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An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward

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Abstract

The study assessed the sustainability of conservation farming in promoting food security among smallholder farmers in Change Ward. The study findings were analyzed using a sustainable livelihood theoretical framework using a qualitative research approach where interviews, focus group discussions, and observations were used. It was found that the farmers are growing a variety of crops, which is resulting in improved crop diversification and more resilience among farmers. This has a positive bearing on increasing food availability, the variety of crops is leading to improved nutritional status at the household level. Also, their resilience to climate change has thus far improved because of conservation agriculture which in turn increases the probability of its sustainability among farmers as they are seeing its benefits. Furthermore, vulnerabilities of this strategy were also highlighted which might pose a threat towards its sustainability, these include dependence on government inputs, too laborious, climate change which is resulting in high and unpredictable rains which come for a short period. The study found out that farmers own land for their agricultural purposes, and have family support which tends to reduce workload at the fields, farmer groups and technical support from the Agritex officers. However, during the research, some participants had a divergent view on the sustainability of this strategy as they do have assets such as land, they are not in any farmers group which has a bearing on the workload. Thus, the study shows that conservation agriculture is one of the key strategies that is being practiced by smallholder farmers towards the improvement of their food security at home. This strategy is sustainable among farmers as there are assets that are put in place that could help the farmers to continue with the strategy in ensuring food security. However, in ensuring its sustainability there were some loopholes which needs to be addressed inorder to address the sustainability aspect of this strategy such as clear and improved land ownership, women empowerment which will go a long way in addressing the shortage of financial resources. Government should introduce and subsidise the mechanization of this strategy as a way of reducing its workload in the fields. There is need for the empowerment of smallholder farmers on soft skills such as unity and respect among the farmers.

Keywords: *Conservative agriculture, Food security, Smallholder farmers, Climate Change, Resilience, Adaptation and sustainability.*

1. introduction

This study seeks to assess and unpack the sustainability of conservation farming in promoting food security among smallholder farmers Change Ward and will highlight the vulnerability of smallholder farmers, to assess the assets owned

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by farmers which could help them to address the shocks and trends associated with conservation agriculture. Thus, this study seeks to unpack the sustainability of conservation agriculture in promoting food security in Change Ward by assessing the community perceptions about conservation agriculture.

Climate change is affecting every country worldwide. It is disrupting national economies and local communities and affecting lives. Like any other country in the world, Zimbabwe is facing adverse impact of climate change, and smallholder farmers are not spared from these impacts as they are facing a decrease in their agricultural outputs.Climate change-induceddrought, manifested as temperature increases and decrease drainfall, is already having a negative impact on Zimbabwe's agricultural sector, particularly smallholder farmers (CIAT and World Bank, 2017). As a result, most smallholder farmers have been the recipient and the ones engaging in conservation farming whose sustainability in providing food security is still questionable. Also, Mazvimavi and Nyamangara (2012) argue that there are many instances of strong conservation agriculture adoption during the active promotion of conservation agriculture projects, followed by dis-adoption, there is a shortage of evidence about farmers' attitudes toward conservation agriculture in SSA and farmers have characterized it as "dig and eat" and "dig and die," highlighting the high labor demands of conservation agriculture. Thus, this makes one view its sustainability to be at stake among smallholder farmers.

Also, with the increase in climatic change, the Ward has not been spared from these effects and in responding to them conservation agriculture has been adopted among most of the smallholder farmers. The adoption of this strategy has been fueled by the subsidies or Presidential inputs such as seeds, fertilizers, and workshops they obtain from the government and NGOs. Despite the advantages of conservation agriculture, a lot of questions have been left unanswered on how it can be practiced over a long time and over generations while achieving food security because it is a subsidized and incentivized mechanism in communities, and when the subsidies are stopped will the communities continue practicing it. Thus, with these reasons behind the adoption of conservation agriculture in Change Ward, the sustainability of this strategy in communities is questionable because it is incentivized.

2. Objectives

The study will be guided by the following objectives:

- To assess the contribution and vulnerabilities of conservation agriculture in promoting food security.
- To determine the capital assets owned by communities in strengthening the sustainability of conservation agriculture.
- To examine the ways employed by smallholder farmers in promoting sustainability of conservation agriculture in ChangeWard.

3. Literature Review

3.1. Vulnerabilities of Conservation Agriculture in Promoting Food Security

As a means of addressing the grave problems that have harmed the life cycle, environment, and humanity, conservation agriculture is emerging. To put it another way, conservation agriculture is a strategy for managing agricultural ecosystems, enhancing productivity and sustainability, boosting benefits, ensuring food security, and protecting the environment (Lugandu *et al*., 2012). A pro-environment farming practise known as "conservation agriculture," tries to safeguard water and soil resources while also making the best possible use of inputs and resources. The employment of conservation agriculture as an exit strategy in recent decades has been prompted by a number of issues, including the degradation of soil and water resources, falling groundwater supplies, declining soil quality, drying out of agricultural fields, and increasing soil erosion (Swaminathan, 2013). A key phase in the transition to sustainable agriculture is conservation agriculture, which is a new paradigm for sustainable agricultural production (Farooq and Siddi, 2015).

3.2. Lack of Acceptance

According to FAO reports from 2018, the conservation agricultural system was only used in 4 percent of the agricultural areas in Asian nations. In contrast to developed Asian nations, poorer nations like Iran reject this agricultural method more frequently. According to polls conducted in 2020 by the Iranian Ministry of Agriculture, just 3.5% of Iranian farmers have used conservation agriculture. The biggest barriers to conservation agriculture's acceptability and growth in Iran, according to Gholami *et al.* (2020), include a lack of government backing, economic and cultural issues, a lack of access to equipment, and adherence to traditional farming practices.

3.3. Farmer's Capacity

Africa faces different implementation difficulties than the conservation agriculture's original home, notably in the semi-aridzones.The success of conservation agriculture in semi-arid locations, especially in Southern Africa (300-500 mm annual rainfall), depends on farmers' capacity to preserve agricultural wastes and provide effective weed control (Giller *et al.,* 2019). In order to increase the quantity and quality of manure, most crop leftovers are either transported to the kraal or grazed by animals in situ. Agricultural systems are primarily mixed crop-livestock systems with low crop production (Murwira *et al.,* 2015). Droughts are frequent, and rainfall is unimodal, irregular, and highly variable both within and between seasons (Challinor *et al.,* 2007).

3.4. Use of IKS

Despite these difficulties, Malawian farmers have knowledge of indigenous systems that enhance the quality of the land and food, maintain soil moisture, and prevent soil erosion (Mulwafu, 2011). In the past, farmers practiced 'makusa,' or shifting cultivation, to increase the fertility of the soil. Farmers gathered and burned grasses and tree branches as part of this method, then combined the ash with soil to grow maize, cucumbers, and pumpkins. The "matutoorkatuto" technique of mound cultivation was applied on the steep hills of the Shire high lands. They were flat mounds that were planted with beans, groundnuts, and intercrops of sweetpotatoes, cassava, and other crops. Before planting maize, cowpeas, pigeon peas, edible gourds (mphonda), and sorghum on the plains, farmers cleared and tilled the ground (Mulwafu, 2011).

3.5. Too Much Labor

Nyanga and Droppler (2019) argue that farmers find it very challenging to give up the plough, and this attitude shift is likely the biggest obstacle to conservation agriculture adoption. Yet, both wealthy and developing nations have begun to accept the practice. In the first year, when six to seven weedings are necessary for Zimbabwe's semi- arid regions, weed management is a significant difficulty. In the second season, this decreases to three weedings, which is comparable to conventional agriculture. Two weddings should be sufficient in the third year and subsequent years. Although these practices are difficult to undertake, proper composting of farmyard manure or plant matter and dry season weeding are essential for weed management in Zimbabwe.

4. Social Capital Assets

Families of smallholders are typically large. In nations like Kenya and Bangladesh, smallholder families typically have seven members, of which two are children under the age of 14. The statistics show no gender-specific disparities in composition; there are roughly equal numbers of adult men and women. These families reside in homes that they, for the most part, own themselves. Household ownership accounts for 98 percent of all small farms across all the nations we investigate (Baig and Gamache, 2019).

5. Financial Capital

Goddard *et al.* (2017) allude that households'access to markets and services is hampered by a lack of roadways. Smallholders' poor access to markets makes them more susceptible to shocks and reduces their capacity to take advantage of economic possibilities that can result from easy trade. It is challenging to represent the technology used by smallholders just through data. To put it another way, farmers work the land in conjunction with labor, seed, fertilizer, and other inputs to create food and other goods. Labor, land, and other resources necessitate a separate examination because these are inputs that clearly distinguish smallholders from other farmers (Pretty, 2017). For instance, the median Tanzanian smallholder consumes 22 kg of inorganic fertilizer per hectare while using a cereal-root mixed farming system, as opposed to the 8 kg used by the typical larger farmer in the nation.

6. Human Capital Assets

The competitiveness and development potential of business units, industries, and economiesare determined by a variety of factors. These days, when the knowledge-based economy and the endogenous growth theory are considered, human factor endowment appears to be one of the fundamental components of progress. Since Schulz and Becker published their well-known study, Human Capital (HC) has drawn the attention of numerous academics and organizations (Salami, 2010). Yet, Quiros and Rodolfo (2019), posit that the definition of human capital itselfis ambiguous. The development of businesses, as well as of states and regions, depends on abilities, skills, and acquired capabilities, which are considered to be a component of human capital. The literature generally agrees that education and training are the primary factors causing human capital, although other signs are less evident.

7. Methodological Approach

This study will be carried out in the Hwange district specifically focusing on Change Ward. The word "research approaches" refers to a variety of techniques and processes that range from broad assumptions to specific data collecting, analysis, and interpretation methodologies. This technique necessitates several decisions, none of which must be made in the order that makes sense to me or that is specified here (Schram *et al.,* 2019). The research will use a qualitative approach in the collection of data from the respondents using a participatory approach where all participants will be free to take part in the entire study. Qualitative data are primarily non- numerical and usually descriptive or nominal in character," says Kabir (2016). Ritche and Lewis (2013) define qualitative research as the expression of information concerning perspectives, feelings, opinions, values, and attitudes, usually in words. According to Kirkless (2018), qualitative research allows for close contact with the subject, allowing for the observation of the participants' attitudes, behaviors, and emotions. Qualitative research is significant, according to Ospina (2004), since it can be used to investigate phenomena that have never been studied before, as well as to improve the design and interpretation of traditional research. Qualitative designs allow for flexibility, allowing for process exploration. Cropley (2015) adds to this by stating that non-numerical data is obtained using qualitative approaches. The purpose of qualitative research is to describe and analyze phenomena from the target group's point of view (Haradhan, 2018). Moreso, this study will use key informant interviews and focus group discussions to collect data from the respondents. The study's respondents will include the Hwange Rural District Council Social officer, Agritex officer, Veterinary Officer, Lead farmers, and traditional leaders then focus group discussions will consist of community elderly and youths.

8. Study Findings

8.1. Contributions

8.1.1. Improved Food Availability

The study unearthed that conservation agriculture has brought a number of positive impacts in the community. The participants during the focus group discussions alluded that food availability has increased since they started practising conservation agriculture. Smallholder farmers have alluded that the availability of food at household level have increased. One of the respondents was quoted saying during the focus group discussion:

> *Since the time I started conservation agriculture in 2017 there has been enough food to last my household throughout the year.* (FGD 1, Participant 2)

Still on the same issue another participant emphasized that:

> *In these past few years I have managed to harvest enough food for my family unlike when we did conventional farming we could end up buying food in the shops but now with conservation agriculture the yields can last us throughout the year. This is as a result of us having a minimum of 3 hectares of land which has enabled us as a household to get enough and even sell some of the grains to those who are doing broiler and layers projects.* (FGD 2, Participant 1)

Thus, based on the above quote, it is clear that the conservation agriculture has improved and enhanced food availability at household level among smallholder farmers. This shows the huge contribution of conservation agriculture in improving the availability of food which is a key pillar towards food security at house hold level. It also shows its importance and likelihood towards improving food security and its sustainability in the long run. When this strategy is practiced farmers could continue enjoying the fruits and the benefits of conservation agriculture which are improved food security through making its availability high.

8.2. Improved Yields

Furthermore, the respondents alluded that there has been an increase in the harvests and yields. They opined that the farmers have experienced an increase in their farming output especially on millet and cowpeas. This was evidenced by one respondent that:

> *For the past three years I have experienced an increase in the number of drums that I have harvested with my household of six members. I have managed to harvest five drums of millet which is an increase from the maximum three drums which we usually got from the past years.* (FGD2 Participant 4)

This shows that conservation agriculture is playing an important role in contributing towards food security across smallholder farmers as these are now experiencing higher yields. Conservation agriculture promotes increased plant

growth and crop yield by reducing the damage to the physical properties of the soil, improving soil health through crop residue cover, crop rotation, and minimal soil disturbance (Key and Roberts, 2017). This results in increased crop diversification and higher yields, which improves household food security. This has a huge bearing on the sustainability because smallholder farmers are experiencing some benefits of using this farming method which include improved yields. As a result, the famers are having a variety of crops at their disposal.

8.3. Soil Conservation

The study found out that conservation agriculture is key towards the improvement of soil structure and quality. This practice has been important to smallholder farmers as this farming strategy is helping to preserve and conserve soil which in turn is improving soil fertility in the fields. One participant expressed that:

> *Smallholder farmers who are doing conservation agriculture (gantshompo), collect manure, put some fertilizers and crop residues or grass to improve the soil fertility. This has been helping farmers in improving the soil fertility which is key towards enhancing the crop yields in our fields. So with minimum tillage the soil structure is helping to contribute to improving soil fertility and giving them a high probability of increasing yields.* (Key Informant 3)

8.4. Use of Organic Fertililzers

Apparenlty, the study findings indicate that conservation agriculture reduces the need for synthetic fertilizers and pesticides, which can be expensive for farmers. The smallholder farmers alluded that conservation agriculture is cost effective. There is less to no use ofpesticides as they are using locally available alternatives and they are economic. This was further concurred during the focus group discussions that:

> *The use of conservation agriculture as the farming strategy has helped us to minimize the need and the use of pesticides because we are now depending on the readily available manure, intercropping to minimize the costs on pesticides.* (FGD 1, Participant 6)

This further corroborated with the findings of Kumar and Mitta (2019) that this approach relies on organic or natural fertilizers, such as animal manure, crop rotation and intercropping which are accessible and affordable to small-scale farmers. By reducing the dependence on synthetic inputs, farmers can allocate resources towards other areas that improve household food security. This shows that conservation agriculture is contributing much to the food security in a cheaper and affordable way within smallholder farmers.

8.5. Increased Resilience to Climate Change

With the abject and the increase in the global warming, the participants were appreciating the contribution of respondents vowed that:

> *The conservation agriculture towards the improvement of food security has been high in Change Ward. The respondents alluded that with the Ward experiencing reduced rainfall patterns year after year so the introduction of conservation agriculture has enabled us as smallholder farmers to be resilient to these impacts of climate change*. (FGD 2, Participant 1)

The study shows that conservation agriculture is much more sustainable among smallholder farmers as it is helping the communities to respond well to the effects of climate change. They are able to be resilient and harvest increased yields despite having reduced rainfall. FAO (2021) highlighted that Pfumfudza program helps farmers build resilience to climate change, which is increasingly affecting agricultural production in Zimbabwe. The conservation agriculture practices promoted by the program, such as mulching and soil cover cropping, conserve moisture and protect soil from erosion, making crops more resilient to climate variability. Conservation agriculture improves the resilience of households to withstand severe weather events and climate change. It does so by protecting soil health, conserving water resources, and promoting crop diversity, which enhances soil microbiota health. Households can, therefore, continue to produce food even during periods of water scarcity, despite the increased occurrence of extreme weather events as a result of climate change.

8.6. Nutritional Status

The respondents highlighted that they are now experiencing improvement in their nutritional status. The use of conservation agriculture has helped the farmers to come up with mixed farming strategy. One of the key informants alluded that:

The use of mixed farming has helped smallholder farmers through the growing of a variety of crops which include cowpeas, groundnuts, Bambara nuts (round nuts), millet, sorghum, maize and some have beans. All these are good to meet the smallholder's nutritional demands and as we will be having a variety of food at our disposal at household level. (KII 7)

Thus, the above quote shows that conservation agriculture is playing an undeniable role in promoting the nutritional status in the community among smallholder farmers. This is because they are now able to cultivate a variety of crops which will have a positive impact on their choice of food. Mavendenge *et al.* (2019), argues that the initiative promotes crop diversification by encouraging farmers to plant a variety of crops through mixed approach. This increases the availability of nutritious foods, reduces reliance on a single crop, and enhances food security. In this regard one can say that the fact that conservation agriculture is improving food security through enhanced nutritional status and variety of crops grown shows that its contribution is key towards its sustainability among smallholder farmers in Change Ward.

8.7. No Need for Animal Drown Plough

The smallholder farmers expressed that, with the conservation agriculture there is no longer any need for animal drown plough. Even those without any livestock such as cattle and donkeys can now freely do their farming without any delays. This was expressed by one participant that:

In the past decades we used to suffer especially us, who did not have large livestock to pull the animal drown plough, we used to wait for those who have those animals to finish their fields in doing so we could be delaying. As this was happening our crops used to fail as we have limited rains. However, now with conservation agriculture we can now finish all our fields without any need of the plough. (FGD 1 Participant 5)

Therefore, based on this conservation agriculture is playing an important role among smallholder farmers in the communities as it is enabling them to cultivate their crops on time without any delays. This has a huge contribution towards food security considering that the rainfall periods have been shortened due to climatic changes. So, with this strategy farmers have been benefiting beyond doubt as they are able to plant on time.

9. Vulnerabilities Section Climate Change

Climate change has profoundly affected Africa's weather patterns, leading to unpredictable rainfall patterns, prolonged droughts, pests, and diseases. Conservation agriculture is exposed to these climate change effects since it relies on rain-fed systems. Considering that this Ward is in Region 4 and progressing towards 5 exposes it mostly to all the ravaging effects of climate change as the rainfalls are no longer predictable and also very low. Without rain, the soil dries out, leading to crop loss and food insecurity, while prolonged rainfall events lead to soil erosion. The study findings further find out that climate change has led to prolonged dry spells which makes it hard for the crops to sustain the moisture in the soil. One of the participants was further quoted saying:

As far as conservation agriculture is most suitable in dry spells and doesn't need too much rains but with these sandy soils that we have in our Mvuma Mountain could not resist the high temperatures. This year in 2023 we received too much rains in January and by the end of the month the rains were gone and we stayed more than a month without rains. The sun was very hot and the crops could not be resistant and most of the crops were burnt and wilted due to shortage of rains. (FGD 2, Participant 10)

The prolonged dry spells that has been experienced in the Change Ward which has led to wilting of crops despite the smallholder farmers practicing conservation agriculture. Their dependence on rain fed farming has a negative impact on their output and crops at large. This further supported by Reardon and Barrett (2019), that climate change has profoundly affected SSA's weather patterns, leading to unpredictable rainfall patterns, prolonged droughts, pests, and diseases. Conservation agriculture is exposed to these climate change effects since it relies on rain-fed systems. For instance, Mujeyi (2021), in Malawi prolonged droughts have caused numerous soil health challenges for farmers, with most soils' nutrient content depleting. This clearly shows that despite having all the contribution but it remains more vulnerable to climate change variables as the prolonged dry spells are damaging and affecting their crops.

Moreso, still on the same matter of climate change, some respondents highlighted rainfall patterns are unpredictably changing due to climate change. They have since experienced high rainfalls during the month of January which affected the growth of the crops as there was water logging in the fields. This water logging is a result of these farmers no longer using fertilizers like top dressing which has nitrate which help to absorb water thus reducing the likelihood of water logging. It was further argued by one participant that:

The rainfall patterns are increasingly and rapidly changing because when we were growing up January had low rainfall and we usually expected high rainfalls in the month of February when the crops are towards their final stage. But now the rains are very high in January, especially this year in 2023 the rains were excess in January and we never experienced them again which affected the growth of crops. (FGD 1, Participant 9)

Furthermore, on the same note one emphasized that:

The reduction in rainfall has a huge bearing on the farmers as the crops wilts, leading to reduced yields, food insecurity, and starvation and to poverty at household levels. These effects of climate change have been experienced in the ward which begs the question of whether we are doing the right thing to address and mitigate these impacts of climate change. (FGD 2, Participant 1)

The rains came as a surprise to the smallholder farmers as they usually expect such rains around February when their crops are at their final stage but this year the rains came very early thus affecting growth of the crops. This was mostly experienced in clay soils in (Goba Area) and the participants are alluding that the sustainability of this strategy remains in question if it is not able to prevent water logging.

9.1. Land Ownership

Change ward is one of the wards with limited land for farming which makes young people to be left without land. This was unearthed during the study that most of the youths do not own land for their farming purposes as all the land has been shared among families with some having two or three fields. At the same note some elders especially those who recently relocated into the village have no land so they are leased maybe every year by those who own multiple pieces of land. This was highlighted during the focus group discussion:

The youths have no entitlement to any field except the ones they are given by their family or parents. They are given small portion of land which could not sustain them with their family for the entire year. This in turn affects the sustainability of this strategy as we have limited land in the community. The Agritex officers are saying one needs one hectare to be able to yield food that can sustain for a year but we will be given a land smaller than a hectare. (FGD 2, Participant 8)

Thus, the fact that some smallholder farmers have no land that is entitled to them affects the sustainability of this farming strategy. This is because there are a lot of delays in the farming which makes these farmers not realize the positive impacts of conservation agriculture. This was further corroborated by the findings of Derpch (2015) that land ownership is a contentious issue in Africa. Intense competition for land due to population growth and urbanization often leads to land conversion and degradation. Conservation agriculture relies on land tenure security to promote long-term investments, whereas the lack of tenure security hinders the adoption of conservation agriculture practices. This shows the vulnerability of smallholder farmers involved in conservation agriculture as they do not own land where they can make their own decision on how to use the land for their agricultural purposes and less effort will be put to improve the soil fertility.

9.2. Lack of Agricultural Financing

The study participants opinioned that one of the vulnerabilities of conservation agriculture is that it is not well financed. There is limited funding from government and other non-governmental organization. This strategy is too laborious and without proper funding it is hard to execute it. There is need for funding especially on inputs such as fertilizers and seeds, some of us do not have access to the presidential inputs as they are selected families that well connected to the Extension Officers and the village heads. One of the farmers alluded that:

The ones who fail to get the presidential inputs end up resorting to sourcing their own farming inputs but not all of the farmers are able to purchase inputs like seeds and fertilizers. Those who do not have access to loans or any financial support from their relatives always suffer and use their own previous yields as seeds that are not treated. (Participant 13)

Still on the same note, previous studies by Eide (2018), find out that access to affordable credit and financing is a significant hindrance for smallholder farmers. These farmers often have little collateral to put up, making it challenging to secure loans to purchase inputs and other farming essentials. Conservation agriculture requires substantial investments in soil conservation, water management, and other farming practices. However, most smallholder farmers in SSA lack access to affordable financial services to fund these investments. For example, in Kenya, many smallholder farmers struggle to access credit to finance investments in soil conservation practices. The Pfumfudza program is largely

dependent on the government for funding. However, in some cases, funding has been insufficient, and farmers have not received the required support to implement the program effectively (Buhler, 2015).

9.3. Dependence on Government Inputs

The farmers expressed their concern on the sustainability of this strategy due to their dependence on government funding. The farmers had the view that there is no sustainability and they remain vulnerable especially when the government stop giving them inputs for this strategy. One of the farmers lamented that:

> *This is a good initiative brought by the government to promote the uptake of conservation agriculture among smallholder farmer. However, the future of this strategy remains blink as long the farmers are not capacitated to source their own inputs this strategy dies the day the government stops its funding.* (FGD2, Participant 4)

This shows that the dependence on government's inputs has an effect on the sustainability of conservation agriculture because when the government stops funding this strategy farmers will fail to have adequate inputs needed for this strategy. Farmers will fail to procure seeds, fertilizers and other pesticides that will help to promote good output if the government stops its funding. Thus, the sustainability of this strategy is in question as long as farmers still depend on the government funding for this strategy will not continue with it after the end of the funding.

9.4. Lack of Knowledge and Skills

The study findings unearthed that most of the farmers lack knowledge and skills on how to practice conservation agriculture in the correct manner. This was alluded during the interviews that the agriculture extension officer fails to cover and reach all the smallholder farmers which in turn left a certain group with limited information on how to practice conservation agriculture. The participants argued that the failure by the Agritex officer can be attributed to the large area that he needs to cover and a lot of farmer groups. This makes him fail to reach to all of them on time that's jeopardizing the output of the strategy as the farmers will be not knowing whether they are doing the right things. The Officer fails to reach most of the farmers who are in Chilanga and Shangano who are in the outskirts and unreachable most of the time and are left uninformed on how to effectively practice conservation agriculture. On the same note, one alluded that young people, also have limited skills and ability to effectively practice this strategy considering that there is a need for a lot of skills and knowledge in order to get good output. This was further concurred by a study by Duke and Powles (2018) that smallholder farmers often lack the knowledge and skills required to practice conservation agriculture effectively. For example, in Uganda, most smallholder farmers practice farming methods that are not sustainable, and only a small percentage has knowledge of conservation agriculture practices

9.5. Too Much Labor

The study highlighted that the smallholder farmers are being strained by conservation agriculture as they have seen it to be to laborious. There is too much work that is needed in practicing conservation agriculture which makes it to be more straining. One of the participants was quoted saying:

> *The issue of conservation agriculture needs someone who is more energetic and hardworking because, someone needs to measure the holes and start digging them, applying manure and fertilizer. After this when it comes to weeding one has to weed two to three times which most of smallholder farmers are not willing or happy to do.* (Participant 17)

Thus, based on this, conservation agriculture remains more vulnerable as it needs those with more strength and power to do it and the lazy ones will be left behind. In the long run smallholder, farmers will not continue with this strategy, especially the elderly who are not physically strong to do all the needed activities. The farmers have limited knowledge and resources to buy equipment needed for mechanized conservation agriculture. Thus, as this happening the sustainability of this strategy remains a night mare among smallholder farmers as they are viewing it as a strategy that is too demanding for them as it needs too much labor.

9.6. Soil Quality

In Change ward most farmers are in sandy soils which are infertile due to over ploughing year in and year out. These soils have a huge impact on their agricultural output as they will not get much yields. The advent of conservation agriculture has not helped in the improving the soil quality despite with the use of manure. The poor quality of soils has an impact on the acceptance and the sustainability of this strategy. They alluded that without good soil quality, conservation agriculture tactics such as crop rotation, reduced tillage, cover crops, and agroforestry lose their effectiveness in promoting soil health. Soil quality is vital for plant growth and food production. This was further concurred by

Hussain and Hanjra (2019) that soil quality is vital for plant growth and food production. Soil degradation, severe erosion, nutrient depletion, and depletion of organic matter poses a significant threat to conservation agriculture in Africa. Soil degradation, severe erosion, nutrient depletion, and depletion of organic matter poses a significant threat to conservation agriculture in Africa. Without good soil quality, conservation agriculture tactics such as crop rotation, reduced tillage, cover crops, and agroforestry lose their effectiveness in promoting soil health. Soil quality affects the success of conservation agriculture. Soil degradation, severe erosion, nutrient depletion, and depletion of organic matter pose a significant threat to conservation agriculture in SSA. Thus, the fact that the study findings, collaborate with previous study that the soil quality is paramount importance in the sustainability of conservation agriculture.

10. Assets Owned Sessions

10.1. Natural Assets

10.1.1. Land ownership

The study findings show that land ownership was one of the assets owned by the smallholder farmers. This was most frequently among the male participants, who alluded that one of the largest assets they have is the fields that they plough. One was quoted saying:

> *The land in this community is mostly owned by men who are the head of the family. As men, we inherit the land from our parents and also, we are given it by the village heads. So, having this asset will have a long way in sustaining conservation agriculture as they will be using their own land.* (FGD 2, Participant 9)

These findings are in line with previous findings of Derpsch (2015) that smallholder farmers in SSA own land that they use for crop production, which is a critical resource for practicing conservation agriculture. With secure land tenure and land rights, smallholder farmers can invest in long-term conservation practices. Landholdings contribute to soil conservation, biodiversity, and the improvement of soil structure. Thus, this shows that the smallholder farmers own land which makes it easy for them to practice agriculture without any struggles.

However, during the study, it emanated that the community is partriachial in nature with reference to assets such as land. Women alluded that they are considered second-class citizens and they are not given the right to own any land as most of these fields are owned by their male counterparts. The study participants highlighted:

> *As women who are into farming, we are the ones who do all the work in the fields with the man coming in during weeding if they feel like coming. However, the unfortunate part is that we do not have the rights to own the land. When our husbands die the fields are either taken by our male children when married leaving us without land. This in turn affects our securities and the sustainability of the strategy as we end up not using a lot of manure as we will be knowing that this land will be taken from us and we cannot put manure to make it more fertile.* (FGD 1, Participant 2)

Thus, this shows that land ownership in the community or ward is controlled and guided by patriarchal guidelines where land is owned by men despite having women being the ones fully involved in farming. This at large have a huge impact on the sustainability of this strategy because the ones who are actively involved in agriculture do not own land. This results in limited decision making on improving or making the land more productive Henceforth, there is need to advocate for women land ownership and make sure that they are given adequate and equal access to land resources the same way men have so that the sustainability of this farming strategy can be enhanced thus promoting food security.

10.2. Livestock

Apart, from land the study unearthed that most smallholder farmers own small livestock. The farmers alluded that besides engaging in crop farming, they are also in animal rearing. They are doing this as a way of supplementing their nutritional value and also to supplement food availability at household level. They vowed that they are rearing animals such as goats, chickens, turkey, darts and some sheep. These livestock help in times of food shortages or in procuring some of the needed inputs which are key in agricultural purposes. One of the farmers alluded that:

> *In 2021, I did not get fertilizer during the presidential inputs distribution because I was out of the Ward but I had already dug the holes for conservation agriculture, so had to sell my goats to buy fertilizer. So, imagine if I had no goats I was going to be left stranded but the fact that I have my livestock helped me to counter the risk and vulnerability of conservation agriculture*. (FGD 2, Participant 4)

This shows that the smallholder farmers fully have adequate natural assets that are key towards improving the sustainability of this farming strategy. They are able to sell their livestock in order to promote conservation agriculture. This in turn will go a long way as the farmers are taking full responsibility of all the needs that are supposed to be done in order to obtain good yields in conservation agriculture.

10.3. Social Assets

10.3.1. Farmer Groups

The first asset raised was the issue of farmer groups where smallholder farmers create the groups based on their relations in the community. This was purported by one of the participants during the discussions:

> *We as smallholder farmers through the help of Amalima Loko we have lead farmer's initiative where a lead farmer is supposed to have her group of ten farmers whom they teach and help each other to dig the holes in each other fields. However, as a community we have split the groups into two where five mothers help each other in the fields.* (FGD 1, Participant 9)

Consequently, having such initiatives in the community is a step towards sustainability as the farmers are coming together to help each other in minimizing the labor involved in conservation agriculture. By working together, the farmers encourage each other and also help one another on their weakness so that no one will be left without having adequate food. This corroborated with the study finding of Shepherd *et al.* (2019) who alluded that smallholder farmers in SSA often form farmer groups that pool their resources and knowledge, promoting sustainable agriculture practices so much as conservation agriculture. By collaborating and sharing costs, smallholder farmers can invest in long-term farming activities such as soil conservation and agroforestry practices. Smallholder farmers often work together towards common goals such as land conservation, improving soil health or raising productivity. Collective action promotes social cohesion, which can lead to the successful implementation of conservation agriculture practices. Also, Upton (2022), argues that smallholder farmers can make use of social capital invested in relationships they have with other farmers, organizations, and local leaders. Through these networks, farmers can share experiences, get advice, learn about new farming technologies, and access resources, all of which contribute to promoting the sustainability of conservation agriculture.

However, some of the farmers have a divergent view concerning the farmer groups as they highlighted these usually fuelled conflicts amongst the groups. The farmers alluded that some of the group members tend to work tirelessly if it is in their field but when they visit someone's field they will be working as if they do not want. In doing so this usually affect the effectiveness of these groups. One participant pointed that:

> *I was once in that farmer group, when we were doing the turns and when it was my turn, for them to come to my field just three came and the other gave an excuse and the following week only two came. From that moment I decided to quit the group and worked with my family because I saw that I wasn't benefiting anything from this group*. (FGD 1, Participant 5)

Thus, based on this, it shows that as far as the farmer group are key in sustaining conservation agriculture strategy there is need to train the farmers on soft skills such as conflict resolutions, training of group dynamics and importance of these group. This will be done among smallholder farmers to make sure that they keep doing what is good and share the responsibility equally in the group. They have to work equally and support each other in the group. If this is not cemented, the farmer groups will collapse and the smallholder farmers will give up on this strategy considering that it is too laborious.

10.3.2. Family Support

The smallholder farmers pointed that they have their family member's support. They alluded that they go with the family to help them with weeding and also digging holes. The family members are involved and help the elders, this was noted when one participant vowed that:

> *Someone like me who does not have a farmer group, I go with my children or my husband during his off days to help me with measuring and digging holes. This is because on your own it is too much one cannot be able to finish on time as the Agritex officer make support visits to check progress*. (FGD 2, Participant 1)

This reveals that the involvement of the family members is key towards the sustainability of this practice as the children will be learning and the skills will be diffused to them which will make its continuity to last for long time. Besides, diffusion of knowledge and skill, the family support help to reduce the workload on the parents due to high workload on this strategy. Smallholder farmers receive support from their families, who often contribute labor and other resources required for agriculture activities. Families can also participate in conservation agriculture activities such as intercropping and cover cropping, contributing to sustainability.

10.3.3. Traditional Practices

The study unearthed that conservation agriculture is one of the communities and traditionally embedded farming practices which can be traced back to their ancestors. They highlighted that this is one of the tried and tested method which have higher output compared to any farming practices and can help to promote food security at household level with or without high rainfall. One of the key informants suggested that:

> *The community have been doing this strategy through dry planting before the government started advocating for this Pfumfudza. The smallholder farmers where doing mixed farming where they farmed a variety of crops and this has helped them to sustain and contain their food needs so with the government subsidizing and supporting the farmers with inputs will continue helping the farmers*. (Key Informant 3)

This was further confirmed by Govera (2010) that smallholder farmers have practices that are embedded in their culture and customs, which can promote sustainability. For example, traditional practices such as leaving fallow land can improve soil health and promote biodiversity. Thus, based on this, conservation agriculture is one of the trusted initiative and strategy for agriculture which has the strength and potentially increasing the yields of smallholder farmers. This on its own has a huge bearing on the sustainability of this strategy toward ensuring food security at household level.

10.4.. Financial and Technological Assets

The study found out that there is lack of financial support for boosting their yields and making huge outputs. The study findings unearthed that most of the famers are not having access to financial support from either government, bank or any microfinances. This affects the sustainability of conservation agriculture as without any financial support those who lack opportunity to get presidential inputs will fail to get money to buy these inputs. They argued that:

> *As farmers we do not have the capacity or collateral to collect and get loans to support this strategy. Some of us have failed to buy some pesticides, seeds among other inputs because there is no financial support from the government.* (FGD 1, Participant 7)

The farmers are failing to have access to loans or any government support financially which has a bearing on the sustainability of this strategy towards the achievement of food security in the ward as they will not be able to buy all the needed inputs to sustain the strategy. This was further confirmed by a study by FAO (2021) that smallholder farmers in sub-Saharan Africa often lack access to formal financial services, which make it difficult for them to invest in sustainable agriculture practices, including conservation agriculture. However, smallholder farmers possess several financial assets that contribute significantly to promoting the sustainability of conservation agriculture.

10.5. Technical and Capacity Building

The study participants alluded that they appreciate the knowledge and capacity building they have been receiving from their Agritex officers and the other partners. They alluded that:

> *The smallholder farmers attend workshops and trainings that are organized by either the Agritex officer, Amalima Loko or World Vision to capacitate us on how to practice conservation agriculture in a way that can increase our yields. These sessions are called and every smallholder farmer is welcome to join, in doing so we remain capacitated as farmers.* (FGD2, Participant 8)

Thus, the above assertion highlights the issue of technical support that the smallholder farmers are getting from the experts within the ward which has a huge positive impact on the sustainability of this strategy. The shows that the smallholder farmers are successfully having the skills and the training they need for them to fully practice this strategy as there is support from NGO's and the government which are teaching them. The Pfumfudza program provides farmers with education and training in conservation agriculture practices. This helps farmers acquire skills and knowledge to implement sustainable production techniques, enhancing food security in the long term (Murungweni, 2021).

10.6. Human Assets

10.6.1. Labor

The study further unearthed that the available human assets among smallholder farmers is the availability of labor at household levels. The farmers alluded that this strategy tend to demand too much labor and there is need for more workforce. The households with more family members tend to be saved from the demand of labor. This was highlighted during the study that:

> *Our family members play an important role in conservation agriculture during the digging of holes, our household members come to help us with measuring, digging and planting in those holes. The families are important in this strategy in helping us as smallholder farmers.* (FGD2, Participant 3)

So, the availability of labor at household levels is one of the asset which contributes much to the sustainability of conservation agriculture which has a bearing on food security. The presence of labor have a huge impact in the success and the sustainability of this strategy. Smallholder farmers often provide the labor required for land preparation, weeding, and harvesting. The labor helps in maintaining the sustainability of conservation agriculture practices, improving soil health, and preventing environmental degradation.

10.6.2. Local Knowledge

The farmers highlighted that conservation agriculture is one of the strategies that has been used from generation to generation and the skill as have been transferred from those generation upto now. The communities showed to have mastered this strategy and are aware of all the components of conservation agriculture. One of the respondents alluded that:

> *The government is trying to take us back to the old days where we used to conduct and now they want to teach us what we already know. This is not something new to us as farmers we learnt this and we know this. We have full knowledge of this strategy the only thing that we were lacking on was the issue of use of fertilizers not manure*. (FGD 1, Participant 7)

The fact that this strategy has been passed on from generation to generation the community has been considered and been able to grasp the information and the skills on how to practice it. The community farmers consider this strategy as it is embedded in community knowledge and understanding. This traditional knowledge and skills have a huge bearing on the sustainability as it will help to the communities to trust it and be able to execute it without any doubt thus promoting food security. This further concurred with the previous study of Nancy *et al.* (2018), smallholder farmers possess traditional knowledge relating to agriculture, soil, and climate, passed down from past generations. The knowledge is critical for promoting sustainable agricultural practices, including conservation agriculture.

10.6.3. Indigenous Crops

The farmers alluded that they are basing on indigenous crops for this strategy, these crops are already and readily available in the communities. They are cultivating small grain crops such as millet and sorghum which are drought resilient. The farmers highlighted when they do not have adequate money to buy seeds they usually recycle their seeds without buying them from the retail shops. One of the participants expressed that:

> *For the smallholder famers we usually select the cops with large grains (Ibhabhadla) as the ones to preserve for our next farming seasons as we believe that those grains are the one which can be retained. This on its own help to reduce the stress of buying seeds as we have limited funds.* (FGD 1, Participant 6)

Thus, based on the above assertion, it is highlighted that farmers are depending on retaining seeds which make them reduce the financial stresses of buying seeds when they are not given or receive the presidential scheme. However, the issue of returning seeds has a negative impact on the yields and the nutrition status which affects the sustainability of this strategy because by returning seeds as the farmers are doing it will have a huge impact in the long run. As this is happening it shows that smallholder farmers are putting and have adequate resources and assets to keep this strategy to be more sustainable in their quest towards food security. For example, Mupangwa *et al.* (2017) argues that smallholder farmers in SSA cultivate traditional crops that are resistant to pests and diseases that may affect other crops. Indigenous crops enhance agro-biodiversity, and by adopting conservation agriculture, smallholder farmers can protect native species diversity.

10.6.4. Ways to Improve Women's Empowerment

The study participants vowed that in order to improve the sustainability of conservation agriculture among smallholder farmers there is need to promote women empowerment. This was argued that women were the ones who are involved

fully into this strategy and their empowerment will go a long way to promote its sustainability. One participant was quoted saying:

> *Most women in this ward do not own land while they are the ones who are tilling the land. So as women we are requesting for the government support or any other stakeholders to engage the village heads to give us land that we can have it in our names. Also, besides this there is need to help us as women to have financial links which will help us to fund our own agricultural needs.* (Participant 11)

This was further concurred by Reardon and Barrett (2019), that women play a crucial role in smallholder farming and are often responsible for food preparation and processing. Women's empowerment through access to resources such as land, credit, and training can lead to the adoption of conservation agriculture practices. Promoting women's inclusion and empowerment can enhance the sustainability of conservation agriculture practices through gender-sensitive interventions and policies. Thus in order to improve and keep the sustainability of this strategy there is need to promote women empowerment which will help these women to acquire resources and inputs that are key towards the improvement of the strategy.

11. Access to Credit or Financial Support

During the study there were some respondents who alluded that they fail to get the presidential inputs as they are excluded based on a variety of reasons. They suggested that they is need to improve and create credit lines for them to be able to get money to procure their inputs which they need for the strategy. The farmers are facing high levels of financial constraints which affects the sustainability of this strategy among the farmers as they are failing to access finances from the microfinance or banks. If the government could help the smallholder farmers with financial mechanisms which can help and boost their finances. Access to credit and financial services can allow smallholder farmers to invest in sustainable conservation agriculture practices that promote long-term sustainability.

12. Water Harvesting

The smallholder farmers are depending on rainfall for their agricultural purposes. Agricultural activities are embedded on the rainfalls so when dry spells prolong this has negative impact on the crop yield. The farmers argued that there is need to have irrigation systems for the farmers which are similar to those in Dick and Lubweludile which can help them to increase their resilience to the effects of climate change. There is need to increase water management systems which will help the communities to sustain their crops during the prolonged dry spells. This was further supported by Nancy *et al.* (2021) that water management practices such as drip irrigation, rainwater harvesting, and irrigation scheduling can promote conservation of water resources in rural communities. Conservation agriculture is dependent on rainfall patterns, and in areas where rainfall is erratic, farmers may not be able to effectively implement the program. Thus, considering that these conditions it is of paramount importance in the improving of the sustainability of this strategy.

13. Access to Mechanized CA

The study unearthed that there is need for an improvement of conservation agriculture in where this strategy will be mechanized. The farmers highlighted this approach being laborers and time consuming by digging the holes. Thus when this is mechanized with better equipment it will lessen the workload for the farmers. One of the key informants expressed that:

> *The government should try to import the same technology that is being used in other countries on mechanized conservation agriculture. This type of machinery will help in the digging of holes, planting putting manure which will substitute all the practices that are done by human hands in this strategy*. (Key Informant 6)

So, based on these assertions it is clear that there is need to improve and have mechanised conservation agriculture will enable farmers to have lessened workload. This will also help to preserve and promote food security at household level. Thus, the government and non-governmental organization should intervene and help the smallholder farmers to improve the sustainability of this strategy.

14. Agritex Officer to Work closely with Lead Farmers

The Agritex officer highlighted that the Ward is too big for him to reach to all the farmers and farmer groups. In light of this, it was suggested that the Agritex officer should utilize the available trained lead farmers in their communities. The officer should conduct regular workshop and trainings for lead farmers. These farmers will capacitate and disseminate the information to their fellow farmers in their villages. This will lessen the burden on the Agritex officer as he will get all the feedback from the lead farmers. The lead farmers will go a long in empowering and being the eyes and ears of the Agritex in the communities which will help to inform the Agritex on the challenges faced by all the farmers.

15. Access to Markets

The program aims to increase smallholder farmers' access to markets by connecting them with buyers, including large-scale food retailers. This provides farmers with a reliable market for their produce, leading to increased income and food security. The Pfumfudza program aims to improve smallholder farmers' income by increasing crop yields and enabling them to access markets. This improves their purchasing power, enabling them to buy food and other essential goods through the selling of the surplus obtained through an improved crop output. As this is happening to smallholder farmers they will reduce their dependence on the Presidential scheme to support them rather they will be able to procure their own seeds and all needed inputs, thus enhancing food security and promoting the sustainability of this initiative among smallholder famers.

16. Conclusion

The study unearthed that conservation agriculture is key strategy among smallholder farmers in ensuring and improving food security in their households. Through the adoption of conservation agriculture households have seen an increase in their crop yields which has led to improved food availability at household level, improved nutritional status on the family and also enhanced their resilience and adaptation to climate change. There is some vulnerability associated with conservation agriculture in which it is laborious where it needs more labor for one to execute this strategy. The other negative aspect raised was the issue of climate change has led to prolonged dry spells and decline in rains which has affected the output of using this strategy. The other issues raised was the soil quality of soils, poor financial support and lack of skills especially on young farmers. The study unearthed that farmers have both social, human, technical and financial assets which are helping them to improving and adopting this strategy.

16.1. Recommendation

The study further recommends the following recommendations in order to improve the sustainability of conservation agriculture among smallholder farmers as a way of improving food security:

- Mechanization of Conservation Agriculture, as this will help to reduce the workload among smallholder farmers. The government should import such machineries and subsidies it to smallholder farmers as this will help with small families which are not in farmer groups.
- There is need to enhance women empowerment in the Ward, where women can have adequate access to land where they can do their farming activities freely without fear of them being removed after the death of their husbands.
- Government should empower all the smallholder farmers in a way that will reduce their dependence on the government for the inputs as this will have a long-term impact on the sustainability of this strategy when farmers can now source their own inputs.
- Training and capacity building of farmer groups so that they can have constitutions and binding agreements so that these people can support each other in those groups equally without any favor.
- Establishment of policies and government actions to promote and create favorable conditions for the application of conservation agriculture (such as free access to information)
- Promotion of appropriate farm advisory services, public and private partnerships, and rewards for environmental protection services.

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