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Abstract: Climate smart agriculture has enhanced the viability and sustainability of smallholder farming in Umguza District of Zimbabwe. This study documents how smallholder farmers in Umguza District have responded to the adverse effects of climate change by venturing into small grains production, conservation farming and small livestock production. This paper discusses the vulnerability of smallholder farmers in Umguza District to climate change induced risks. The vulnerability profile is followed by an exposition of the resilience strategies used by the farmers to mitigate the effects of climate change. Additionally, the paper considers how the government institutions and development agencies can mainstream the adoption of climate smart farming technologies. The study used qualitative and quantitative approaches as methods of data collection, data were gathered through five key informants, and 30 in-depth semi structured questionnaires. This study suggests that government institutions and development practitioners should intensify resilience-building programmes, conduct climate awareness programmes and avail funding to improve the acceptance of CSA practices among smallholder farmers in Umguza and the rest of Zimbabwe.

Subjects: Development Studies; Development Policy; Rural Development

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PUBLIC INTEREST STATEMENT

This paper reveals how smallholder farmers in the Umguza District have responded to the adverse effects of climate change by venturing into small grains production, conservation farming, and small livestock production which are part of Climate Smart Agriculture. This paper discusses the vulnerability of smallholder farmers in Umguza District to climate change induced risks. The vulnerability profile is followed by an exposition of the resilience strategies used by the farmers to mitigate the effects of climate change. Additionally, the paper considers how the government institutions and development agencies can mainstream the adoption of climate smart farming technologies. This study suggests that government institutions and development practitioners intensify resilience-building programmes, address land tenure issues, conduct climate awareness programmes and avail funding to improve the acceptance of CSA practices among smallholder farmers in Umguza and the rest of Zimbabwe.
Keywords: Climate change; climate smart agriculture; resilience; small holder farmers; Umguza; Zimbabwe

1. Introduction

It is now generally accepted that climate change is a crisis of global proportions, and that it poses unprecedented challenges to rain-fed agriculture. Climate change has compromised the livelihoods and food security of millions of people. Smallholder farmers in Zimbabwe have not been exempt from the disruptive and negative effects of climate challenge (Chitongo & Casadevall, 2019; Dube et al., 2016; Murray et al., 2016). Of note is the fact that 67% of the Zimbabwean populace depends on agriculture for income and sustenance (World Bank, 2019a). Successive droughts have meant that Zimbabwe is currently facing its worst humanitarian crisis in decades with over 5.5 million rural people food insecure (Zimbabwe Vulnerability Assessment Committee (ZimVAC)),.

Climate smart agriculture is a sustainable, transformative and technologically innovative approach to farming that has been developed to mitigate the effects of climate change (Taylor, 2018). CSA is meant to enhance food security using environment-friendly farming practices, technologies, and inputs. It is composed of three main pillars, which is sustainable increment of agricultural productivity, bolstering resilience and reducing greenhouse emissions (Abegunde et al., 2019). Climate-smart agriculture bolsters the resilience of agricultural systems and seeks to achieve a balance between the priorities of adaptation, mitigation, and food security (K.P Thornton et al., 2018).

The persistent change in rainfall and temperature patterns threatens agricultural production and exacerbates the vulnerability of those who rely on rain-fed agriculture for their livelihoods (United Nations Framework Convention on Climate Change (UNFCC), 2019; Dube & Phiri, 2013; Dube et al., 2021). Climate change disrupts food markets, putting a larger population at risk of food insecurity, particularly resource-poor smallholder farmers (Intergovernmental Panel on Climate Change. (IPCC), 2019). There are several technologies, practices, and approaches that fall under the ambit of CSA. Such critical practices and techniques include: small livestock rearing, small grains farming, water harvesting, crop diversification through rotations and intercropping, agroforestry, conservation tillage and integrated soil fertility management, among others (Faurès et al., 2013; Murray et al., 2016). These CSA practices and technologies are key climate change management strategies for smallholder farmers in Sub-Saharan Africa.

In light of the aforementioned, the study explores the resilience strategies of smallholder farmers in Umguza District and their adoption of climate smart agriculture technologies. These climate smart technologies are promoted by The Anglican Diocese of Matabeleland operating in Umguza District covering four wards; ward 3, 4, 5 and 6 (Ward 4, 5 and 6 constitute Ntabazinduna village). The Department of Agricultural, Technical and Extension Services (AGRITEX) is also involved in the programme.

The thrust of the paper is as follows: 1) to examine the extent of climate change vulnerability among smallholder farmers in Umguza District, 2) to explore climate smart agriculture practices utilized by smallholder farmers in response to climate change impacts, and 3) to examine how government institutions and development practitioners can complement efforts to promote the adoption of climate smart agriculture technologies.

1.1. Understanding Resilience

The term resilience, generally defined, refers to the ability to withstand adversity. In the context of climate change resilience denotes the change in natural or human systems in response to real or perceived climatic effects, which moderates harm or exploits beneficial opportunities (Intergovernmental Panel on Climate Change, 2007). Similarly, Action on Climate (2018) defines resilience as a process where people, communities, businesses, and various sectors independently
or dependently come together to successfully cope with the effects of climate change. Furthermore, (IPCC, 2012) shows that resilience is the ability of a system and its component parts to anticipate, absorb, contain or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration or improvement of its essential basic structures and functions.

Parry et al. (2008) asserts that resilience is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change. Therefore, increasing resilience can be achieved by reducing vulnerabilities and increasing adaptive capacity. This can be achieved by reducing exposure, reducing sensitivity and increasing adaptive capacity, for every climate change-induced risk (Gitz & Meybeck, 2012).

According to Levine (2014), numerically measuring resilience may prove to be a challenging task because resilience cannot be measured as a singular entity due to the variations of threats or risks to which people are exposed. For instance, a certain community may be vulnerable to floods, while the other maybe facing acute shortages of water. However, Borquez et al. (2017) argue that instead of viewing this as a weakness, it should merely show how complex resilience can be. For example, drought can be reduced by using drought-resistant varieties or keeping stocks of hay for animals (Gitz & Meybeck, 2012). Ultimately, increasing/or building resilience of agriculture-based livelihoods can guarantee food security, reduction of poverty and protection of the environment.

2. Climate change in Zimbabwe
Climate change is occurring at rates much faster than anticipated and its effects are clearly felt worldwide. Available scholarly and scientific evidence reveals that agriculture-based livelihoods are significantly affected by climate change (Intergovernmental Panel on Climate Change, 2014; Intergovernmental Panel on Climate Change. (IPCC), 2019; Jamshidi et al., 2020). Seasonal dynamics, increased frequency of droughts, especially increased mid-season dry spells, increased temperatures, and altered and shortened patterns of precipitation and intensity are some of the extreme weather events evident in sub-Saharan Africa including Zimbabwe (Gbegbelegbe et al., 2018; Mupangwa et al., 2011).

There is a growing drive the world over to increase climate action through scaling up both climate change mitigation and adaptation interventions. The Government of Zimbabwe in partnership with its stakeholders have prioritized national actions that build climate resilience, lower the country’s greenhouse gas emissions (GHGs), and contribute to sustainable development (Climate—Smart Agriculture Manual for Zimbabwe, Climate Technology Centre and Network, 2017). Zimbabwe has actively welcomed innovations and programmes such as Climate Smart Agriculture (CSA). CSA practices are expected to sustainably increase productivity and resilience, reduce GHGs (mitigation), and enhance the achievement of national food security as well as sustainable development goal (15) 15 on climate action. CSA is widely expected to contribute towards achieving the objectives of the Paris Agreement to “hold” the temperature increase below 2 degree Celsius and enhance climate change adaptation (Climate—Smart Agriculture Manual for Zimbabwe, Climate Technology Centre and Network, 2017).

The most crucial climate issue for smallholder farmers in arid and semi-arid regions of Zimbabwe is rainfall. It is estimated that only 37% of the country receives adequate rainfall for rain-fed agriculture (FAO, 2005). Projections of future climate change impacts place southern Africa’s agriculture sector (Zimbabwe included) at the forefront of climate change vulnerability with potential negative impacts on revenue from dry land farming (Gbegbelegbe et al., 2018; Intergovernmental Panel on Climate Change, 2014, 2007).
To sum up, with more than 90% of small-farmers in Zimbabwe depending on rain-fed agriculture for their livelihoods and approximately 70% of the population living in rural areas and relying on agriculture for their livelihood, the impacts of changing rainfall patterns and increasing frequency of droughts could be devastating, unless concrete steps are taken to enhance the resilience of rain-fed agriculture upon which millions of smallholder farmers depend for their food security and livelihoods (OECD, 2012).

2.1. Climate smart agriculture (CSA) technologies in Zimbabwe

Agriculture is one of the sectors significantly affected by climate change and variability. Seasonality dynamics, increased frequency of droughts (especially mid-season dry spells), increased temperatures, and altered patterns of precipitation and intensity cumulating into widespread crop failure are some of the extreme weather events evident in Zimbabwe (Government of Zimbabwe, 2020; Ndlou et al., 2020).

Climate change resilience research in agriculture has identified CSA as one of the many sustainable agricultural practices that can make households withstand the deleterious effects of climate change and variability in smallholder farming systems (Makate et al., 2018). The Zimbabwe’s Ministry of Agriculture and Climate Change has adopted the Intwasa/Pumvudza farming concept, which involves the utilization of small pieces of land and applying the correct agronomic practices for higher returns, also it is based on conservation agriculture principles that seeks to climate-proof agricultural production and simultaneously addressing challenges of low productivity, low production and low profitability of farming among smallholder farmers which continue to negatively affect the food security situation in the country (Government of Zimbabwe, 2020).

It is also the argument of this paper that smallholder farmers have always practiced climate smart agriculture practices like rearing of small livestock like goats and sheep. Scientific evidence has shown that small livestock (i.e. goats and sheep) consume less from the pastures in a specified area and the amount of water drunk by goats and sheep is far less in comparison to cattle that demand more feed due to their sheer size, hence the rationale of their preference against cattle (Phiri et al., 2020). The study acknowledges that increasing the number of goats is destructive to the environment in the long term. However, in the short term, extensive production of goats is critical in the maintenance of rural landscape and with the aim of biomass management that avoids the occurrence of forest fires. The increase of goat production will take into cognizance system sustainability. Needless to say that intensive production of goats may lead to depletion of natural resources and increase environmental pollution (Ngara, 2017). Thus, an equilibrium has to be attained to strike a balance between cost and benefit. A familiar strategy is to practice transhumance, which consists of seasonal movement of animals regularly between two or more areas of seasonal pasture, through established paths. These CSA critical practices like conservation agriculture, rearing of small livestock and cultivation of small grains are key climate change management strategies for smallholder farmers in Zimbabwe. Their complementary and supplementary efforts in resilience to climate change are severely important for farm productivity and income.

3. Location and Geography

Data for this study was collected from March to July 2020 in Ntabazinduna Village, Umguza District, Zimbabwe. Umguza is a peri-urban district which borders Bulawayo Metropolitan province. Ntabazinduna is located 19 miles from Bulawayo Province to the east along the Bulawayo–Harare highway. Umguza district is famous for cattle ranching and market gardening. Rain-fed agriculture is the major livelihood for the district’s rural population, as well as informal trading.
3.1. Map of Umguza in Zimbabwe

3.2. Materials and methods
The study utilised a two-pronged methodological approach that blended a mixed-method design which integrated both qualitative and quantitative data collection tools. Thirty (30) in-depth semi-structured questionnaires were purposively distributed to smallholder farmers who practiced Climate Smart Agriculture in the selected wards of the Umguza district over the past 5 years. Purposively sampled smallholder farmers participating in a Matabeleland Integrated Drought Resilience Program being implemented by the Anglican Diocese of Matabeleland provided the data presented in this study.

Five key informants were drawn from agricultural extension staff, and the Anglican Diocese of Matabeleland technical staff in charge of the Climate Smart Agriculture programme. This data was cleaned, qualitatively coded and analyzed under themes. Respondents were given a voice in this qualitative analysis through verbatim quotations and summaries of their narratives and experiences as they adapt to climate change through CSA. Thematic analysis is the process of identifying themes or patterns within qualitative data (Braun & Clarke, 2006).

The quantitative data was extracted from the key informants. Secondary sources were also used to corroborate primary data which includes government publications, from key experts, and internet articles on climate change and climate smart agriculture.

4. Results and discussions

4.1. Climate change vulnerability amongst smallholder farmers in Umguza District
As previously highlighted in the literature review, smallholder farmers tend to be more vulnerable to the effects of climate change. The following two excerpts from key informants give insight into the susceptibility of the Ntabazinduna community to climate change.
For the past three farming season’s rainfall distribution was very erratic. This is by far the most single factor that contributes to poor crop performance and animal performance. For example 2018/2019 season was characterized by very low rainfall and dry spells which led to delayed planting of all crops that are usually planted early, very poor emergence resulting in low plant populations for all crops, repeated replanting and gap filling and poor crop establishment and high animal mortality in some cases smallholder farmers losing the entire herd of cattle. (Key informant 1, AGRITEX)

Ntabazinduna wards are characterized by erratic and poorly distributed rains which hardly go beyond 450mm per annum coupled with high temperatures which rise beyond 39 Degrees Celsius on hot days. Crop sustainability is very difficult under the given circumstances except for drought tolerant crops which can withstand harsh weather conditions such as sorghum, millet, rapoko and cowpeas. Low and poorly distributed rainfall severely affects the cropping activities and livestock production, as a result the community receives poor harvest and the livestock is always in an undesirable state. Water for both human and livestock is a challenge as most water sources in the community dry up fast because of siltation and evaporation. (Key informant 3, Anglican Diocese of Matabeleland).

Responses by smallholder farmers corroborated the views of the key informants:

Climate change has affected me and my family severely. I now rely on donors to feed my family because what I get from the fields is no longer sustainable. (Household respondent 8, Ntabazinduna).

Due to low rainfall in our area our water bodies dry up as early as August and rains come as late as November, this situation affects both us and our animals. (Household respondent 9, Ntabazinduna)

It is important to note that responses by women (60 percent of the sampled respondents) reveal that vulnerability to climate change is a gendered phenomenon. Female respondents narrated how the unavailability of water affects them, as they have to walk long distances to fetch water for household chores, human and livestock consumption. It emerged from the study that in Ntabazinduna, women are more vulnerable and affected by climate change than men. The foregoing has to be understood within the context of rural to urban migration, where men migrate to other places in search of employment. Consequently, women become responsible for managing the domestic economy of the household and associated care work. What has aggravated the plight of women is the HIV and AIDS pandemic, and the new COVID-19 pandemic.

In addition, the key informants revealed that in the past decade the district has dry spells (see Table 1). The implications of dry spells are wilted crops which require replanting and makes it expensive to farm. Smallholder farmers rely on presidential inputs scheme for their farming activities (seeds and fertilizers) that only come once a year. The result of these

| Table 1. Dry spells 2019/2020 season |
|-------------------------------------|
| Umguza                              |
| 18/11/2019                          | 3/12/20 | 16 | Very poor emergence. Very poor crop establishment. Replanting. Temporary and permanent wilting. |
| 18/12/2019                          | 3/2/20  | 45 |
| 11/2/19                             | 9/3/20  | 28 days | Poor fertilization, grain filling and grain development |
| 10/3/20                             | 4/4/20  | 30 | Poor fertilization, grain filling and grain development. Crop write-off |

Source: AGRITEX file report, 2020
delays lead to low plant populations, poor crop establishment, poor fertilization, poor grain initiation and development, poor grain filling and subsequently, reduced yields (See Table 2) and crop write-offs (See Table 3) in the district (AGRITEX report, 2020).

The percentage of land allocated to small grains remains low compared to maize. Yet the average yield (t/ha) for pearl millet is only double that of maize. Sorghum and pearl millet combined have a percentage three times more than that of maize, yet farmers still want to grow maize. The reason for this scenario is partly because the government continuously distributes maize seeds in abundance and rarely seeds for sorghum, millet and rapoko. Furthermore, the market for sorghum and pearl millet is very limited compared to that of maize. A government-driven policy shift is needed to change this scenario.

Government policy on free/subsidized maize seeds for farmers is largely responsible for the low uptake of small grains production in communal areas. There has always been a strong incentive from the government for the production of maize through agricultural extension services, aggressive marketing by seed houses and millers, favorable pricing policies and good demand. While the government acknowledges the importance of producing small grains in drought prone areas, it has deliberately distributed free maize seeds at the expense of small grains. This intentional policy position has discouraged farmers from producing small grains en masse, hence the low supply in the markets.

From the farmer’s point of view, producing sorghum and millet is labour-intensive compared to maize. The high labour costs in the value chain of small grains production such as land preparation, weeding, and bird scaring to harvesting and grain processing. The ease with which maize is processed cannot be compared to that of small grains. Small grains are labor demanding and therefore less preferred by farmers.

In addition, there are limited marketing opportunities for millet, sorghum, and rapoko in the formal markets. The sustainability of seed and grain production is dependent on assured markets without which farmers have little incentive to produce. Despite efforts by NGOs and brewing companies to assist farmers in the production of small grains, it has not yielded significant results. There is clearly a lack of infrastructure to market the buying and processing of small grains. The

| Table 2: Average yields |
|-------------------------|
| **Umguza District**     | **Average yields** |
|                         | Maize            | Sorghum         | Pearl millet |
| Total area planted 2019/20( ha) | 16,589.87 | 2992.87 | 490.11 |
| Average yields (t/ha)   | 0.2             | 0.23            | 0.4          |

Source: AGRITEX file report, 2020

| Table 3: Area written-off |
|---------------------------|
| **District** | **Crop** |
|              | Maize | Sorghum | Pearl. Millet | Cotton  |
|              | Area ( ha) | %-ge | Area ( ha) | %-ge | Area ( ha) | %-ge | Area ( ha) | %-ge |
| Umguza      | 6062.5 | 36.54 | 796.6 | 26.62 | 216.2 | 44.10 | 157.8 | 25.04 |

Source: AGRITEX file report, 2020
lack of incentives, subsidies, storage facilities, and effective transport arrangements discourages farmers from producing these drought resistant crops (see Table 4).

In relation to livestock, smallholder farmers lost a significant herd of cattle because of dehydration and hunger as a result of loss of pastures and dried up water bodies. It is important to note that in November 2019 alone Ntabazinduna village recorded at least 45 deaths of cattle and Umguza district as a whole lost 768 cattle due to drought (see Table 5) (AGRITEX report, 2020). It is important to note that the account given by both smallholders and key informants corresponded with scientific data that was presented by AGRITEX Matabeleland North Provincial crop and livestock report for 2019/2020 farming season.

An average of 40 cattle per ward per year is too high. On average each beast costs $350usd which means a ward loses $14000 USD every year. Given that we have an average of 30 households in a ward, this translates to $466.67 per family per year which is $38 per month. However from the standard error of 8.3, we are 95% confident that the mean number of deaths of the population is between 23 and 57 translating to between $8050 and $19950 of revenue lost per ward. This is a significant loss for a family given what this amount can buy. However it should be noted that the standard deviation (36.12) is high signifying that the range is high, suggesting that there is a lot of variation in the data set. Skewness (1.03 per standard deviation) suggests that most of the deaths were on the lower side.

4.2. Climate smart agriculture practiced by smallholder farmers in Umguza district

In line with the reviewed literature, the researcher(s) found that there are a number of CSA technologies undertaken by smallholder farmers in Umguza District. These CSA technologies are: the practice of growing of small grains; conservation agriculture and rearing of small livestock.

4.2.1. Conservation agriculture

Conservation agriculture is a combination of soil management practices that includes crop rotation, soil cover (through mulching) and reduced soil disturbance (Corbeels et al., 2015; FAO, 2008). Conservation agriculture (CA) has its roots in the principles of providing permanent soil cover, minimizing soil disturbance and rotating crops, and is now considered an important contributor to

| Table 4. Land allocation |
|--------------------------|
| Umgua District           |
|                         |
| **Crop**                |
| Total area planted2019/20 (ha) | 16,589.87 | 2992.87 | 490.11 |
| Percentage Area planted 2019/20 | 82.6    | 14.9   | 2.4   |
| Average yields (t/ha)    | 0.2     | 0.23   | 0.4   |
| Area written-off (ha)    | 6062.5  | 796.6  | 157.8 |
| Relative Percentage Area Written-off | 86.40   | 11.35  | 2.25  |
| District Percentage area written-off | 36.54 | 26.62 | 25.04 |

Source: Field research, 2020

| Table 5. Cattle poverty deaths, in Umgua District: November 2019 |
|---------------------------------------------------------------|
| Ward | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| Cattle deaths | 25 | 15 | 15 | 28 | 3 | 14 | 7 | 90 | 101 | 34 | 112 | 21 | 65 | 17 | 19 | 50 | 8 | 105 | 39 |
| Total deaths | 768 |

Source: AGRITEX file report, 2020
sustainable agriculture (Jayne et al., 2018). Conservation agriculture as a climate smart agriculture practice aims to achieve sustainable and profitable agriculture, simultaneously improving livelihoods of smallholder farmers through the application of the three conservation principles, which are minimal soil disturbance, permanent soil cover and crop rotation (Farooq & Siddique, 2015).

Both smallholder farmers and key informants from government agency and NGO agency stated that CSA had improved food security at household level, regardless of the size of field that farmers had. Conservation farming program is being spearheaded by The Anglican Diocese of Matabeleland an NGO agency implementing CSA practices in the area under study and AGRITEX a government agency implementing the programme under Intwasa/Pfungwudza scheme. An AGRITEX officer indicated that:

Intwasa/Pfungwudza is a government program that seeks to enhance smallholder farmers’ resilience to climate change by adopting conservation farming techniques and involves the use of small plots and applying the correct agronomic practices for higher yields. (Key informant 1, AGRITEX)

An NGO expert reiterated that:

Conservation agriculture has proved to be the most crucial and highly adopted climate smart agriculture practice for a reason that it does not need a draft power. While earlier it has been labor intensive, we have provided ripper tines that have lessened the burden. Ripper tines are conservation agriculture tools that are used to prepare planting stations in the form of rows on an uncultivated land so as to achieve conservative agriculture principle of minimum soil disturbance. (Key informant 3, Anglican Diocese of Matabeleland).

This was validated by a smallholder farmer who said that:

Conservation agriculture has improved yields to some of us who used to struggle to do meaningful farming because of lack of draft power. Now I do not have to wait for draft power from my neighbor or even hire a tractor. (Household respondent 15, Ntobazinduna)

Both key experts and smallholder farmers acknowledged the importance of conservation agriculture in strengthening resilience to smallholder farmers but pointed out that the challenges on the low uptake of small grain production is attributed to labour constraints, non-availability of mulching materials and failure to maintain fields all year round.

Smallholder farmers indicated that they have been taught that after harvesting they should keep the residual crop for mulching and protect it from animals. Despite the cost cutting benefits of this strategy, it is hard to implement because residual crop is used as stock feed during the peak drought months (October- November). Therefore this study found that the need of food for the animals outweighs that of maintaining climate smart agriculture fields, this therefore shows that CSA agriculture technologies must cater for the supplement feed of animals.

4.2.2. Small grains production
The preference for small grains (sorghum, millet and rapoko) derives from the fact that they are more ecologically compatible with semi-arid areas compared to maize. Small grains are drought tolerant, have a long storage life and are seldom attacked by insects and pests. Small grains also serve other functions besides addressing the key issue of food insecurity like non-alcoholic beverages (Dube et al., 2018; Phiri et al., 2019).

Another smallholder farmer noted that:

We grew up planting small grains millet, sorghum, rapoko and cowpeas on a small scale. Usually rapoko and sorghum have been used for beer brewing especially for traditional
ceremonies, and for selling, Amalima (Social contract by which smallholder farmers come together to help each other with activities such as land cultivation and tending livestock) and for self-consumption. We also dry cowpeas leaves kept for relish and its harvest usually sold and exchanged for some household items from traders post-harvest. (Household respondent 10, Ntabazinduna)

Despite the scientific evidence and observations that small grains are resistant to climatic changes compared to maize, we found that the majority of smallholder farmers still dedicate more hectares to maize production. Experts and smallholders farmers attributed the foregoing reality to the fact that maize is a staple cereal and has a bearing on the uptake of small grains. It is imperative to note that in spite of the benefits of cultivating small grains, the government’s presidential input scheme mainly distributes maize seeds. In contrast, the Anglican Diocese distributes small grains.

Since 2014 we have pursued a programme of assisting farmers with expertise and provision of farming inputs for small grains. The uptake has been improving since the start of the project but we’ve noted that smallholder farmers plant small grains like rapoko, millet and sorghum mainly for beer brewing and feeding their chickens and consumption becoming secondary.

(Key Informant 3, the Anglican Diocese of Matabeleland)

4.2.3. Small livestock production

Small-scale communal livestock rearing plays an essential role in sustaining livelihoods in developing countries. Livestock is central to food security, balanced nutrition, and is a source of organic fertilizer (Phiri et al., 2020). Most of the smallholder farmers are being sustained by small livestock production. Respondents noted that livestock rearing as a diversification strategy insures against poor harvests as animals are sold or exchanged for food.

Small livestock farming is one of the climate smart agriculture approaches. An Anglican Diocese officer recounted that:

Our organization provided goats to smallholder farmers in Ntabazinduna. The primary objective despite other benefits was that goats will give farmers a cushion in an event of poor harvest. 50 Farmers were provided with 2 goats each, considering the birth-rate of goats in two years a farmer is expected to have over 10 goats and in 4 years over 200 farmers will covered by the programme. (Key Informant 3, The Anglican Diocese of Matabeleland)

Traditionally, subsistence farmers preferred cattle to small livestock. This is because culturally a man’s wealth and influence was measured by the number of cattle he had. More so, goats were usually kept for slaughtering during small family gatherings and sheep for their fat which is used in cleansing ceremonies. Thus, there is need for civic education that will challenge the idea that cattle are the only store and measure of wealth. While goats cannot be used as drought power, they are drought resistant and goat breeding is viable commercial undertaking.

5. Community experiences with climate smart agriculture (CSA)

With the country experiencing successive droughts, the community of Ntabazinduna has not been exempted from this ordeal. The community has managed to gain significant produce from the fields owing to climate smart agriculture technologies that they have incorporated into their farming system (The Anglican Diocese of Matabeleland, 2020). The respondents were of the view that climate change was a source of their food insecurity and diminished livelihoods. Therefore, they understood the need to be resilient to the impacts and threats of climate change.

Research participants indicated that the CSA initiatives that were introduced and intensified has helped in improving food security and increasing their asset base significantly. Conservation farming and small grains production had improved crop yields and cereal sufficiency significantly (The Anglican Diocese of Matabeleland, 2020; AGRITEX report, 2020). In addition, small livestock production has helped by providing both income and household food security. The small grains
project which included cowpeas, millet and sorghum has significantly increased household food security and income as the surplus is sold to Bulawayo market which is 40km away (The Anglican Diocese of Matabeleland, 2020). Given the aforementioned one smallholder farmer noted that:

**Prior to the community engagement with Anglican NGO in 2014 our yields were insignificant year after year because of very shortened rainy season and prolonged dry season, we lost many livestock with many farmers losing their entire herd of cattle, but the introduction of Intwasa, farming of cowpeas, sorghum and goat farming has brought relief among the community, now I am able to harvest food that lasts me up to the next farming season (Household respondent 13, Ntabazinduna)**

Participants of the study also indicated that they faced challenges in the implementation of these CSA. A significant number of participants cited labour constraints especially with regards to conservation agriculture. Conservation farming requires a significant labour input that is a challenge to labour constrained households. The Anglican Diocese of Matabeleland spearheading this initiative however indicated that this challenge is being addressed through the introduction of ripper tines instead of basins. In this regard a field officer from the Anglican Diocese of Matabeleland remarked that:

*Conservation farming is labour intensive, considering that most smallholder farmers are females, labour becomes a challenge therefore we introduced ripper tines which lessens the amount of labour. (Key Informant 3, Anglican Diocese of Matabeleland)*

The challenges also included unavailability of technical assistance and post-harvest management assistance. Key experts also indicated that they are facing resistance from the community and the implementation of these programs. They noted that most farmers are still holding up on the past and are unable to accept new interventions, and they also cited political interference as a barrier to their efforts.

### 5.1. Government institutions and development practitioners on CSA

A strategic, developmental and traditional role of the state is that of policy making, implementation, monitoring and evaluation in all sectors (Kanyenze et al., 2011). Policies are designed to promote inclusive growth and human development (Alliance for a Green Revolution in Africa (AGRA), 2014). Like any other government program, without appropriate institutional structures in place, climate smart agriculture programs may burden smallholder farmers and may not achieve their desired objective.

Strong institutional support is required to: promote inclusivity in decision making; improve the dissemination of information; provide financial support and access to markets; provide insurance to cope with risks associated with climate shocks and the adoption of new practices; and support farmers’ collaborative actions (Alliance for a Green Revolution in Africa (AGRA), 2014).

Many institutions and stakeholders, for instance, farmer organizations, private sector entities, public sector organizations, research institutes, educational institutions, and Civil Society Organizations (CSO) can play important roles in supporting the adoption of climate-smart agriculture (Newell et al., 2019). Additionally, the Government not only needs to coordinate financing for CSA technologies and practices, but also have the flexibility to plan and work across sectors (Newell et al., 2019). As markets become increasingly important, private sector players such as the smallholder farmers themselves become significant. There are growing opportunities for inclusive partnerships involving governments, private sector agribusinesses, and development organizations to collaborate on CSA issues such as carbon finance (Alliance for a Green Revolution in Africa (AGRA), 2014).
Key expert from AGRITEX noted that there is a need of greater involvement of government at all stages of farming. He noted that:

The increase in input costs such as seeds; fertilizers; veterinary chemicals; unsustainable transport costs to the markets and unreliable market prices makes planning for next season very difficult. Therefore the government must support smallholder farmers through the subsidies, provision of inputs in time for preparation of the next farming season and promotion of local available seed varieties. (Key informant 1, AGRITEX)

In its mandate in the community, The Anglican Diocese of Matabeleland program director noted that:

Our main objective is to improve community resilience and socio-economic recovery by providing relevant skills for communities to better meet their basic needs and cope with future shocks. This can be done through strengthening their drought mitigation capacities by increasing social capital; identifying, pooling and linking community resources that enable farmers to have the capacity to respond, absorb and bounce back from shocks with little or minimum effect to their livelihoods. (Key Informant 3, the Anglican Diocese of Matabeleland)

We argue that the government of Zimbabwe needs a strong institutional support in order to fully implement CSA agriculture practices. The Government must formulate a clear and consultative policy that is inclusive to all citizens and not one size fits all approach. Government’s input programmes for example Command Agriculture; Command Piggery, and Presidential input programme for cereals must not only be for card carrying members but for all citizens, this will build smallholder farmers resilience against climate change. Essentially, smallholder farmers, local authorities, central government, private sector, CSOs, academia, and NGOs must collaborate to ensure the success of CSA in Umguza district and the greater parts Zimbabwe.

6. Discussion
The study revealed that smallholder farmers in Umguza district are aware of the impacts of climate change. Notable changes have been shortened rainfall season, decrease in precipitation, dry spells and increased temperatures that affects crops and animals leading to loss of water in dams through evaporation. Farmers who participated in the study exhibited resilience to climate change through the adoption of climate smart agriculture practices like small livestock rearing, conservation agriculture and cultivation small grains. The study found that these climate smart agriculture practices were not imported into Umguza smallholder farmers but have been practiced albeit at a small scale and through various stakeholders’ intervention they have increased in intensity.

Based on the above, this study notes that smallholder farmers cannot successfully adopt climate smart agriculture strategies like small grains without the contribution of government and its development partners in terms of training, inputs distribution and rigorous awareness campaigns. The effectiveness and viability of small grains is dependent on support given by the government and its development partners to the smallholder farmers. In Umguza district, the successful farmers with who exhibited good yields and with a potential to transfer best practices were supported by The Anglican Diocese of Matabeleland initiative programme in collaboration with AGRITEX. Without this external support, there is no record of significant success for CSA practices. This means that more farmers have to be supported to realize notable success.

The study also revealed that CSA practices are beset by challenges, of which the main one is reluctance of small holder farmers to adopt small livestock. Secondly, conservation agriculture is facing a barrier of availability of mulching material where farmers are choosing to feed their livestock crop residues instead of keeping them as a mulch and opening their fields for their animals which disturbs fields. Thirdly, more labour burdens are borne by women as men migrate to urban areas and neighboring. The responsibility to work in the fields and herd livestock in left on
them over and above their other domestic chores. The government lacks a clear and coordinated policy and financing for CSA (Farooq & Siddique, 2015; Lipper & Zilberman, 2018; Phiri et al., 2019, 2020).

7. Conclusions
The study concludes that the adoption of CSA strategies like small grains and small livestock should be broadened through knowledge dissemination and awareness in all wards of Umguza district instead of the current four out of the total nineteen. The challenge currently is that interventions target a few farmers and leave out others. Going forward, knowledge and training should be emphasized until communities fully appreciate the adaptation options suitable and appropriate for their areas. Raising awareness of climate change issues can be done through the local media and extension staff. Dissemination of climate change information from national and local meteorological stations to farmers through extension agents is also very critical.

This study concludes that uptake of many climate smart practices has been held back by limited access to suitable and affordable implements and limited markets for the produce. For instance, the small hectarage currently being put on small grains is on account of limited inputs like seeds and fertilizer and labour demands in comparison to maize produce. There is a potential for improving both the productivity and profitability of small grains uptake if the government shifts policy to accommodate them the same way it does to maize production.

There is a need for a sustained partnership to showcase CSA. For instance, the use of farmer-managed demonstration plots that showcase CSA practices can be supported and expanded, particularly by facilitating partnerships with input suppliers or equipment manufacturers also seeking to market their products. This approach is more sustainable and will ensure wider coverage while also cultivating strengthened connections and relations between farmers and the private sector. These demonstrations are also expected to act as local centers of excellence for use in trainings, field days, and other promotional activities. Programs for recognizing, rewarding, and celebrating excellence at various levels (not only for farmers but also extending staff and private sector companies and their agencies) will be facilitated to galvanize interests and motivate good practice (Climate—Smart Agriculture Manual for Zimbabwe, Climate Technology Centre and Network, 2017).

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