Stewart, Asfary, Belloum, Steiner, Friedrich: 2008; Dumanski *et al.* 2006, Mazvimavi, Nyathi, & Ndllovu and Minde, 2010). Other than looking at the impact of CA on food security the study also investigates how CA impacts on livelihoods of the communities in Mangwe.

LIVELIHOODS AND THE SUSTAINABLE LIVELIHOODS APPROACH

Livelihoods are a "means of gaining a living" (Chambers, 1995: vi). Livelihoods necessarily encompass people's skills, income, assets and activities necessary to get the necessities of life. In this paper we assess the contribution of CA in improving people's skills, their income and asset base. We also show how the people's skills, income and assets are impacting on their uptake and performance in conservation agriculture. According to Scoones (2009) livelihoods can be perceived from the point of view of locale (e.g. rural livelihoods); occupations (e.g. farming) and social difference (gendered or age defined livelihood). All these dimensions inform the analysis of the data gathered from Mangwe district.

Various ways of trying to understand people's livelihoods have been formulated over time. One such approach is the Sustainable Livelihoods Approach (SLA). The concept of SLA was 'an attempt to go beyond the conventional definitions and approaches to poverty eradication after decades of limited success in eliminating rural poverty' (Krantz, 2001:1; Carney, 1999:1). The conventional approaches had been found to be "too narrow because they focused only on certain aspects or manifestations of poverty, such as low income, or did not consider other vital aspects of poverty such as vulnerability and social exclusion" (Krantz, 2001:1). The SLA is premised on "working with people, supporting them to build upon their own strengths and realise their potential, while at the same time acknowledging the effects of policies and institutions, external shocks and trends" (Carney, 1999:1). It is a way of "improving the understanding of the

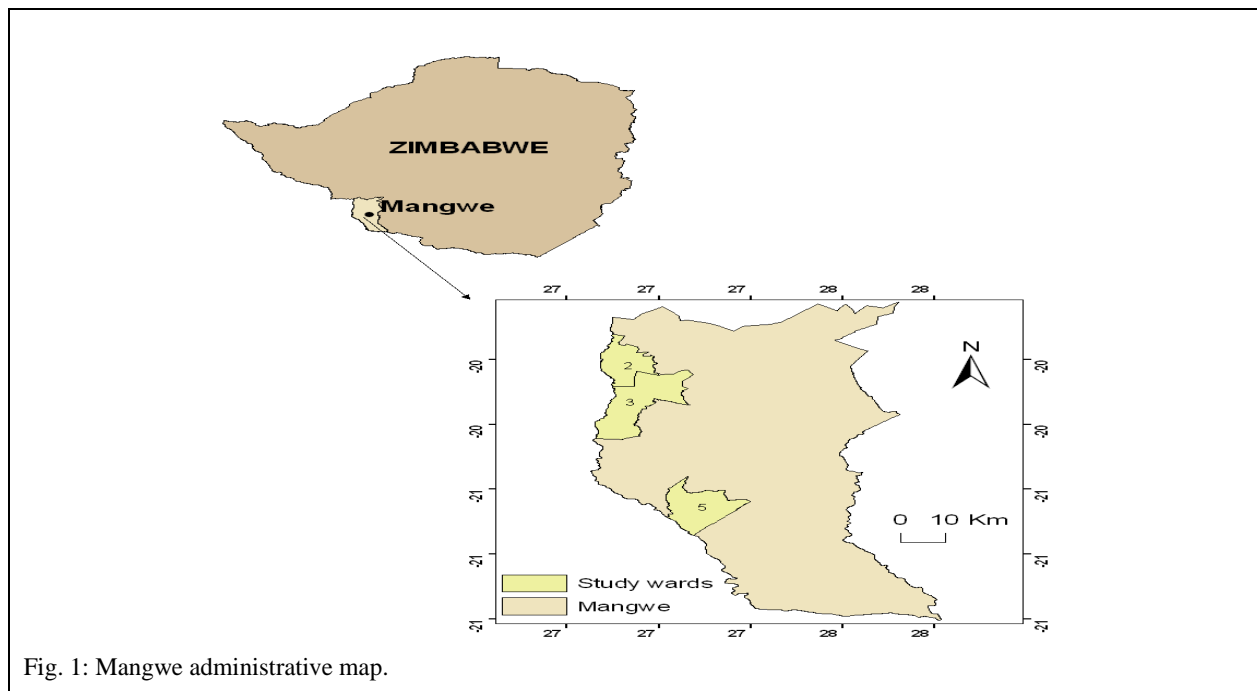
livelihoods of poor people; draws on the main factors that affect poor people's livelihoods and the typical relationships between these factors and can be used in planning new development activities and in assessing the contribution that existing activities have made to sustaining livelihoods” (<http://www.ifad.org/sla>). SLA is “a framework that helps in understanding the complexities of poverty and has a set of principles to guide action to address and overcome poverty” (<http://www.ifad.org/sla>).

Indeed as Krantz (2001:2) posits,

there are three insights into poverty which underpin SLA. The first is the realization that while economic growth may be essential for poverty reduction, there is not an automatic relationship between the two since it all depends on the capabilities of the poor to take advantage of expanding economic opportunities; secondly, there is the realization that poverty — as conceived by the poor themselves — is not just a question of low income, but also includes other dimensions such as bad health, illiteracy, lack of social services, etc., as well as a state of vulnerability and feelings of powerlessness in general; and finally, it is now recognized that the poor themselves often know their situation and needs best and must therefore be involved in the design of policies and project intended to better their lot.

MATERIALS AND METHODS

This study was carried out in the Mangwe district of the Matabeleland South Province in Zimbabwe. Mangwe district shares borders with Botswana on the West, Matobo district on the East and Bulilima district on the North (Practical Action, n.d.). The District has 17 administrative wards (See fig.1 below).



The District is in the ecological regions 4 and 5 and on average receives between 450-500mm of rainfall and in the 2011-12 rainfall seasons, the District received an average of 365,4mm of rainfall (Mangwe Agritex, 2012). Temperatures are

as high as 40°C during summer months and on average 13°C during winter (Practical Action, n.d.). These climatic conditions make the area very vulnerable to meteorological hazards such as droughts, floods and gusty winds, as well as lightning and epidemics during the wet and hot season (Practical Action, n.d.).

The population is estimated at 88 000 people with more than 77 000 cattle. Vegetation is patchy and this renders the area very vulnerable to environmental hazards such as flooding, soil erosions, gusty winds and general environmental deterioration (Practical Action, n.d.). Due to the environmental attributes just described above, crop production in Mangwe district is mainly for household subsistence; producing surplus is an exception. Conventional farming has, over the years, resulted in low yields leading to hunger and food insecurity in the District. This region is good for livestock production and growing of drought tolerant crops.

Research design

The collection of the data was done in June 2012. Data collection was both qualitative and quantitative. This enriched the analysis and the data validation and its findings. Data collection was through the means of in-depth interviews, semi-structured questionnaires and focus group discussions.

The villagers who practiced conservation agriculture were found to be widely dispersed throughout the rural heartland of Mangwe. The average catchment area radius was found to be around 100 kilometers. This created logistic problems in the mobilization of the villagers. As such this necessitated the use of convenience and purpose sampling when carrying the questionnaire form of interview. In light of the preceding, Wards 2, 3 and 5 were selected for the questionnaires and focus groups.

The research was post-positivist in nature. Post-positivism argues that positivism is dead. The word 'Post' itself reflects a gradual progression in thinking and implies that positivism is outdated. However, it can be argued that because positivism came earlier than post-positivism, these two paradigms have some related features in the sense than the latter used the former as a platform and the foundation from which to propel it. Within the paradigm arena, this is reiterated by Guba and Lincoln (1994) who noted that the paradigms are interwoven as they echoed the same streams of thought, even though the boundaries between the paradigms are shifting. These boundary shifts as identified by Guba and Lincoln (1994) are further projected by Howell (2004) with the reiteration that:

...with the change in ontology and epistemology between positivism and post-positivism we observe the recognition of human fallibility and theory replacement through critical analysis. This accepts that theory changes through falsification, which in itself is part of a historical process; critical theory through challenging the status quo, renders this same point explicit (p15).

Post-positivism accepts that social reality is multi-dimensional and complex and such seeks a broader interpretive approach in social sciences in practice (Fischer, 1998). Guba (1990) identified the post-positivist methodology as critical multiplism and pluralism, for it gives way to both qualitative and quantitative methods. Letourneau (1999: 194) defined critical multiplism "as merely another form of triangulation, as promoting relativism (which denies objective knowledge

of realities independent of the knower) and accommodating incommensurability (an inability of theories from different paradigms to be measured against each other point by point), and as being too costly” . As such:

...critical multiplism accepts that no research is perfect without some element of bias and as such methodologically aims to reduce bias. Through the exhaustive study of the phenomena from as many different perspectives as possible, critical multiplism accepts theory as a huge fishnet of complex, mutually interacting relationships among constructs and variables (Letourneau, 1999:194).

Sample and survey administration

The research questionnaire was targeted to the rural farmers in the Mangwe District who practised CA. Eighty two farmers responded to the questionnaires. The questionnaires were semi-structured. This facilitated the researchers to probe further. The questionnaires were done face to face. This proved effective and less time consuming as the data collection was immediate. The dialogue between the research and the researched subjects was therefore immediate and so was the mutual understanding and clarifications on the questionnaires. Leedy (1993) regarded a questionnaire as the most widely used technique for collecting primary data.

In-depth interviews

Ten in-depth interviews were carried out with key informants in the Mangwe District. These composed of *inter alia*, Agriculture Technical and Extension Service (Agritex), the lead farmers and trainers who practised CA, the NGOs such as the Catholic Development Commission (CADEC) and the Organization of Rural Associations for Progress (ORAP). The interviews sought to find out how CA is practiced in Mangwe, the factors that influence the adoption of CA, whether farmers received any financial support and the latter’s perception towards CA especially on its contribution to food security.

Focus group discussions

A total of 8 focus discussions were conducted with the farmers. The focus groups included farmers who practised CA and those who did not. Each focus group took an average of an hour to complete. The researchers led the focus group, guiding the process with minimum interference through participative observations. The focus group discussions sought to establish the reasons for non adoption of CA by non CA farmers, get a comparative view of the farmers on the conventional and conservation systems of farming. The next sections are dedicated to the presentation and discussion of the findings.

SUMMARY OF FINDINGS

As highlighted in the foregoing, a total of 82 farmers responded to the questionnaires. The following table is a summary of some major findings:

Table 1: Selected demographic characteristics of respondents

						No responses provided
Age Range in years	10-20	21-30	31-40	41-50	50 ^t	
No. of respondents	2	16	14	8	42	0
Income range in US\$	100 or less	101-200	201-400	401-800	801-1000	
No. of respondents	50	26	1	1	1	3
Educational Level	Never attended school	Some Primary Schooling	Completed Primary Schooling	Some Secondary Schooling	Completed Secondary Schooling	
No. of respondents	2	18	22	26	8	6

Table 1 shows that the majority (53%) of respondents were more than 50 years of age and in terms of income are of a low disposition with 93% earning less than US\$200 per month. The respondents are fairly literate with 92% of the respondents having some form of education. The household sizes are fairly large with 63% of the households constituted by between 5 to 7 members. The respondents' occupational livelihoods are limited in range as 80% of them rely on farm-based livelihoods with the remainder engaged in self-employment activities such as baking bread and vending.

One of the key objectives of this study was to assess the impact of practicing CA on food security and as a proxy indicator for food security. Proxy indicators are alternatives for indicators that more directly reflect the phenomenon or characteristic to be measured. Respondents were asked to make a comparison in terms of crop output from the two systems of farming i.e. conventional farming and conservation agriculture. The initial intention was for the respondents to provide quantitative comparisons per given unit area of land, but all of them could not quantify their yields in this manner. In view of this shortcoming, as an alternative we asked the respondents to provide impressionistic and qualitative comparisons of the same. All respondents indicated that CA gave them a better yield output compared to conventional farming. However, the respondents went further to qualify their judgements by stating that the potential of increased yield output from CA is hamstrung by adverse agro-ecological conditions that characterize their locality.

Another proxy indicator that was used in an attempt to gauge the impact of CA on food security was realized through quizzing the respondents on their comparative perceptions of the likely contributions of the two systems of farming to their household food requirements. The respondents were asked to weigh the contribution on a scale of 1-10. Fig. 2 summarises the findings on this aspect.

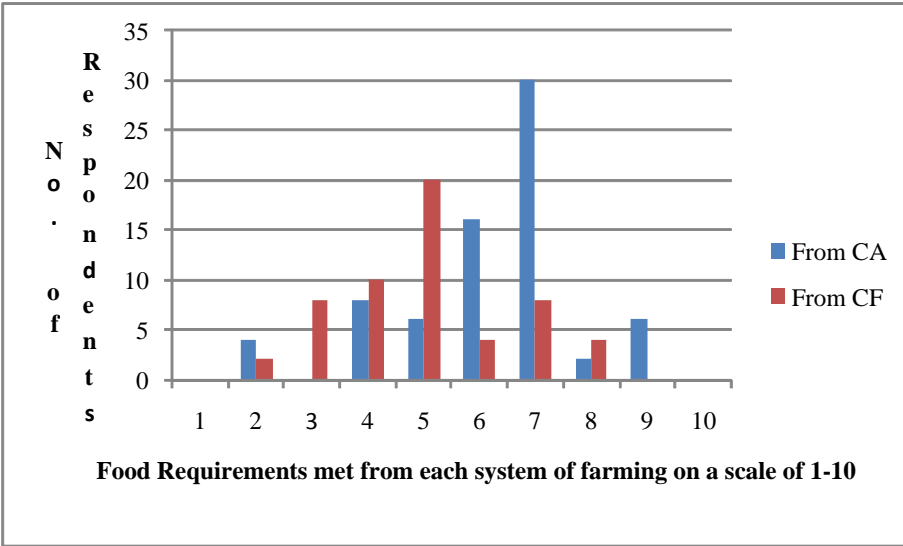


Fig 2: CA and Conventional farming’s contribution to food availability.

N=72 for CA and 48 for Conventional farming

A related proxy indicator for the potential impact of CA on food security was based on respondents’ frequency of meals as correlated to each system of farming. In this vein, respondents were asked to state how many times they generally had meals when they were practicing conventional farming and now when they are into CA. The findings are summarized in fig. 3. Other variables could be used to explain frequency of meals which have nothing to do with the systems of farming concerned. Such factors could include an improving socio-economic environment in the country, role of Non-governmental organizations of providing food relief etc.

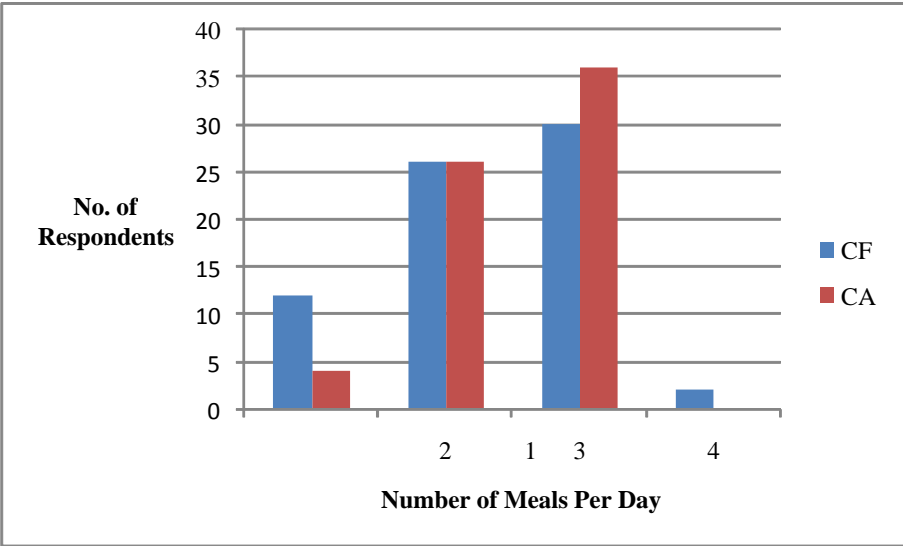


Fig.3: No. of meals per day for respondents correlated to system of agriculture

N=66 for CA and 70 for Conventional farming

The study also tried to determine the impact of CA on food security through asking respondents whether or not they were times when adult members of the household had to forego meals for the sake of ensuring that children had something to

eat. From the findings 53% of CA farmers and 68% of conventional farmers forego meals for the sake of children. Fig. 4 summarizes the findings.

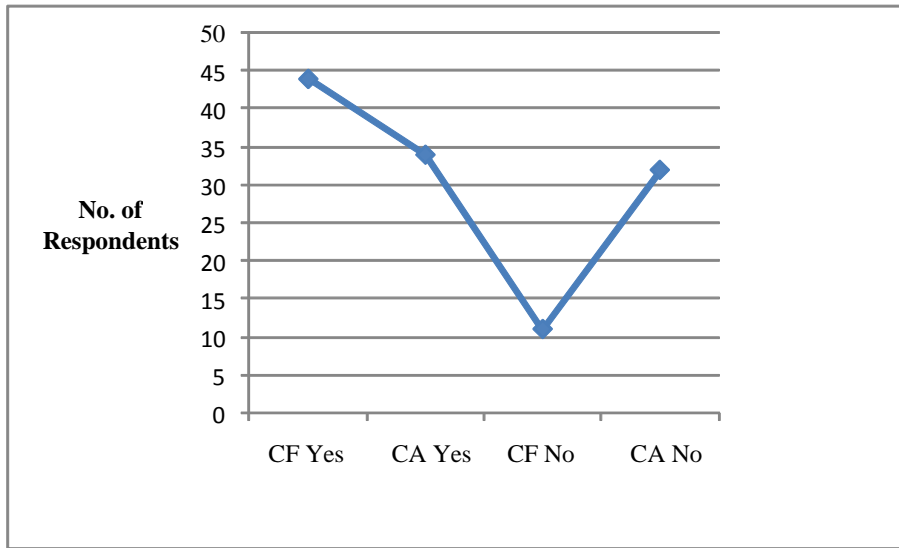


Fig 4: No. of Adults skipping meals to cater for children

N=66 for CA and 66 for Conventional farming

THE PRACTICE OF CONSERVATION AGRICULTURE IN MANGWE DISTRICT

CA has proved to provide sustainable farming in many agricultural environments virtually around the world (Reicosky and Saxton, 2007 in Putz, 2008). Concerns over low agricultural productivity in the Mangwe district led to the adoption of the concept of conservation agriculture with the aim of improving food security. The concept was introduced and implemented by humanitarian organizations, such as ORAP, CADEC and World Vision with the help of agricultural extension officers. AGRITEX officers are responsible for the training of the lead farmers who then train other farmers in their wards.

Conservation agriculture farmers conform to the three general principles discussed earlier. However, in Mangwe district farmers have adapted conservation agriculture in the process of adopting the concept. Adaptation in Mangwe is influenced by the agro-ecological conditions, this means that farmers do not entirely adhere to the original three principles as is the case in the United States of America or Brazil where the concept originated. Baudron *et al.* (2007) argue that the implementation of conservation agriculture will differ from one area to another. For example researchers tried to implement Brazilian CA knowledge in Zambia without adaptation, the implementation experienced serious challenges due to differing conditions. It is the role of the implementing stakeholders (humanitarian organizations and AGRITEX officials) to administer adaptive management in the district. Moore and Dillaha (2006) and Moore (2009) argue that adaptive management is a repetitive process of learning by doing and working to solve problems as they arise in the situation.

Farmers in Mangwe grow mainly drought resistant crops such as sorghum, millet and maize. Ground nuts and pumpkins are grown as cover crops to retain moisture and possibly nitrogen fixation. Conservation agriculture practiced in Mangwe is non-mechanical, that is to say they use hand hoes. This is due to the fact that the farmers cannot afford to purchase mechanical equipment such as jab planters. This means that there is a lot of labour involved in the preparation of land, tillage as well as weeding. Thus most farmers are encouraged by the NGOs to till small plot sizes ranging from 0.2 to 0.5 hectares. According to Grabowski (2011), although the farmers in Mozambique described many benefits of using CA there was little sign of adoption beyond the plots where NGOs provided inputs. He further observes that with basin conservation agriculture, adoption is constrained by increased labour requirements for land preparation and weeding. This is an indication of the constraints associated with the nature of CA in Mangwe. Many farmers do not have access to inputs and labour requirements to cultivate larger pieces of land. In places where CA is mechanized research has shown that labour requirements are reduced drastically. For example, an International Fund for Agricultural Development (IFAD)/FAO joint study that explored the potential of CA as a labour saving practice found out that the labour inputs in the CA system could be reduced by 75% (in the hand labour/hoe system) when a jab planter was used compared to hand hoe. In the draught animal powers category the CA system (with knife roller and direct seed drill) the labour reduction was 80% (IFAD/FAO, 2004).

The processes of mulching and permanent organic soil cover as dictated to by the principles of conservation agriculture technologies are less applicable in Mangwe. The major reason why there is less of organic soil cover, especially in the form of plant residue, is because after harvest the plant residue acts as stock feed. Livestock are allowed to feed in the fields thereby removing the residue that would have acted as mulch. For mulching the farmers have to resort to tree leaves from the nearby mountains, which also act as manure. The other reason for adaptation is that the farmers are generally poor and they cannot afford the required materials. In Mangwe most of the farmers are not gainfully employed hence the farm implements are out of their reach. They resort to seeking assistance from the implementing organization or improvising so as to get on with farming. This according to Sustainable Development Approach highlights the lack of financial capital amongst the households in Mangwe.

Provision of farming inputs is the first stage to a successful CA season. In Mangwe farmers are faced with the problem of the necessary inputs such as herbicides, fertilizers and seeds, equipment, and financing. Herbicides are often necessary for the early stages of CA because tillage is no longer conducted for weed management. The study revealed that the farmers have never used herbicides as they could not afford them. Yet herbicides are often critical to achieving a decrease in labour requirements, which is an adoption incentive stressed by CA proponents (Giller et al. 2009). In contrast to the observation made by Giller *et al.*(2009), farmers in Mangwe have to weed three times before they harvest, which on its own is a deterrent to those who want to adopt CA. The implementing organizations also confirmed that herbicides are very expensive to acquire for the local farmers. Implementing organizations do occasionally provide inputs and it is not mandatory that they do so.

Another example of lack of financial capital in the Mangwe district is the failure by some farmers to purchase fertilizers and seeds. It has been argued by Huggins and Reganold (2008) that conservation agriculture demand extra nitrogen fertilizer to meet the nutritional requirements of some crops because increasing organic matter at the surface immobilizes

nutrients. Financial constraints to purchase fertilizers have led some farmers to improvise by making use of 'inhlabathi yesiduli' (soil from ant hill). Thus from a sustainable livelihood approach, farmers are now resorting to their natural capitals to sustain CA.

Hybrid seeds are recommended for a successful CA programme in every season. The situation in Mangwe district is that hybrid seeds are provided for by the humanitarian organizations, however, interviewed farmers and AGRITEX officials revealed that it's not always the case that they are provided for with hybrid seeds by the NGOs. This has resulted in the farmers resorting to planting seeds from the previous harvest. Research has revealed that such seeds do not usually produce high yields. This also reflects on the vulnerability state of the households as farming is the main source of their livelihoods. It also calls into question the sustenance of conservation agriculture in the District. Thus Giller *et al.* (2009), argue that finance is required for the successful implementation of CA practices. Baudron *et al.* (2007) posit that, in Zambia, most CA implementers use hybrid seeds and fertilizers on credit, allowing them to implement more CA inputs and increase their chances of successfully practicing CA.

In line with the observation made by Mazvimavi *et al.* (2010) in their study on practice and adoption of conservation agriculture in Zimbabwe, this study revealed that the average age of household head was 50 years and it was 80% women. On average, farmers have 7 to 10 years of formal education. This means that household heads across the surveyed wards have attained up to primary level of education and are generally literate. The literacy levels in the districts are a sign that the knowledge input from the AGRITEX officers is well received and put into use. However, of concern is the average age of practising farmers and the fact that the majority of them are women. As noted in the foregoing discussion that the nature of CA being practised in Mangwe is basin conservation agriculture, it involves digging of basins during the dry season using hand hoes. The procedure is laborious and strenuous. The major reasons that can be attributed to this kind of demographic structures of the practising farmers are; outward migration and HIV/AIDS. Mangwe district is geographically bordering with Botswana and most of the young people cross the border to Botswana and South Africa soon after completing their secondary education. Some young people seek better paying employment opportunities in urban areas as agriculture is not economically attractive and its returns are slow. Agriculture is therefore competing with other sectors of the economy for the same young human capital and it has to be extra attractive to retain the youth.

HIV/AIDS has grossly affected mainly the sexually active age groups leaving behind the old to practise agriculture. It can therefore be argued that CA in Mangwe district suffers from lack of human capital hence its future is questionable. The demographic composition of the farmers also put into question the ability of conservation agriculture to liberate women to engage into other businesses that will bring about income into their homes. This is because women spend much of their time in the field weeding and attending to their crops. The foregoing observation is contrary to the findings made by Friedrich and Keinzle (2007) in South America where CA has reduced the labour requirements for tillage, land preparation and weeding. This has liberated women from their traditional role of weeding and has afforded them opportunities for diversification options such as for example poultry farming or on farm sales of produce, or other off-farm small enterprise developments that now (with time available) are a 'real' opportunity. In view of the adaptations and

adoptions that have been made on CA in Mangwe the next section seeks to discuss the findings on its impact on food security.

IMPACT OF CONSERVATION AGRICULTURE ON FOOD SECURITY IN MANGWE DISTRICT

Any farmer or agricultural system with access to sufficient inputs, knowledge and skills can produce large amounts of food. When this is achieved, the food becomes available. Over the years, Mangwe communities have depended on conventional farming for the production of food. The introduction of CA by NGOs in Zimbabwe seems to have brought a big influence on how food security can be improved. Communities that engage in CA have spoken very highly of how the practice has made food available at the household level. What makes conservation agriculture unique is that it directly affects many of natural, social and economic resources on which it relies for success.

Most of the interviewed farmers practicing CA in Mangwe confirmed that they harvested more grain on CA cultivated land than conventional farming. This is the benefit of natural capital, where communities benefit from the natural environment due to good soil, water and fertility control. This link becomes a key improvement to the community as it increases the amount of available food. Most smallholder farmers interviewed in their individual capacities as well as in focus group discussions pointed out that it was out of disappointment at the lack of success with conventional system of agriculture that led to the emergence of CA as a new approach to farming. The farmers reiterated that although CA is labour intensive, the yields are higher than on conventionally tilled land. The findings of this study pertaining to the potential of CA to improve yields and most likely food security too, are consistent with those of earlier studies conducted in different parts of the world. For instance Mazvimavi *et al.* (2010) in Mazvimavi (2011) state that CA plots tended to produce higher yields than conventional plots as exemplified by the harvests of the 2008/2009 season where on average maize yielded 1 546 kg/ha on CA compared to 970 kg/ha on conventional farming. Mousques and Friedich (2007) also noted the positive impact of CA on yields in China and the Democratic People's Republic of Korea. This increased food availability could be the reason why 72% of respondents put forward that under CA they are able to meet 60-90% of their food requirements from their farming activities compared to a paltry 29% of respondents who stated that they could meet the same amount of food requirements from conventional farming. However, notwithstanding these pronouncements by the respondents they also qualified their estimates by stating that these were dependent on the amount of rainfall. This is in line with Mazvimavi's (2011) findings where for the 2007/2008 maize yields were seen to be much lower because of less rainfall. Another issue to note is that CA's potential increases over time as its array of environmental benefits take root. Thus, for now the impact of CA on yields as is currently practised is still minimal.

A related proxy indicator for food security was the number of meals consumed per day compared across the two systems of farming. This indicator dovetails the 1996 World Food Summit definition of food security which emphasises physical and economic access to safe and nutritious food. On this dimension CA has potential to impact food security positively as it ensures diversity of crops grown through crop rotations, mixing and relay cropping. The safety of the food grown in CA plots is likely to be much safer given its averseness to non-organic inputs. Diversification of crops grown also reduces the risk of harvest failure in times of droughts or other such adverse climatic conditions. In good harvest years there are opportunities for increased incomes emanating from increased sales. These increased incomes enhance the

access dimension of food security as the farmers are in a position to buy food items that they would not have grown in their fields. However, Mangwe farmers have not seen much of such benefits because the performance of CA is largely hamstrung by adverse agro-ecological conditions. This is reflected on the respondents' indications pertaining to the average number of meals they have when they are either doing conservation or conventional farming. From CA plots only 55% of respondents indicated that they could have an average of three meals a day which is the Zimbabwean standard, whereas 46% of the respondents stated that they had 3 or more meals through conventional farming. To further reflect the minimal impact that CA has on food security in Mangwe 53% of the respondents practising CA said they sometimes skipped meals to ensure the young members of the family had enough to eat. This percentage is equally high (68%) under conventional farming. The interviewed farmers pointed out that under CA households tended to access the food that they enjoy consuming as opposed to what they normally receive when there is a food aid programme. When the situation becomes critical, families or households tends to strategize and conserve their food through reduced meals per day.

The unimpressive statistics relating to the contribution of CA to food security in Mangwe can largely be explained in two ways. One of the ways is the nature of CA adaptation in Mangwe that was explained earlier on. The CA that is practised in its current state cannot produce the same yield turnover as in other areas since as the standard biological processes that are the hallmark of CA are not given room to flourish. For instance limited or zero mulching encourages the growth of weeds and lack of crop rotation hamstrings the regenerative properties of CA on the soil. Secondly, the adverse agro-ecological conditions obtaining dictate that rain-fed agriculture's impact on food security is limited. Firstly, there is the problem of failing to address transitory food insecurity generally associated with the peak hunger months of January to March (ZimVac, 2012). The small yields realised through summer cropping cannot cater for the households' needs through to the next harvests. There is thus need to introduce winter cropping which would necessarily be supported by viable irrigation systems. Therefore in light of Clover's (2003) assertion that food insecurity is due to faulty analysis and faulty actions, this study is of the view that in Mangwe the analysis of the food insecurity problem is correct though the remedial action is found wanting as highlighted in the foregoing.

In addition, farmers practising CA tended to realise social capital where they build partnerships between groups within the community. The concept of *Amalima* (local language that means social capital or working in partnerships) is mostly employed to counteract the labour intensity of CA as is practised in Mangwe especially where weeding is concerned. One local NGO, ORAP maintains that this is the best philosophy to achieve community development. As one of the promoters of CA in Mangwe, the NGO sees the social capital increasing community participation and cohesion. There is cooperation of people in groups and it enhances participatory processes.

CA practice, therefore allows farmers to put land under cropping with the type of food they traditionally consume. As a result, the small grain seeds such as *rapoko*, (finger millet) *indumba* (beans) *amabele* of various types and ground nuts are preferred over maize grain. Communities in Mangwe tend to access the food through their harvests should there be good yields from their fields. Due to the concept of social capital or better known in local language as *Amalima* (collective farming), communities find it easier to access food because the partnerships built during the planting season

extend well beyond the harvest season. After the harvests, the farmers who receive surplus yields can share with those who would have realised inadequate yields. The concept of *amalima* also saves money for the farmers as cooperating during the labour process (especially where weeding and digging basins are concerned) offsets the labour costs that would ordinarily be part of the input costs. This tends to improve the financial capital as it enhances the levels of incomes to farmers. During the focus group discussions, members indicated that the *Amalima* concept helps those members that are impoverished and vulnerable access food at the household level due to nature of CA practice. However, when given access to farming inputs timeously farmers in Mangwe are in a position to improve food access. The UNCTAD and UNEP (2008) study, confirms that poverty remains the root cause of hunger and malnutrition in the world. It further states that lack of access to markets means that farmers and communities can neither sell their surplus nor purchase food in times of shortage. This leads to inconsistent food availability thus contributing to food insecurity.

IMPACT OF CA ON LIVELIHOODS

There is a significant linkage between food security discussed above and livelihoods in rural areas. In most rural communities, households diversify their livelihoods in order to improve the availability of and access to food, which translates to food security. In Mangwe, subsistence farming is the main livelihood strategy and conventional farming has been the most practiced farming system. However, due to pervasive external shocks posed by the changes in the environmental and climatic conditions, communities, through the assistance of NGOs and agricultural extension offices, have adopted CA as a coping strategy to the challenges posed. This is in line with the assertion that livelihood attempts to “capture not only what people do in order to make a living, but the resources that provide them with the capability to build a satisfactory living, the risk factors that they must consider in managing their resources and the institutional and policy context that either helps or hinders them in their pursuit of a viable or improving life” (Ellis, 2005:4).

In literature, the commonly discussed impacts of CA on livelihoods include higher and more stable yields with lower input costs, implying availability of surplus for sell and consequently better economic and social wellbeing of the farmers (ACSAD & GTZ, 2008). Notably, CA in Mangwe, just like in other areas where it is practiced, has several impacts on livelihoods. Respondents indicated that with low albeit consistent rainfall, CA has a huge potential to improve the food security status of households, improve their asset base and increase their income levels, as such improving their livelihood outcomes. Improved food security, increased household income and strengthened social capital networks all impact positively on capital assets as discussed in the SLA, thus improving the livelihoods of farmers. The study noted that CA promotes group work where households combine their labour to work on their plots. This aspect strengthens their social networks which they ride on to diversify and form cooperatives to do other income generating projects. This was evidenced in Dukwe village in Ward 3 where women formed a bread baking cooperative as a livelihood diversification strategy to boost the financial capital. As such CA is potentially boosting the capital assets of households in Mangwe, thus increasing the possible livelihood diversification options that households can take up.

A study on CA, labour and livelihoods in the Arab Region indicated that:

There are more direct impacts which have potential to turn around the daily and seasonal calendar and on the long term change the rhythm of farmers’ family because of the reduced labour requirements for tillage, land preparation and weeding likely to occur. Especially women may be released from weeding tasks that traditionally were a ‘woman’s task. More time availability offers real opportunities for diversification options

such as for example poultry farming or on farm sales of produce, or other off-farm small enterprise developments that now (with time available) are a 'real' opportunity, (Friedrich and Kienzle, 2008:31).

This assertion however, does not hold true with Mangwe due to the fact that the CA they practice is highly manual and as such labour intensive, demanding much of the households' time to be spent on the CA plots preparing the land for sowing and also weeding. As such, although CA promotes livelihoods diversification, it is not through reduction of labour requirements for tillage but rather strengthened social capital and increased capital assets. Another pertinent issue is that in Mangwe district, women are the core workforce in CA and such there is no way they can be released from weeding. Their male counterparts and the youth in general as stated above, migrate to Botswana and South Africa in search for better employment opportunities.

The majority of the respondents in the district noted that in the past years, with consistent rainfall, they could produce significant amounts of yields from which they got surplus. According to the SLA, this results in food security as a livelihood outcome, thus having a positive impact on livelihoods. Some respondents indicated that they could sell this surplus and manage to buy kitchen utensils, pay school fees for their children, and buy livestock, among other things. This is in agreement with Serrat, (2010:2) that potential livelihood outcomes from activities aimed at enhancing household livelihoods, just like CA, can include 'more income, increased well-being, reduced vulnerability, improved food security, more sustainable use of the natural resource base, and recovered human dignity'.

Similarly, a study in Paraguay analysing farmers with 7 to 10 years experience in CA compared conventional farmers and with their initial situation before adopting CA and the findings show that:

All farms had increasing crop yields after the change to CA due to the rapidly improving soil fertility. These effects lead to increased farm income which combined with the reduced production costs resulted in significantly higher net income (Friedrich and Kienzle, 2008:31)

Although the farmers in Mangwe had not practiced CA for a lengthy period, these findings tally with the sentiments of the farmers in the district under study. The farmers noted that with low rainfall, CA could produce high crop yields that could result in realization of surplus which in turn could be sold and result in increased household income. The income could be instrumental in fueling livelihoods diversification, hence improving their livelihoods. However, due to erratic rainfall in Mangwe, the strategies that were taken up as forms of livelihood diversification have now become the main sources of livelihood. Notably, Nkala, Mango, Corbeels, Veldwisch & Huising (2011:5524) caution that "attributing all livelihood benefits to CA in the absence of robust quantitative approaches capable of isolating effects of other exogenous factors could be oversimplification of an otherwise very complex process". In Mangwe district, for an example, Practical Action (n.d.) notes that most of the households' livelihoods are mainly anchored by remittances from either Botswana or South Africa, although the respondents were silent about that aspect.

Moreover, in the prevailing conditions of erratic to scant rainfall in Mangwe, CA's effectiveness towards better livelihood outcomes in the district has been highly compromised, thus negatively affecting the sustainability of livelihood activities in the district. Although Carney (2002) and Toner (2002) cited in Nkala, *et al* (2011:5521) argue that "CA may

be a panacea to sustainable livelihoods for smallholder farmers amid poverty, vulnerability, political and economic instability and civil conflicts”; their argument overlooks the notion of confounding variables such as erratic rainfall. This is because CA can perform well even under low rainfall conditions but erratic rainfall confounds its virtues. As such this, coupled with the labour intensive nature of the practice has downplayed CA’s ability to positively impact households’ livelihoods.

This highlights the vulnerability context of the District of which the SLA notes that “vulnerability is characterized as insecurity in the well-being of individuals, households, and communities in the face of changes in their external environment” (Serrat, 2010:2). The “vulnerability context includes shocks, seasonalities, critical trends and technological trends” (Serrat, 2010:2). These seasonal shocks in the form of erratic rainfall in the district reduce the positive impact of CA on livelihoods. Therefore, in light of the main tenets of the sustainable livelihoods approach, it is evident that, all things being constant, CA has potential to enhance livelihood opportunities in Mangwe district. However, its impact is thwarted by erratic rainfall and its labour intensive nature, among others.

CONCLUSION

This paper assessed the impact of CA on food security and livelihoods in Mangwe. It revealed that the CA practiced in Mangwe is an adapted form and consequently fails to extend most of the benefits that other forms of CA extend to farmers. The problem of food insecurity is still pervasive in Mangwe district despite the adoption of CA by a significant number of farmers. Whilst CA theoretically holds promise as a panacea to food insecurity its major limitation as is currently practiced in Mangwe is that it is heavily reliant on rainfall. This is a major limitation in an arid to semi-arid area such as Mangwe as transitory food insecurity typically of peak hunger periods remains unaddressed. If CA is to address food insecurity challenges in the District, it is critical for policy makers to address the problem of water shortages and its labour intensity. To this end a consideration to mechanize some aspects of the agricultural process can be made by introducing equipment such as jab planters on some kind of a hire purchase scheme. Concurrently, there is need to usher in irrigation-fed CA, which can improve the food security status of the community. If this is done other dimensions of livelihoods can be positively influenced by the adoption of CA. More-so, in terms of livelihoods; the fact that CA is mostly practiced by aged women farmers requires that stakeholders do a gendered analysis of the impact of CA as is currently practiced.

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