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Evaluating the role of climate-smart agriculture towards sustainable livelihoods in Mutare district, Zimbabwe

William Muzorewa[1*], Munyaradzi Chitakira[2]

[1]University of South Africa, College of Agriculture and Environmental Sciences, Department of Environmental Sciences, Private Bag X6, Florida, 1710. South Africa
[2] Environmental Management, University of South Africa, School of Ecological and Human Sustainability, Department of Environmental Sciences, Private Bag X6, Florida, 1710. South Africa,

* Corresponding author: williammuzorewa@hotmail.com

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Increasing climate variability continues to threaten livelihoods in Southern Africa, where communities face the challenges of addressing context-specific complexities associated with rain-fed agriculture. Zimbabwe is equally vulnerable, but the country is going through a transformation in agriculture by implementing climate-smart agriculture practices that endeavour to enhance adaptation, resilience, and increase productivity. The study was undertaken in Mutare district, Zimbabwe to explore the role of climate-smart agriculture practices applied to construct sustainable livelihoods. The study employed qualitative data collection techniques that involved households and key informant interviews. Descriptive statistics and exploratory research design were applied to give a meaningful narrative of the data. The results revealed traditional and innovative agriculture production methods based on least soil disturbance, preservation of ground cover, and crop diversification. Small livestock farming was lauded as a basic strategy that ameliorates immediate family needs, whilst large livestock farming was revealed as a symbol of status and source of funds to mitigate important family events such as deaths or weddings of a close relative. Forestry farming was established as a reliable source of income that is earned from the sale of timber, woodcrafts, and fodder for livestock, among others. The paper further established that changes in climatic conditions resulting in droughts, thunderstorms, leaching of crops, and infestation of pests are the major challenges that reduce the implementation of climate-smart agriculture practices that support robust, sustainable livelihoods. The paper recommends continued financial and technical support from government and non-governmental organizations to promote climate-smart agriculture practices that support sustainable livelihood outcomes and mitigate the detrimental effects of climate variability and change.

1. Introduction

Climatic trends in Southern Africa indicate that climate variability and change will increase with increased intensity of extreme weather conditions such as droughts, floods, mean temperature, and altered patterns of precipitation (Makate, Wang, Makate, & Mango, 2016; Mubaya, Njuki, Mutsvangwa, Mugabe, & Nanja, 2012; Nhemachena & Hassan, 2007). Climate variability is described as short-term fundamental features of the climate that manifests clearly in changes over months, seasons, and years (Lamsal, Kumar, & Atreya, 2017). Although Southern Africa is vulnerable to climate risks due to reliance on rain-fed traditional agricultural production systems, agriculture continues to be vital for economic growth, poverty alleviation, and food security (Adele & Todd, 2011). Zimbabwe is equally exposed to the devastating vagaries of climate variability and change (Zinyemba, Archer, & Rother, 2018). The country is especially vulnerable because the livelihoods of the majority of the population depend on rain-fed agriculture, which employs about 70% of the population (Muzari, Nyamushamba, & Soropa, 2016; Nhemachena & Mano, 2007).

The reliance on agriculture calls for capacity building through sound technical assistance that focuses on improving established and new agriculture practices and technologies that ensure the construction of sustainable livelihoods. Sustainable livelihoods refer to "the ability of a livelihood to cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base"(-Chambers & Conway, 1992).

Climate variability and change studies in agriculture have established that climate-smart agriculture (CSA) is among the various agriculture systems that developed as promising ways of securing food and ensuring sustainable livelihoods for the increasing world population that is faced with climate change scenarios (Manda et al., 2016). The practice involves integrated agriculture development programmes that aim at improving environmental stewardship, productivity, and sustainable livelihoods (Rosenstock et al., 2016).

The Food and Agriculture Organisation (FAO) of the United Nations first conceived CSA as agriculture that seeks to increase sustainable productivity, strengthen farmers' resilience, reduce agriculture's greenhouse gas emissions, increase carbon sequestration, strengthen food security, and deliver environmental benefits (McCarthy, Lipper, & Zilberman, 2018).

Manda, Alene, Gardebroek, Kassie, and Tembo (2016) posit that CSA is among the best viable agriculture strategies that can combat the impacts of climate variability and change and ensure sustainable livelihood outcomes in rural and urban communities. CSA incorporates principles that include: (a) adaptation - having technologies that suit the specific areas in which they are practiced; (b) productivity-increasing agriculture productivity and livelihood benefits; and (c) mitigation – alleviating greenhouse gas emissions (Kpadonou et al., 2017; Rosenstock et al., 2016). There is a need for micro-level study of these principles' influence in supporting the construction of sustainable livelihoods. This paper focuses on agriculture production technologies that sustain the livelihoods of rural and urban households. Most specifically, the study evaluates traditional and innovative production technologies that are applied to address context-specific complexities in agriculture production systems that support sustainable livelihood outcomes. Knowledge developed from this study aims to contribute to the location-specific data bank that enhances understanding of the role of CSA that ensures sustainable livelihoods. The structure of the manuscript includes a discussion of materials and methods, presentation of results, discussion, and conclusion

2. Materials and methods

2.1 Description of the study area and population

The study was undertaken in the Mutare district in eastern Zimbabwe. The district is about 265 km east of Harare, the capital city of Zimbabwe. Mutare district is surrounded by Chimanimani, Buhera, Makoni, and Mutasa districts and shares a border with Mozambique on the east, as shown in Figure 1. The topography is distinguished by large and rugged mountains, steep slopes, valleys, and a network of streams and rivers. Zimbabwe is classified into five natural regions (NR) that are determined by rainfall regime, soil quality, and vegetation, among other factors (Mugandani, Wuta, Makarau, & Chipindu, 2012; Ndebele-Murisa & Mubaya, 2015). The study area is situated in both NR I and II, which are the most agriculture productive regions in Zimbabwe (Mugandani et al., 2012; Nyamadzawo, Wuta, Nyamangara, & Gumbo, 2013).

Mutare district includes rural and urban communities. Mutare urban is located near Vumba Mountain and Murahwa Hill and is accessed through the Christmas pass tunnel. The latitude is18°58'0" and longitude is 32°40'0" (Mapira, 2011). The Sakubva River and its tributary Nyaphumbi pass through Mutare urban.

In 2012 the population of Mutare District was approximately 449 745 and was composed of 262 124 in Mutare rural and 187 621 in Mutare urban (Zimstat, 2015). The composition of households was 58 400 in Mutare rural and 48 258 in Mutare urban (Zimstat, 2015). The population was predominately African

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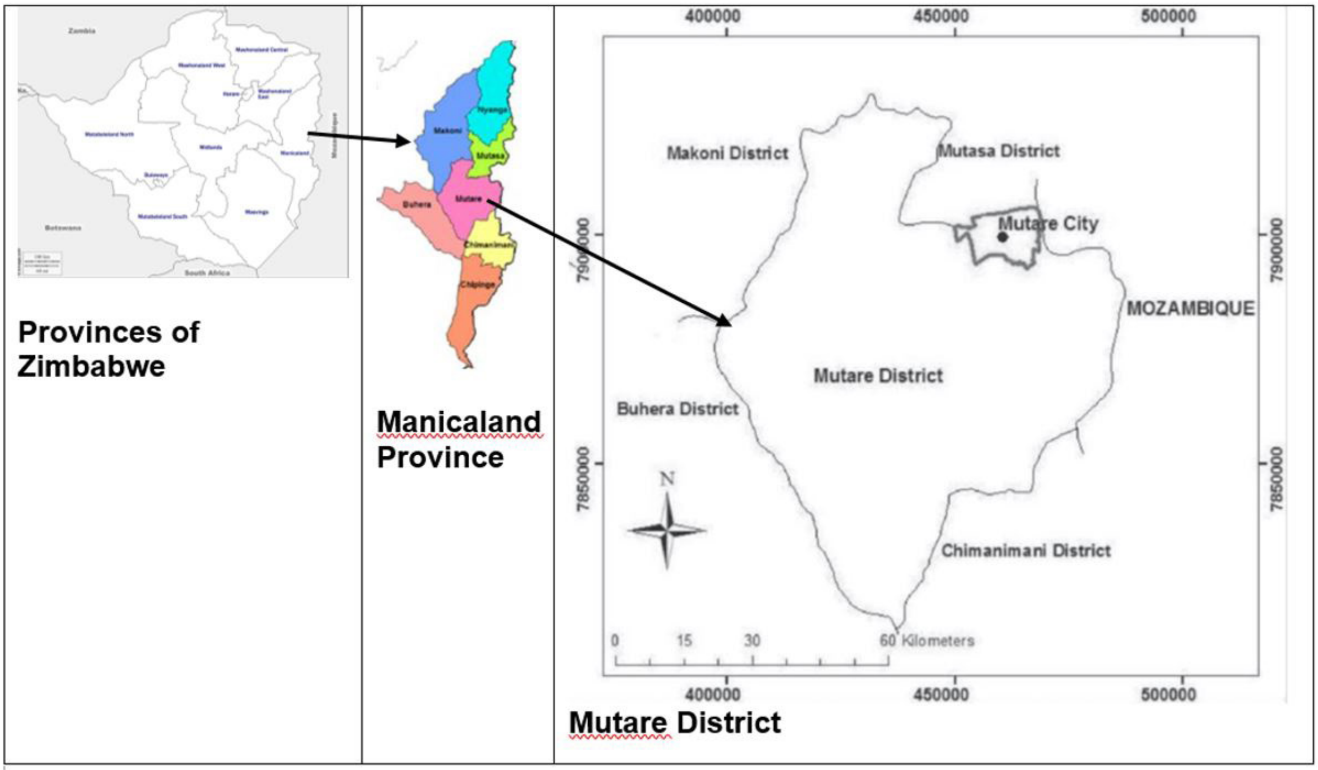

Figure 1. Map showing Zimbabwe, Manicaland Province, and Mutare District, adapted from Mabaso et al. (2015)

ethnic origin with less than 1% European, Asiatic and mixed origin.

2.2 Strategy of Inquiry

The study applied qualitative research enlightened by descriptive statistics and exploratory research designs. The qualitative inquiry collected participants' perceptions and experiences of the study phenomenon. Tenny, Brannan, Brannan, and Sharts-Hopko (2017) posit that qualitative research can explain processes and patterns of people's experiences and behaviours that are carried out through interviews but are difficult to quantify. Mwongera et al. (2017) postulate that interviews are carried out individually with those knowledgeable about the phenomenon under study.

Descriptive statistics was chosen because it gives an in-depth summary of the sample under study (Kaliyadan & Kulkarni, 2019). The descriptive statistical method applied was the survey method. Exploratory research was employed because it lacks a formal structure and a high degree of flexibility (Swedberg, 2020). Descriptive statistics and exploratory inquiry allowed the researchers to dwell deeper into the participants' perceptions and experiences of the role of CSA that ensure their livelihoods.

2.3 Data collection and analysis

Purposive sampling was applied to gather data during the field research between January and March 2020. This involved interviews with purposively selected 266 households (144 rural and 122 urban), 4 traditional leaders, 5 ward councillors, 4 focus group discussions (FGDs), 4 state and local government level extension services officials, and 2 NGO officials. The FGDs were structured as 3 mixed gender rural smallholder farmers and 1 mixed gender urban smallholder farmer. The sample size was decided upon following the principle of saturation – the survey was stopped when the interviews brought no more new data different from responses already collected (Saunders et al., 2018). The inclusion for household participation was pegged at a minimum of 10 years of continuous stay in their communities. Open-ended questions that could be changed to match the participants' level of comprehension and intelligence were employed to allow the participants to explain their experience, feeling, and thinking about the role of CSA in influencing their livelihood outcomes. Households who were not comfortable articulating their experiences in English were interviewed in their local dialect of the Shona language. Interviews were supplemented with field observations. Adequately trained 10 research assistants undertook transect walks with note-taking and were constantly interacted with the principal researchers. Content analysis was employed to examine the results of the qualitative research. Content analysis is a systematic coding and categorizing approach that is employed to examine a large amount of data and break it into manageable units, determine trends and patterns of words used, their relationships, frequency, and decide what needs to be divulged to others (Ayres, 2007; Grbich, 2012).

3. Results

3.1 Inquiry into participant's comprehension of CSA practices

Interviews were conducted between January and March 2020. A question was asked to probe participants' understanding of CSA. The feedback in Figure 2, where 'n' represents the number of participants in rural and urban communities, demonstrates that the largest number of participants indicated 'partial understanding' followed by 'never heard of it' and 'good understanding.' The participants who indicated that they have a good understanding were mainly from Mutare urban, where they engage in more technical and labour-intensive CSA based on horticulture. In contrast, participants who indicated that they had never heard of it were mainly rural households who rely on subsistence farming to mitigate food insecurity.

3.2 Conservation agriculture practice

The participants were further probed on their understanding of one of the techniques of CSA. They were asked a related question, 'Have you heard about conservation agriculture (CA), and the responses were a dichotomous 'yes' or 'no.' The dispersion of responses was 'yes' 93% and 'no' 7%. However, the overwhelming yes response illustrates a lack of understanding that CA is one of the hundreds of technologies, practices, and approaches that fall under CSA (Makate et al., 2016). This assertion is substantiated because participants who rated their knowledge of CSA as never heard of it were among the 93% who overwhelmingly reported that they had heard of CA. CA is based on the concurrent implementation of three principles: minimum mechanical soil disturbance, maintenance of ground cover with organic matter, and diversification of crop species grown in rotation or sequence (Kassam, Friedrich, Shaxson, & Pretty, 2009). The practice is strengthened through improved comprehensive participatory agriculture extension services, technical and financial support. Participants pointed out that when they practice CA, they can often sell surplus yields to support other livelihood outcomes that save lives through the enhancement of natural resources management.

3.3 Forms of conservation agriculture practices in the study area

Further questions associated with CA were asked to comprehend rural communities' perception of CSA agricultural practices. The participants were probed by asking the question, 'What is the most productive CA practice on your farm?' Participants were expected to indicate what they perceived to be their most productive CA based on their lived experience of their communities. The pie chart Figure 3, where 'n' represents the number of rural households interviewed, reveals that planting basins is the most practiced CA technique.

3.3.1 Planting basins

The practice of planting basins has its advantages and disadvantages. The advantages that were highlighted include solving the problems of inadequate draughts power that usually delay planting, which inadvertently affects crop yields. Besides, participants pointed out that planting basins gives them the advantage of preparing their fields during the dry season ahead of the rain season. This reduces the pressure for labour demands during the onset of the rain season. Participants highlighted that the major disadvantage is that the technique is labour intensive. This assertion concurs with the findings of other researchers who observe that conservation tillage requires a lot of labour during the first year but becomes less labour intensive during subsequent years since the same ripper furrows or planting basins will be used (Wagstaff &

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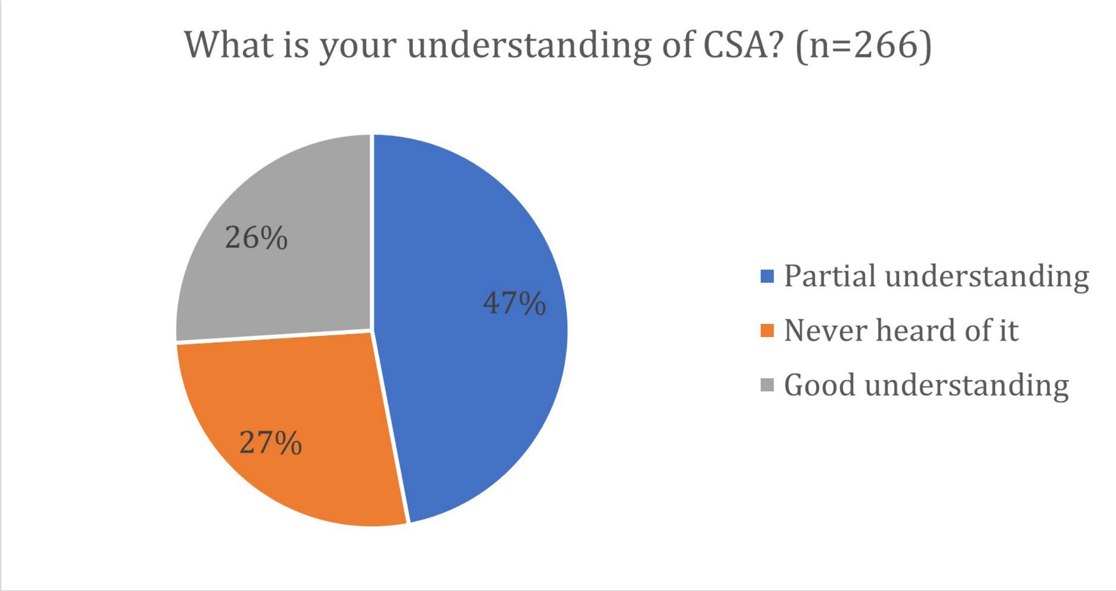

Figure 2. Participants' understanding of CSA (Fieldwork January – March, 2020)

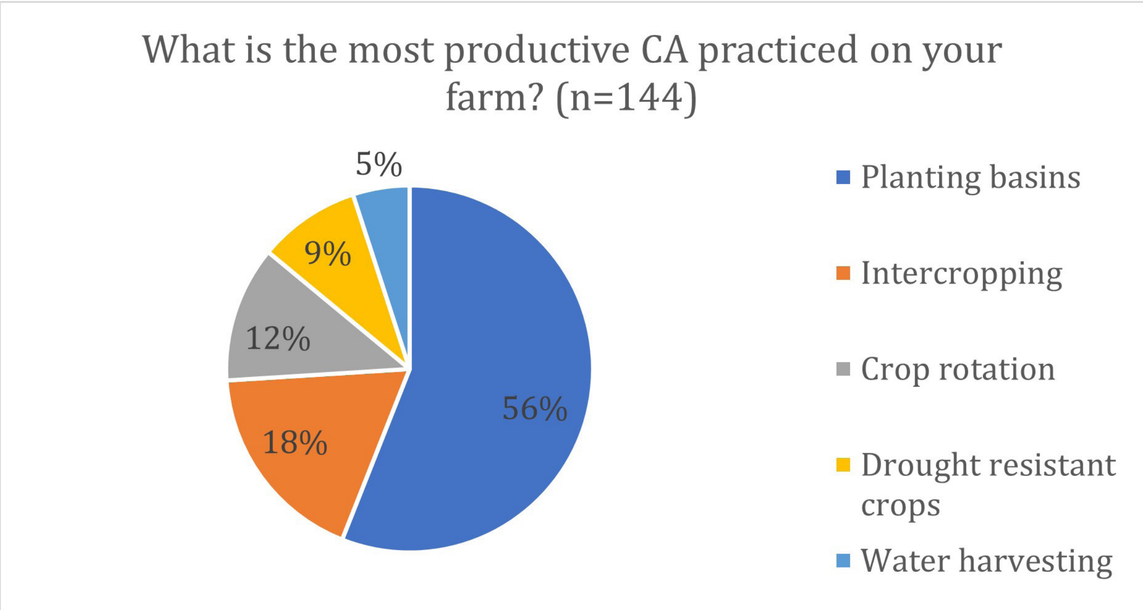

Figure 3. CA practice on farms (Fieldwork January – March, 2020)

Harty, 2010). Participants alluded that while planting basins is the most productive farming practice, they generally apply it with other practices.

3.3.2 Intercropping

Interview participants concurred that intercropping is the second most practiced strategy. Intercropping is the method of farming that involves concurrent planting of more than one variety of crops on the same field (Makate et al., 2016). The crops may belong to the same or different species, and this is done as basic ecological principles that include diversity, competition, and facilitation (Hauggaard-Nielsen et al., 2016). Intercropping efficiently makes use of light, land water, and nutrients while stabilizing the agroecosystem (Ning et al., 2017). Participants elaborated their comprehension of intercropping when one farmer explained that:

For the past 10 years, my banana and coffee yields have continued to improve since the method of planting the two in the same field was introduced on my farm. I now know the importance of combining crops as a moisture retention practice since bananas have large leaves that have a positive influence on moisture retention through the provision of shade. In addition, I practice intercropping maize with leguminous crops such as beans, pumpkins, watermelons, and cucumbers. (Female, 52-year-old farmer)

Further narratives from FGDs concluded that many households are now mixing leguminous crops such as cowpea and red speckled sugar beans with maize production. FGDs agreed that intercropping of leguminous crops with cereals enhances the soil's facilitation of nutrients. They further reveal that the practice has improved livelihood outcomes, including improved food security, nutrition, and income. Additionally, participants argued that they practice intercropping to reduce the impact of extreme events driven by crop failure because different crop types have specific climatic adaptability.

3.3.3 Crop rotation

There was a consensus among interview participants that many households in the Mutare district are practicing crop rotation. Crop rotation is defined as the routine of growing a sequence of plant species on the same field (Dury, Schaller, Garcia, Reynaud, & Bergez, 2012). The participants stated that they alternate legumes such as soybeans and cowpea with maize crops to improve soil fertility and control diseases and pests, thereby reducing agrochemicals. Participants indicated that crop rotation reduces weeds, insects, need for nitrogen fertilizers, soil erosion but increases soil fertility and yields per hectare. However, a key informant observed that some farmers still prefer to grow maize without crop rotation because maize generates more cash. This observation is in line with studies in Zambia, which reveal that households usually favour cultivating maize even in areas suitable for proper rotation with other crops (Nolin & Von Essen, 2005).

3.3.4 Cultivation of drought-resistant crops

It emerged in this study that farming systems located in the marginal environments of the district are characterized by a shift to growing drought-tolerant crops such as small grains. Participants expressed that they are cultivating drought-resistant crop varieties to improve food security and as a mechanism for constructing sustainable livelihood outcomes. However, a key informant from the Zimbabwe Farmer's union regretted that some smallholder farmers are still biased towards the production of cash crops which are highly susceptible to extreme weather events. The key informant recommends that farmers need a mindset change to start to think of re-energizing small grain products such as millet, finger millet, and sorghum that are drought resistant. Regarding staple crops such as maize, the informant recommended that smallholder farmers ought to opt for hybrid varieties that take a shorter period to mature than the traditional ones.

3.3.5 Rainwater harvesting practice (n=167)

A question relating to rainwater harvesting was asked to comprehend how households apply the technology. Rainwater harvesting is described as a technology applied to gather and store water from land surfaces using methods such as artificial ponds and reservoirs (Helmreich & Horn, 2009). Other technologies involve collecting rainwater from rooftops and storing it in tanks or cisterns mounted on elevated platforms. Rainwater harvesting is an adaptation strategy that ensures the organized use of rainfall to boost agriculture productivity (Rioux et al., 2016; Wambugu, Franzel, & Rioux, 2014). Participants were asked the question 'What is the rainwater harvesting practice on your farm,' and in response, they highlighted the following options: (a) external water harvesting, which involves collecting run-off from rainfall over a surface; (b) domestic rainwater harvesting which is collecting rainwater from rooftops; and (c) in situ rainwater harvesting which is collecting rainfall on the surface where it falls and stores it in the soil. The number of participants who responded was 107 in rural communities, and 60 were urban dwellers. The distribution of responses was: (a) domestic rainwater harvesting – 78%, (b) in situ rainwater harvesting – 15%, and (c) external water harvesting - 7%.

The participants explained that they harvest rainwater

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from rooftops, store it in polyethylene tanks, and use it for market gardening and domestic and livestock water supply. Rainwater harvesting has the advantage of providing water which is a vital part of the natural capital required to ensure sustainable livelihoods (Kahinda, Taigbenu, & Boroto, 2007). External water harvesting is practiced mainly in commercial farming communities that are endowed with rivers, streams, waterfalls, and valleys that can be converted to large water reservoirs. On the other hand, in-situ rainwater harvesting is practiced in rural communities where shallow wells are dug to collect rain and surface water used for domestic and market gardening.

3.3.6 Challenges that impede the adoption of CA

Interview participants expressed that one of their biggest challenges is changes in climatic conditions. Results from the FGDs and interviews with the elders indicated that rainfall comes sporadically, and when it does, it comes with a lot of thunderstorms that destroy crops. Thunderstorms were specifically identified as major challenges that cause leaching and waterlogging. Waterlogging results in crops turning yellow, compelling farmers to apply stronger fertilizer (urea) instead of ammonium nitrate, which is applied as a topdressing. In addition, the participants indicated that changes in the climatic condition are causing infestation of pests that include diamondback moth (*Plutella xylostella*) (cabbage moth) that force them to use more pesticides, adding to the high cost of inputs. Besides, the participants added that they are faced with the challenge of an unfavourable political landscape where government-supplied agriculture inputs are distributed on partisan grounds. The study established that although CSA is not entirely a new concept, the challenge is that it is a practice that requires refinement and intensification through technical and financial support without patriotism to political affiliations.

3.4 Livestock farming

3.4.1 Small livestock farming

Interview participants agreed that a variety of livestock farming alongside crop production ensures sustainable livelihood outcomes. The participants explained that basic small livestock strategies like fowls, piggery, sheep, and goats give them safety nets. Livestock farming is valuable as they meet immediate family needs, especially small livestock, including poultry and goats (Baudron, Mwanza, Triomphe, & Bwalya, 2007). Small livestock such as indigenous chicken breeds were highlighted as a valuable source of instant cash instead of large livestock, that are sold to fund major events. This is what one of the interview participants had to say:

I rear chicken (popularly known as road runners) as opposed to broilers which are expensive and exhausting to manage. My breed survives on anything including small grains, vegetables, and insects. My preferred breed is Rhode Island. I improve my turnover through strategies such as preventing the chickens from brooding and as a result, they start to lay again within 21 days. Chickens are easy to sell and I combine poultry production with other on-farm activities such as using chicken manure as fertilizer for vegetable gardening. (Male, 57-year-old livestock farmer)

The general sentiments from this narrative were shared by most smallholder farmers who were unanimous that chicken farming leads to positive livelihood outcomes in their communities. The researchers were shown a variety of livestock projects and agreed that poultry that included breeds such as Rhode Island, Black Australorp, and Potchefstroom Koekoek was the dominant occupation in rural households, whereas urban households tend to raise broilers for meat and hybrid hens that lay lots of eggs.

3.4.2 Traditional climate-smart livestock farming strategies

The study additionally sought to understand the perspective of sampled village elders' traditional climate-smart livestock farming strategies that have sustained livelihood outcomes in Mutare district over the years. One of the 4 interviewed elders narrated that:

We had our hard mashona cattle, goats, and chicken breeds that were resistant to droughts and common diseases. The breeds started to disappear after the introduction of breeds that were bigger making them more valuable on the market. However, these breeds were/are expensive to maintain and tend to struggle during extreme events. (Male, 78-year village elder)

A key informant spoke of the advantages of reverting to livestock farming of indigenous breeds resistant to drought. The informant recommended that livestock farmers in Mutare district, as is the case with the rest of Zimbabwe, should adapt to small animal breeds such as the Boran cattle breeds that are hardy, drought-resistant, and can survive most common diseases. The informant further recommended the rearing of goats as they are adaptive to cold or hot climatic conditions, and the quality of their manure is good for gardening. The researchers agreed with the key informant's recommendations because interview participants contended that they are turning to rear goats for meat and, to a lesser extent, milk sources.

3.4.3 Cattle pen fattening and dairy farming

Smallholder farmers expressed the view that intensive cattle farming is a strategy that they use as a symbol of status, source of protein, manure, draughts power, and most importantly, funding important events. The participants pointed out that apart from the thriving dairy industry, they are cattle fattening before selling them to abattoirs. The participants further narrated that they grow fodder for feeding dairy cows and beef livestock. The smallholder farmers indicated that they preserve fodder for use when livestock feed is scarce during the dry season. Additionally, they buy maize and wheat straws from other farmers after harvest and preserve them for their animals during the dry season.

Smallholder livestock farmers highlighted tick-borne disease as the main challenge they face due to the non-availability of dipping facilities. As a result, the participants are forced to spray dip chemicals. Some participants said they have no choice but to buy medicines for their sick animals as the veterinary department struggles to treat them. The participants bemoaned that medicines are very expensive, so it is not always possible to recover costs when they sell their livestock. Lastly, the smallholder farmers pointed out that cattle rustling was becoming a major challenge to achieving sustainable livelihoods.

3.5 Urban Agriculture

The study sought to ascertain the reason behind the proliferation of urban farming activities, consistent with the general trend across Zimbabwe. Urban agriculture is not a recent phenomenon as it has always been the mainstay of many households (Chaminuka & Dube, 2017). Urban participants indicated that they practice some form of agriculture for different reasons. The participants were asked a specific question: 'What benefits do you derive from urban agriculture?' The responses included: 'food supplement,' 'employment creation,' 'community development,' 'access to land,' and 'social bonding.' The pie chart Figure 4 where 'n' presents the number of urban households interviewed shows the distribution of responses. A majority (78%) indicated that they practice urban agriculture as a coping strategy that mitigates the ever-increasing food prices. The participants argued that urban farming reduces their dependence on maize meal from shops and open markets such as Sakubva Musika (Vendor market) in Mutare.

Participants in FGDs further added that they are actively engaged in urban CSA with technical and financial assistance from Caritas Mutare, the development arm of the Catholic Church, Mutare diocese. According to Gwetsayi, Dube, and Mashapa (2016), households in Mutare engage in horticulture as strategies that sustain livelihoods. Participants revealed that they practice precision agriculture techniques in their backyard gardens to supplement their income. The practice entails more precise and controlled cultivation of crops (Belder, Rohrbach, Twomlow, & Senzanje, 2007). Participants revealed that they are practicing horticulture, where they apply techniques such as drip irrigation. They further stated that they use hybrid seeds to grow maize, tomatoes, cabbages, carrots, broccoli, cauliflower, onions, and sweet peppers and have recorded increased yields. On the other hand, urban poverty and high unemployment influence the increase of urban farming. Besides supplementing food requirements, 13% of households indicated urban agriculture as a source of employment. Many urban agriculture projects are run by women who engage youth and invariably provide them much needed skills training.

3.6 Agroforestry and related activities

The participants revealed that sustainable forestry creates many benefits, including timber, wood fuel, wood crafts products, and livestock fodder. They also showed that sustainable forestry could provide a re-

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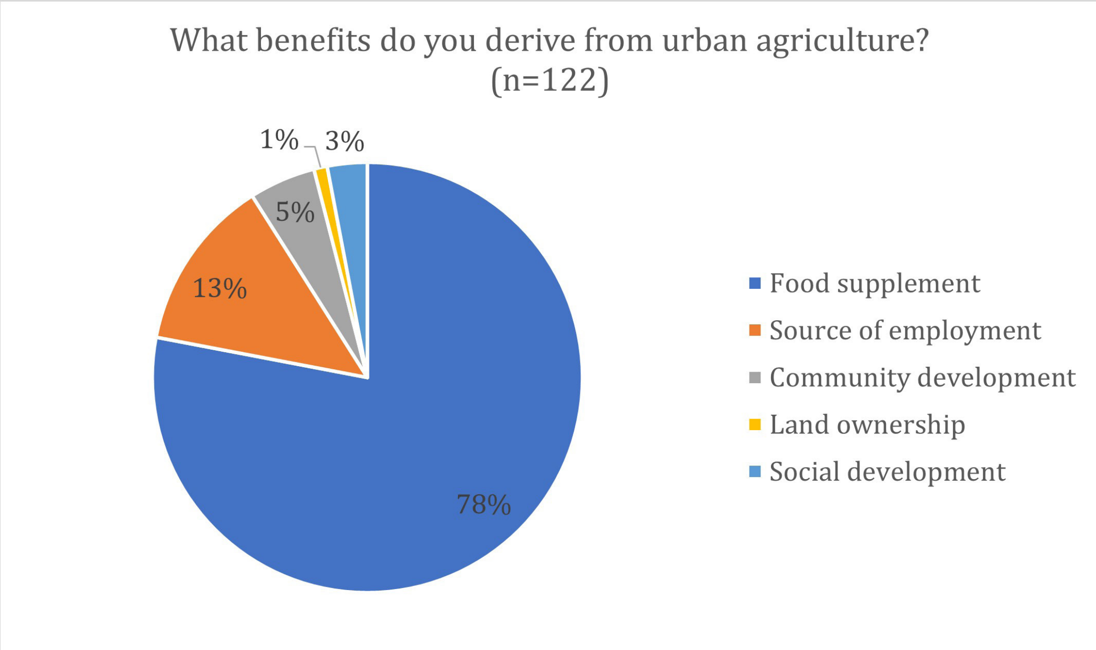

Figure 4. Benefits derived from urban agriculture practice (Fieldwork January - March 2020)

liable source of income through the supply of timber and other wood crafts products (Cavatassi, 2005). Some participants said tree species, shrubs, and grass are extremely valuable to livestock during droughts that cause a moisture loss. By grazing on these native plants, livestock produces better beef and milk. Others said that draft animals benefit from the tree vegetation. In the study area, there are many miombo woodlands, which supports a variety of livelihood outcomes. Participants argue that they use wood fuel for cooking, heating, and lighting their houses. (Lawrence, Tapiwa, Lovemore, & Michael, 2020). Trees that provide a source of energy and fruits included a mixture of *Brachystegia spiciformis, Jubenardia globorora, Brachystegia boehmii, B. tamarinodoide, and Uapaca kirkianaand* (Kujinga, Chingarande, Proisca, & Nyelele, 2012). The researchers established that forestry farmers grow mostly *eucalyptus globulus* and *pinaceae* for commercial purposes

Challenges forestry farmers face are that people in Mutare district are turning to commercial timber poaching for survival due to socio-economic practices that harm sustainable forestry. Forestry farmers regret the practices that harm sustainable forestry. In addition, fires such as those used when hunting, or wood fuel, are damaging their woodlands. Also, with the unavailability of electricity in rural communities, and the unreliability of electric power, forestry farmers stated that their woodlands are being pressed.

4. Discussion

Mutare district in eastern Zimbabwe is transforming agriculture through models that seek to continually improve productivity, environmental stewardship and ensure sustainable livelihoods (Muzorewa & Chitakira, 2020). A combination of results of the participants who indicated partial and good understanding (73%) of CSA is in line with the findings of Huyer and Nyasimi (2017), who submit that while the CSA approach is new and still developing, most of the practices already exist worldwide and are currently used by farmers to cope with various production risks. It is the finding of this study that through the practice of CA, households improve their long-term food requirements and very often in the short-term as well.

Steenwerth et al. (2014) concurred that CA increases the capacity for farmers to adapt to climate variability and change by reducing vulnerability to extreme events. Most importantly, CA increases synergies among resources conservation, food production, and sustainable livelihoods. The study results are consistent with the findings of other scholars who pointed out that planting basins are the most popular CA alternative that is practiced in Zimbabwe (Twomlow et al., 2006). The technique is locally known as conservation tillage, differentiating from other CA practices. Conservation tillage comprises different soil management practices that involve inverting the soil using either a plough or handheld tool (Baudron et al., 2007; Marongwe et al., 2011). This mechanical manipulation of the soil does not affect the soil characteristic, including temperature, soil, water, conservation, evaporation , and infiltration (Busari, Kukal, Kaur, Bhatt, & Dulazi, 2015).

The unreliability of rainfall patterns and increasing temperatures forces farmers to shift to growing drought-resistant crop varieties that include finger millet, sorghum, beans, and sunflowers (Rusinga, Chapungu, Moyo, & Stigter, 2014). On the other hand, small livestock farming supports households by providing important livelihood benefits. According to Mutibvu, Maburutse, Mbiriri, and Kashangura (2012), apart from being an important source of protein, small livestock such as goats, sheep, and fowls are a source of income as they are easily disposable when the need arises, unlike large livestock. Chickens, in particular, offer a fast off-take that plays an important role in the lives of resource-poor households, whereas small livestock such as goats provide a vital source of meat and milk (Muchadeyi, 2007). Researchers elsewhere in Zimbabwe acknowledge this view when they state that livestock is kept for different uses that include meat, milk, draughts power, and different cultural uses (Mavedzenge, Mahenehene, Murimbarimba, Scoones, & Wolmer, 2006; Mutibvu et al., 2012; Ndebele et al., 2007; Svotwa, Hamudikuwanda, & Makarau, 2007).

5. Conclusion

The study established that households in Mutare district, Zimbabwe employ various CSA practices that include crop, livestock, and forestry farming as advocated for in Zimbabwe. CSA has increased synergies among food production systems that have significantly produced surplus quantities sold to support the construction of sustainable livelihood outcomes. The agriculture revolution is achieved through practices such as CA that include minimum soil disturbance through planting in basins, intercropping, crop rotation, cultivation of drought-resistant crops, and rainwater harvesting. Key informants included elders who submitted that CSA is not entirely a new agriculture strategy but is a practice that requires refinement and intensification through technical and financial support. The study recommends more research on livelihoods of resource-poor households to guide policy initiatives and development programmes that enhance livelihood adaptation strategies, thereby creating desired livelihood outcomes. There is a need for a level social, economic, and political playing field to remove impediments that lead to agriculture inputs being distributed on partisan grounds to improve food security.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the study's design, in the collection, analyses, or interpretation of data, in the writing of the manuscript, and in the decision to publish the results.

Reference

Adele, A., & Todd, A. C. (2011). Impacts of climate change on smallholder farmers in Africa and their adaptation strategies: What are the roles for research?: International Symposium and Consultation (29-31 March, 2010, Arusha, Tanzania): Centro Internacional de Agricultura Tropical (CIAT); Pan-Africa Bean Retrieved from https://cgspace.cgiar.org/bitstream/handle/10568/54340/wd221_final_web.pdf?sequence=1&isAllowed=y

Ayres, L. (2007). Qualitative research proposals—part I: posing the problem. Journal of Wound Ostomy & Continence Nursing, 34(1), 30-32.

Baudron, F., Mwanza, H., Triomphe, B., & Bwalya, M. (2007). Conservation agriculture in Zambia: a case study of Southern Province. Retrieved

ISSN-Internet 2197-411x OLCL 862804632

from https://vtechworks.lib.vt.edu/bitstream/handle/10919/68465/4227_Zambia_casestudy.pdf?seq

Belder, P., Rohrbach, D., Twomlow, S., & Senzanje, A. (2007). Can drip irrigation improve the livelihoods of smallholders? Lessons learned from Zimbabwe: Global Theme on Agroecosystems Report no. 33. Retrieved from http://oar.icrisat.org/2386/1/Can_drip_irrigation_improve1.pdf

Busari, M. A., Kukal, S. S., Kaur, A., Bhatt, R., & Dulazi, A. A. (2015). Conservation tillage impacts on soil, crop and the environment. International Soil and Water Conservation Research, 3(2), 119-129. doi.org/10.1016/j.iswcr.2015.05.002

Cavatassi, R. (2005). Valuation methods for environmental benefits in forestry and watershed investment projects. doi.org/10.2139/ssrn.3307569

Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: practical concepts for the 21st century: Institute of Development Studies (UK). Retrieved from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/775/Dp296.pdf?sequence=1ant

Chaminuka, N., & Dube, E. (2017). Urban agriculture as a food security strategy for urban dwellers: A case study of Mkoba residents in the city of Gweru, Zimbabwe. People: International Journal of Social Sciences, 3(2). doi.org/10.20319/pijss.2017.32.2645

Dury, J., Schaller, N., Garcia, F., Reynaud, A., & Bergez, J. E. (2012). Models to support cropping plan and crop rotation decisions. A review. Agronomy for sustainable development, 32(2), 567-580. doi 10.1007/s13593-011-0037-x

Grbich, C. (2012). Qualitative data analysis: An introduction: Sage.

Gwetsayi, R. T., Dube, L., & Mashapa, C. (2016). Urban Horticulture for Food Security and Livelihood Restoration in Mutare City, Eastern Zimbabwe. Greener Journal of Social Sciences, 6(3), 056-064. doi.org/10.15580/gjss.2016.3.082116130

Hauggaard-Nielsen, H., Lachouani, P., Knudsen, M. T., Ambus, P., Boelt, B., & Gislum, R. (2016). Productivity and carbon footprint of perennial grass–forage legume intercropping strategies with high or low nitrogen fertilizer input. Science of the Total Environment, 541, 1339-1347. doi.org/10.1016/j.scitotenv.2015.10.013

Helmreich, B., & Horn, H. (2009). Opportunities in rainwater harvesting. Desalination, 248(1-3), 118-124. doi:10.1016/j.desal.2008.05.046

Huyer, S., & Nyasimi, M. (2017). Climate-smart agriculture manual for agriculture education in Zimbabwe.Retrieved from https://cgspace.cgiar.org/handle/10568/89632

Kahinda, J.-m. M., Taigbenu, A. E., & Boroto, J. R. (2007). Domestic rainwater harvesting to improve water supply in rural South Africa. Physics and Chemistry of the Earth, Parts A/B/C, 32(15-18), 1050-1057. doi:10.1016/j.pce.2007.07.007

Kaliyadan, F., & Kulkarni, V. (2019). Types of variables, descriptive statistics, and sample size. Indian dermatology online journal, 10(1), 82. doi.org/10.4103%2Fidoj.idoj_468_18

Kassam, A., Friedrich, T., Shaxson, F., & Pretty, J. (2009). The spread of conservation agriculture: justification, sustainability and uptake. International journal of agricultural sustainability, 7(4), 292-320. doi:10.3763/ijas.2009.0477

Kpadonou, R. A. B., Owiyo, T., Barbier, B., Denton, F., Rutabingwa, F., & Kiema, A. (2017). Advancing climate-smart-agriculture in developing drylands: Joint analysis of the adoption of multiple on-farm soil and water conservation technologies in West African Sahel. Land Use Policy, 61, 196-207. doi.org/10.1016/j.landusepol.2016.10.050

Kujinga, K., Chingarande, S. D., Proisca, H., & Nyelele, C. (2012). Interface Between Research, Development and Local Actors in Enhancing Sustainable Forest Resources Management: Lessons from Chimanimani District. Zimbabwe. J. Soc. Dev. Afr, 27, 23-56. doi: 10.1080/13504509.2016.1198939

Lamsal, P., Kumar, L., & Atreya, K. (2017). Historical evidence of climatic variability and changes, and its effect on high-altitude regions: insights from Rara and Langtang, Nepal. International Journal of Sustainable Development & World Ecology, 24(6), 471-484. doi: 10.1080/13504509.2016.1198939

Lawrence, M., Tapiwa, K. A., Lovemore, M., & Michael, M. (2020). Smallholder Tobacco Farmers and Forest Conservation in Mutasa District, Zimbabwe. landscape, 30, 33. doi: 10.11648/j.eeb.20200501.12

Mabaso, A., Shekede, M. D., Christa, I., Zanamwe, L., Gwitira, I., & Bandauko, E. (2015). Urban physical development and master planning in Zimbabwe: An assessment of conformance in the City of Mutare. Journal for Studies in Humanities and Social Sciences, 072-088. Retrieved from http://journals.unam.edu.na/index.php/JSHSS/article/view/1005

Makate, C., Wang, R., Makate, M., & Mango, N. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. SpringerPlus, 5(1), 1135. doi 10.1186/s40064-016-2802-4

Manda, J., Alene, A. D., Gardebroek, C., Kassie, M., & Tembo, G. (2016). Adoption and impacts of sustainable agricultural practices on maize yields and incomes: Evidence from rural Zambia. Journal of Agricultural Economics, 67(1), 130-153. doi: 10.1111/1477-9552.12127

Mapira, J. (2011). River pollution in the city of Mutare (Zimbabwe) and its implications for sustainable development. Journal of Sustainable Development in Africa, 13(6), 181-194. Retrieved from https://file.ejatlas.org/docs/marange-diamond-mines-pollute-rivers-zimbabwe/River_Pollution_in_the_City.pdf

Marongwe, L. S., Kwazira, K., Jenrich, M., Thierfelder, C., Kassam, A., & Friedrich, T. (2011). An African success: the case of conservation agriculture in Zimbabwe. International journal of agricultural sustainability, 9(1), 153-161. doi=10.3763/ijas.2010.0556

Mavedzenge, B., Mahenehene, J., Murimbarimba, F., Scoones, I., & Wolmer, W. (2006). Changes in the livestock sector in Zimbabwe following land reform: the case of Masvingo province. Institute for Development Studies, Brighton, Retreived from https://www.ids.ac.uk/download.php?file=files/Masvingo_workshop_report.pdf

McCarthy, N., Lipper, L., & Zilberman, D. (2018). Economics of climate smart agriculture: An overview. Climate Smart Agriculture, 31-47. doi 10.1007/978-3-319-61194-5

Mubaya, C. P., Njuki, J., Mutsvangwa, E. P., Mugabe, F. T., & Nanja, D. (2012). Climate variability and change or multiple stressors? Farmer perceptions regarding threats to livelihoods in Zimbabwe and Zambia. Journal of environmental management, 102, 9-17. doi.org/10.1016/j.jenvman.2012.02.005

Muchadeyi, F. (2007). Assessment of genetic diversity of Zimbabwe village chicken eco-types: Cuvillier Verlag. Retrieved from https://cuvillier.de/de/shop/publications/1699

Mugandani, R., Wuta, M., Makarau, A., & Chipindu, B. (2012). Re-classification of agro-ecological regions of Zimbabwe in conformity with climate variability and change. African Crop Science Journal, 20(2), 361-369. Retrieved from https://www.ajol.info/index.php/acsj/article/view/81761

Mutibvu, T., Maburutse, B., Mbiriri, D., & Kashangura, M. (2012). Constraints and opportunities for increased livestock production in communal areas: A case study of Simbe, Zimbabwe. Livest Res Rural Dev, 24(9). Retrieved from http://www.lrrd.cipav.org.co/lrrd24/9/muti24165.htm

Muzari, W., Nyamushamba, G., & Soropa, G. (2016). Climate change adaptation in Zimbabwe‟ s agricultural Sector. International Journal of Science and Research, 5(1), 1762-1768. Retrieved from https://www.researchgate.net/publication/318262826

Muzorewa, W., & Chitakira, M. (2020). Climate-smart livelihood strategies in rural and urban communities in eastern Zimbabwe: an in-depth literature study. South African Geographical Journal, 1-16. doi.org/10.1080/03736245.2020.1835701

Mwongera, C., Shikuku, K. M., Twyman, J., Läderach, P., Ampaire, E., Van Asten, P., . . . Winowiecki, L. A. (2017). Climate smart agriculture rapid appraisal (CSA-RA): A tool for prioritizing context-specific climate smart agriculture technologies. Agri-

ISSN-Internet 2197-411x OLCL 862804632
UniKassel & VDW, Germany- February 2022

cultural systems, 151, 192-203. doi.org/10.1016/j.agsy.2016.05.009

Ndebele-Murisa, M., & Mubaya, C. (2015). Climate change: Impact on agriculture, livelihood options and adaptation strategies for smallholder farmers in Zimbabwe. Beyond the Crises: Zimbabwe's Prospects for Transformafion, 155-198.

Ndebele, J., Muchenje, V., Mapiye, C., Chimonyo, M., Musemwa, L., & Ndlovu, T. (2007). Cattle breeding management practices in the Gwayi smallholder farming area of South-Western Zimbabwe. Livestock Research for Rural Development, 19(11). Retrieved from http://www.lrrd.org/lrrd19/12/ndeb19183.htm

Nhemachena, C., & Hassan, R. (2007). Micro-level analysis of farmers adaption to climate change in Southern Africa: Intl Food Policy Res Inst.

Nhemachena, C., & Mano, R. (2007). Assessment of the economic impacts of climate change on agriculture in Zimbabwe: A Ricardian approach: The World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/7484/Wps4292.pdf?sequence=1&isAllowe

Ning, C., Qu, J., He, L., Yang, R., Chen, Q., Luo, S., & Cai, K. (2017). Improvement of yield, pest control and Si nutrition of rice by rice-water spinach intercropping. Field Crops Research, 208, 34-43. doi.org/10.1016/j.fcr.2017.04.005

Nolin, J., & Von Essen, C.-F. (2005). Conservation farming in Zambia.

Nyamadzawo, G., Wuta, M., Nyamangara, J., & Gumbo, D. (2013). Opportunities for optimization of in-field water harvesting to cope with changing climate in semi-arid smallholder farming areas of Zimbabwe. SpringerPlus, 2(1), 100. doi.org/10.1186/2193-1801-2-100

Rioux, J., Gomez San Juan, M., Neely, C., Seeberg-Elverfeldt, S., Karttunen, K., Rosenstock, T., . . . Kimaro, A. (2016). Planning, implementing and evaluating climate-smart agriculture in smallholder farming systems. Mitigation of Climate Change in Agriculture Series (FAO) eng no. 11. Retrieved from https://www.fao.org/3/a-i5805e.pdf

Rosenstock, T. S., Lamanna, C., Chesterman, S., Bell, P., Arslan, A., Richards, M., . . . Cheng, Z. (2016). The scientific basis of climate-smart agriculture: A systematic review protocol. Retrieved from https://cgspace.cgiar.org/bitstream/handle/10568/70967/CCAFSWP138.pdf?sequence=1

Rusinga, O., Chapungu, L., Moyo, P., & Stigter, K. (2014). Perceptions of climate change and adaptation to microclimate change and variability among smallholder farmers in Mhakwe communal area, Manicaland province, Zimbabwe. Ethiopian Journal of Environmental Studies and Management, 7(3), 310–318-310–318. doi.org/10.4314/ejesm.v7i3.11

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., . . . Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. Quality & quantity, 52(4), 1893-1907. doi.org/10.1007/s11135-017-0574-8

Steenwerth, K. L., Hodson, A. K., Bloom, A. J., Carter, M. R., Cattaneo, A., Chartres, C. J., . . . Horwath, W. R. (2014). Climate-smart agriculture global research agenda: scientific basis for action. Agriculture & Food Security, 3(1), 1-39. doi.org/10.1186/2048-7010-3-11

Svotwa, E., Hamudikuwanda, H., & Makarau, A. (2007). Influence of climate and weather on cattle production semi-arid communal areas of Zimbabwe. Electronic journal of environmental, agricultural and food chemistry, 6, 1838-1850. Retrievd from https://www.researchgate.net/publication/267855584_Influence_of_climate_and_weather_on_cattle_production_semi_arid_communal_areas_of_Zimbabwe

Swedberg, R. (2020). Exploratory research. The production of knowledge: Enhancing progress in social science, 17-41.

Tenny, S., Brannan, G. D., Brannan, J. M., & Sharts-Hopko, N. C. (2017). Qualitative study.

Twomlow, S., Rohrbach, D., Hove, L., Mupangwa, W., Mashingaidze, N., Moyo, M., & Chiroro, C. (2006). Conservation farming by basins breathes new life into small holder farmers in Zimbabwe.

Wagstaff, P., & Harty, M. (2010). The impact of conservation agriculture on food security in three low veldt districts of Zimbabwe. Trocaire development review(2010), 67-84. Retrieved from https://www.trocaire.org/sites/default/files/resources/policy/2010-conservation-agriculture-zimbabwe.pdf

Wambugu, C., Franzel, S., & Rioux, J. (2014). Options for climate-smart agriculture at Kaptumo site in Kenya: World Agroforestry Centre. doi.org/10.5716/WP14394.pdf

Zimstat. (2015). Compendium of Statistics 2014: Zimbabwe National Statistic Agency Harare. Retrieved from https://www.zimstat.co.zw/

Zinyemba, C., Archer, E., & Rother, H.-A. (2018). Climate variability, perceptions and political ecology: Factors influencing changes in pesticide use over 30 years by Zimbabwean smallholder cotton producers. PloS one, 13(5). doi.org/10.1371/journal.pone.0196901

ISSN-Internet 2197-411x OLCL 862804632