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Evaluating the Role of Climate Smart Agriculture towards Sustainable Livelihoods in Mutare District, Zimbabwe

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Abstract

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 through the implementation of climate smart agriculture practices that endeavour to enhance adaptation, resilience and increase productivity. The study was undertaken in Mutare district, Zimbabwe with the aim of exploring the role of climate smart agriculture practices that are applied to construct sustainable livelihoods. The study employed a triangulation and validation of quantitative and qualitative data collection techniques that involved household surveys and key informant interviews. Descriptive statistics was applied to give a meaningful narrative of the data. The paper revealed traditional and innovative production methods that are based on least soil disturbance, preservation of ground cover and crop diversification. Small livestock farming was lauded as basic strategy that ameliorate immediate family needs whilst large livestock farming was revealed as symbol of status and source of funds to mitigate important family events such as deaths or weddings of 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 that result 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 in rural and urban communities.

Keywords: Climate smart agriculture; Conservation agriculture; Livelihood strategies; Adaptation; Productivity; Resilience

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 [1,2]. Climate variability is described as short-term fundamental features of the climate that manifest clearly in changes over months, seasons and years [3]. 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 [4]. Zimbabwe is equally exposed to the devastating vagaries of climate variability and change [5]. The country is especially vulnerable because the livelihoods of the majority of the population depend on rain-fed agriculture which provides employment to about 70% of the population [6]. The reliance on agriculture calls for capacity building through sound technical assistance that focus on improving established and knew 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" [7].

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 ensure sustainable livelihoods for the increasing world population that is faced with climate change scenarios [8,9]. The practice involves integrated agriculture

development programmes that aim at improving environmental stewardship, productivity and sustainable livelihoods [10]. CSA was first conceived by the Food and Agriculture Organisation (FAO) of the United Nations as agriculture that seeks to increase sustainable productivity, strengthen farmers' resilience, reduce agriculture's greenhouse gas emissions, increase carbon sequestration, strengthens food security, and delivers environmental benefits [11]. Manda et al. [8] posit that CSA is among the best practicable 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 [10,12].

There is need for micro level study of these principles' influence in supporting the construction of sustainable livelihoods. 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.

Materials and Methods

Description of the study area and population

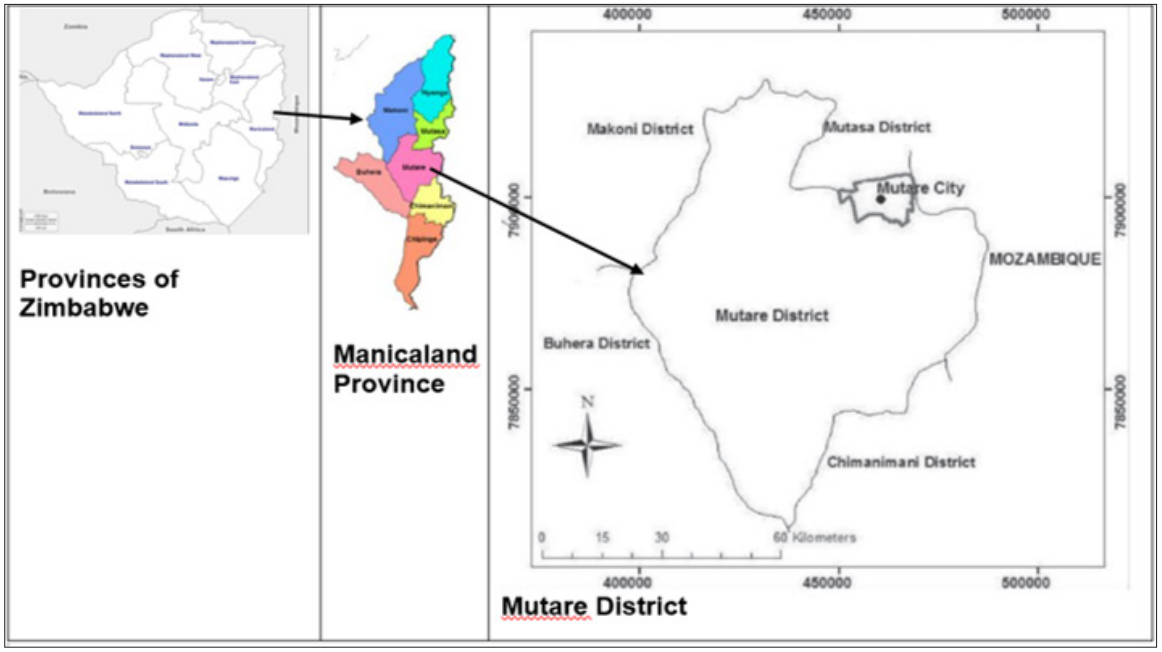

Figure 1: Geographical situation of Mutare District and Mutare City, Zimbabwe. Fieldwork March (2020).

The study was undertaken in Mutare district in eastern Zimbabwe. The district is about 265kms 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 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 [13,14]. The study area is situated in both NR I and II which are the most agriculture productive regions in Zimbabwe [13,15]. Intensive crop farming is a common economic activity producing crops such as tea, coffee, wheat, sorghum, beans, maize, cotton, millet, sunflowers, fruits and vegetables among others [16]. Similarly, intensive livestock farming is a major activity that supports livelihood outcomes. 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" [17]. 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 262124 in Mutare rural and 187621 in Mutare urban [18]. The composition of households was 58400 in Mutare rural and 48258 in Mutare urban [18]. The population was predominately African ethnic origin with less than 1% European, Asiatic and mixed origin.

Strategy of inquiry

The strategy of inquiry involved data gathering techniques that ranged from a household questionnaire, focus group discussions, key informant interviews, and participant observations during the field research from January-April 2020. Mwongera et al. [19] postulate that interviews are carried out individually with those knowledgeable about the phenomenon under study. In this study, this included local elders, policy implementers, agriculture

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extension services and non-governmental organisations who provide expert opinion on traditional and innovative agriculture practices. Participant's observations were used to validate both interview and questionnaire data. To increase the quality of questions, piloting for interviews that involved 10 participants was undertaken prior to the main study. Piloting for interview is an essential exercise of carrying out research as it highlights areas of improvements to the main study [20].

Data collection

The study employed a triangulation and validation of quantitative and qualitative data collection techniques. Cross-sectional studies that involve the capture and analysis of quantitative data gathered at a single snapshot measuring the exposures and outcome in the study population at the same time was employed [21,22]. A sample of participants each from 266 households was asked to complete a structured questionnaire. The sample size was decided upon following the principle of saturation-the survey was stopped when the questionnaire was no more bringing up new data different from responses already collected [23]. The questionnaire was used as vital tool for capturing responses that were converted into quantitative data. Bailey [24] establish that the structured nature of questionnaires produce data that is responsive to being converted into quantitative data that is analyzed using statistical techniques. The questionnaire was considered suitable and cost-effective method and helped to validate findings from qualitative data collection sources. Qualitative data collection method was applied to seek participants' own understanding and in their own words, socio-economic, political and environmental variables that influence CSA practices across the strata. Qualitative data records are records of interviews, focus group discussion, observations and data collected in conservations [25]. The study engaged 4 focus groups each with 10 community members to solicit information relating to CSA practices that construct sustainable livelihoods in Mutare district. Principally, the study paid special attention to women farmers who were considered marginalized and highly vulnerable due to their dependence on natural resources. The Focus Group Discussions (FGD) were chosen on the belief that they had rich knowledge of innovative agriculture practices applied in the study area. The groups confirmed a minimum of 10 years' continuous residents in Mutare district and were comfortable to articulate their experiences and views in shona which is their vernacular language. Interview participants were able to freely make comments and constructively challenge each other on agriculture practices in their communities. The researcher used digital audio recorder to ensure that vital information was not missed in the process but ensured that no identifiable personal information was recorded.

Snowballing sampling technique was used to identify village elders who were 60 years and above as these were considered to have insurmountable knowledge on agriculture practices. Rapport was developed with the elders engaging in their daily activities, watching, listening and asking questions related to agriculture transformation in response to climate variability and change. During this period, the researcher discovered that the nature of Mutare district communities' social life was such that one spoke freely only with people that are personally trusted, known and comfortable with. This knowledge guided the study strategy to employ ethnographic case study which involved the development of personal communication and building confidence with the participants. Personal rapport was an irreplaceable strategy because the elders ended up treating the researcher as part of their families and were comfortable to engage in discussions on any issues related to agriculture revolution in their communities. Purposive sampling was applied to select key informants that promote capacity building and advance innovative agriculture production technologies in the study area. The process of interviewing was undertaken individually with those knowledgeable about CSA practices gathering verbal data. The researcher was able to ask questions with the aim of searching information that was relevant to CSA strategies that support sustainable livelihood outcomes. Semi-structured interviews allowed the researcher to enjoy flexibility regarding how the interview was conducted at the same time maintaining some structure over its parameters [26].

Data analysis

Descriptive statistics were applied to summarize quantitative data and find patterns for a meaningful structured report [27]. Descriptive statistics present simple synopsis of the sample and observations that have been made [28]. Quantitative data analysis comprised statistical and other supporting evidence that are fundamentally a descriptive narrative of socio-economic variables, traditional and innovative agricultural technologies and lived experiences in the study area [29]. Narrative analysis were applied to analyze interviews of participants and observations from the field [27]. This stage of data analysis was arrived at after familiarization with the data; production of first codes; identification of themes; analysis of themes; naming and defining themes; and lastly writing the report.

Results and discussion

Inquiry into participant's comprehension of CSA practices

Participants (n=266) were asked the question: What is your understanding of CSA and were expected to answer by indicating 'good understanding', 'partial understanding' or 'never heard of it'. The results confirm that the largest number of the participants indicated 'partial understanding' (47%) followed by 'never heard of it' (27%) and 'good understanding' (26%). A combination of results of the participants who indicated partial and good understanding (73%) is in line with the findings of Ngara [30] who submit that while CSA approach is new and still developing, most of the practices that make up CSA already exist worldwide and are currently used by farmers to cope with various production risks. Muzorewa and Chitakira [31] state that eastern Zimbabwe is transforming agriculture practice through models that seek to continually increase productivity and improve environmental

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stewardship. Participants who indicated that they have 'good understanding' were mainly from Mutare urban. This agrees with results of research by Gwetsayi [32] who conclude that urban smallholder farmers are engaging in more technical and labour-intensive CSA based on horticulture. In contrast, respondents who indicated 'never heard of it' were mainly rural smallholder farmers. The findings are considered important because the role of CSA in ensuring sustainable livelihoods cannot be considered adequate without rural farmers' full understanding of the concept.

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)?' The participants were expected to respond with a dichotomous answer 'yes' or 'no'. The dispersion of responses was 'yes' 93% and 'no' 7%. The Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement acknowledge an increase in numbers of farmers practicing CA in Zimbabwe, from less than 3,000 in 2004 to almost 1,00,000 in 2010 [33]. However, the overwhelming 'yes' response illustrate lack of understanding that CA is one of the hundreds of technologies, practices and approaches that fall under CSA [1]. This assertion is substantiated by the fact that participants who rated their knowledge of CSA as 'never heard of it' were among the 93% who overwhelmingly reported that they have heard of CA. CA is based on 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 [34]. The practice is strengthened through improved comprehensive participatory agriculture extension services, technical and financial support. It is the finding of this study that by practicing CA, households improve their long-term food requirements and very often in the short-term as well. Participants pointed out that when they practice CA they are often able to sell surplus yields to support other livelihood outcomes that enhance natural resources management. Steenwerth et al. [35] advance that CA increase the capacity for farmers to adapt to climate variability and change by reducing vulnerability to extreme events. Most important of all, CA increase synergies among resources conservation, food production and sustainable livelihoods.

Forms of conservation agriculture practices in the study area

Table 1: What is the most productive CA practice on your farm? (n=144).

Most Productive CA Practice	No of Respondents	Total (%)
Planting basins	81	56
Intercropping	26	18
Crop rotation	17	12
Cultivation of drought resistant crops	13	9
Water harvesting	7	5

Further questions associated with CA were asked in the household questionnaire 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?' Respondents were not given choices to select from but were expected to write what they perceive to be their most productive CA practice. (Table 1) reveal that planting basins is the most practiced CA technique.

Planting basins: The results are consistent with findings of other scholars who contend that planting basins is the most popular CA alternative that is practised in Zimbabwe [36]. The technique is locally known as conservation tillage which differentiates it from other forms of CA practices [36]. Conservation tillage comprise different soil management practices that involve inverting the soil using either a plough or hand held tool [37,38]. This mechanical manipulation of the soil does not affect the soil characteristic that include temperature, soil water conservation evaporation process and infiltration [39]. The practice of planting basins has its own 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 indicated that planting basins give them the added advantage of preparing their fields during the dry season ahead of the rain season. This reduces the pressure for labour demand 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 [40]. Although the study established that planting basins is the most productive farming practice, it is generally applied in conjunction with other practices.

Intercropping: Narrations from interview participants concurred with questionnaire respondents who indicated that intercropping is the second most practiced strategy. Intercropping is the method of farming that involve concurrent planting of more than one variety of crops on the same field [1]. The crops may belong to the same or different species and this is done as basic ecological principles that include diversity, competition and facilitation [41]. Intercropping efficiently make use of light, land water and nutrient whilst at the same time stabilizing the agroecosystem [42]. Interview participants elaborated their comprehension of intercropping when one female farmer in a women FGD 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 of maize with leguminous crops such as beans, pumpkins, water melons and cucumbers. (Female, 52-year old farmer in FGD).

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Further narratives from FGDs concurred when they added that many households are now mixing leguminous crops such as cowpea and red speckled sugar beans with maize production. Intercropping of leguminous crops with cereals enhances the facilitation of nutrients in the soil [43]. The study results reveal that the practice has improved livelihood outcomes that include improved food security, nutrition and income. Additionally, households have applied intercropping to reduce the impact of extreme events driven crop failure because different crop types have specific climatic adaptability [44].

Crop rotation: There was general consensus among interview participants that a significant number of households in NR II are practicing crop rotation. Crop rotation is defined as the routine of growing a sequence of plant species on the same field [45]. The participants stated that they alternate legumes such as soybeans and cowpea with maize crops to improve soil fertility, control diseases and pests thereby reducing the need for agro-chemicals. Researchers elsewhere supported this finding when they state that crop rotation reduce weeds, insects, need for nitrogen fertilizers, soil erosion but increase soil fertility and yields per hectare [46]. However, one key informant observed that some farmers still prefer to grow maize without practicing crop rotation because maize generates more cash. The results are in line with studies in Zambia which reveal that households usually favour cultivating maize even in areas suitable for proper rotation with other crops [47].

Cultivation of drought-resistant crops: The researcher observed that farming systems located in the marginal environments of Mutare district are characterised by a shift to growing drought tolerant crops such as small grains. Interview participants indicated that they are cultivating drought resistant crop varieties as a way of improving food security and as mechanisms for constructing sustainable livelihood outcomes. Research findings revealed that the unreliability of the rainfall pattern and increasing temperatures are forcing farmers to shift to growing drought-resistant crop varieties that include finger millet, sorghum, beans and sunflowers [48]. However, 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 should have a mind-set change so that they start to think of re-energizing small grain production such as millet, rapoko and sorghum that are drought resistant. With regards to staple crop such as maize, the informant recommended that smallholder farmers should opt for hybrid varieties that take shorter period to mature than the traditional varieties.

Rainwater harvesting practice: A question relating to rainwater harvesting was asked in the household questionnaire to comprehend how households apply the technology. Rainwater harvesting is described as a technology that is applied to gather and store water from land surfaces using methods such as artificial ponds and reservoirs [49]. Other technologies involve collecting rainwater from rooftops and store it either in tanks or cisterns mounted on elevated platforms. Rainwater harvesting is an adaptation strategy that ensure organised use of rainfall to boost agriculture productivity [50,51]. Participants were asked the question 'What is the rainwater harvesting practice on your farm?'. The respondents were expected to select from:

a. External water harvesting which involve 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 storing it in the soil [49]. Table 2 show the responses to the question which reveal an overwhelm 78% who indicated that they apply domestic rainwater harvesting technology.

Table 2: What is the rainwater harvesting practice on your farm? (n=167). Fieldwork March (2020).

Rainwater Harvesting Practice	Number of Respondents	Total %
External water harvesting	12	7
Domestic rainwater harvesting	130	78
In situ rainwater harvesting	25	15

The participants explained that they harvest rainwater from rooftops and store it in polyethylene tanks and use it for market gardening, 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 [52]. External water harvesting (7%) is practiced mainly in commercial farming communities that have the endowment of rivers, streams, waterfalls and valleys that can be converted to large water reservoirs. On the other hand, in-situ rainwater harvesting (15%) is practiced in rural communities where shallow wells are dug for collecting rain and surface water which they use for domestic and market gardening.

Challenges that impedes the adoption of CA: Interview participants expressed that one of their biggest challenge is changes in climatic conditions. Results from the four 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 a challenge that cause leaching and water logging. Water logging results in crops turning yellow compelling farmers to apply stronger fertilizer (urea) instead of ammonium nitrate which is applied as topdressing. In addition, the participants indicated that changes in climatic condition is 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 unfavourable political landscape where government supplied agriculture inputs are distributed on partisan grounds. The study established that CA is not entirely a new agriculture strategy but the challenge is that it is a practice that require refinement and intensification through technical and financial support.

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Livestock farming

Small livestock farming: Both interview participants and questionnaire respondents were in agreement that a variety of livestock farming strategies alongside crop production ensure sustainable livelihood outcomes. Livestock farming support smallholder farmers as they provide important livelihood benefits [53]. The interview participants and questionnaire respondents explained that basic small livestock strategies that include fowls, piggery, sheep and goats give them safety nets. Livestock farming is valuable as they meet immediate family needs especially small livestock that include poultry and goats among others [37]. Small livestock such as indigenous chicken breeds were highlighted as valuable source of instant cash as opposed to large livestock which are only sold to fund major events. According to Mutibvu et al. [54], apart from being an important source of protein, chickens are a source of income as they are easily disposable when the need arise unlike large livestock. 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 the 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 in FGD).

The general sentiments from this narrative was shared by most smallholder farmers who were unanimous that chicken farming leads to positive livelihood outcomes in their communities. Muchadeyi [55] posit that poultry offers a fast off-takes that play an important role in the lives of rural and urban households. The researcher was shown a variety of livestock projects and agreed that poultry was the dominant occupation in both rural and urban communities. The observation concurs with findings made in Zimbabwe by Mutibvu et al. [54] who assert that chickens breeds such as Rhode Island, Black Australorp and Potchefstroom Koekoek ranked first among livestock species kept in Gokwe South District.

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 struggle during extreme events. (Male, 78-year village elder).

A Key informant spoke of the advantages of reverting to livestock farming of indigenous breeds that are 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 rearing of goats as they are adaptive to cold or hot climatic conditions and the quality of their manure is good for gardening. This study collaborates with the key informant's recommendations because interview participants and questionnaire respondents stated that they are turning to rearing goats for meat and to a lesser extend for source of milk. Mutibvu et al. [54] assert that goats are a vital source of meat and milk for rural communities in Zimbabwe.

Cattle pen fattening and dairy farming: Smallholder farmers expressed the view that intensive cattle farming is a strategy that they use as symbol of status, source of protein, manure, draughts power and most importantly as source of funding important events. Researchers elsewhere in Zimbabwe acknowledge this view when they state that livestock are kept for different uses that include meat, milk, draughts power and different cultural uses [54,56-58]. The participants pointed out that apart from the thriving dairy industry, they are engaged in cattle fattening prior to selling them to abattoirs. The study findings reveal that participants grow fodder which they use to feed dairy cows and beef livestock. The interview participants indicated that they preserve fodder for use during the dry season when livestock feed is scarce. Additionally, they buy maize and wheat straws from other farmers after harvest and preserve them for their animals during the dry season. The finding is consistent with result of a study carried out in Nkayi district, Zimbabwe, where Masikati [59] revealed that crop leftovers are familiar sources of animal feeds during the dry season.

Livestock farmers highlighted tick-borne disease as the main challenge they face due to none availability of dipping facilities. As a result, the participants are forced to resort to spray dip chemical for spraying their animals. Some participants said they have no choice but to buy medicines for their sick animals as the veterinary department struggles to treat their sick animals. The participants bemoaned that medicines are very expensive so much that it is not always possible to recover cost when they sell their livestock. Lastly the participants pointed out that cattle rustling was becoming a major challenge to their efforts to achieve sustainable livelihoods.

Urban agriculture: The study sought to ascertain the reason behind the proliferation of urban farming activities which is consistent with the general trend across Zimbabwe. Urban agriculture is not a recent phenomenon as it has always been the mainstay of many households [60]. Urban participants indicated that they practice some form of agriculture for different reasons. According to Chaminuka [60], various benefits can be derived from urban agriculture. The participants were asked specific question: 'What benefits do you derive from urban agriculture?' and were expected to choose a response from options that included: 'food supplement', 'employment creation', 'community development', 'access to land' and 'social bonding'. The bar chart Figure 2 show the distribution of responses. A majority (78%) indicated that they practice urban agriculture as a coping strategy that mitigate the ever-increasing food prices. Urban households have always been considered the most vulnerable group whose source of income are

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often unreliable and inadequate [61]. In Mutare urban, farming reduces the dependence on maize meal from shops and open markets such as Sakubva Musika (Vendor market).

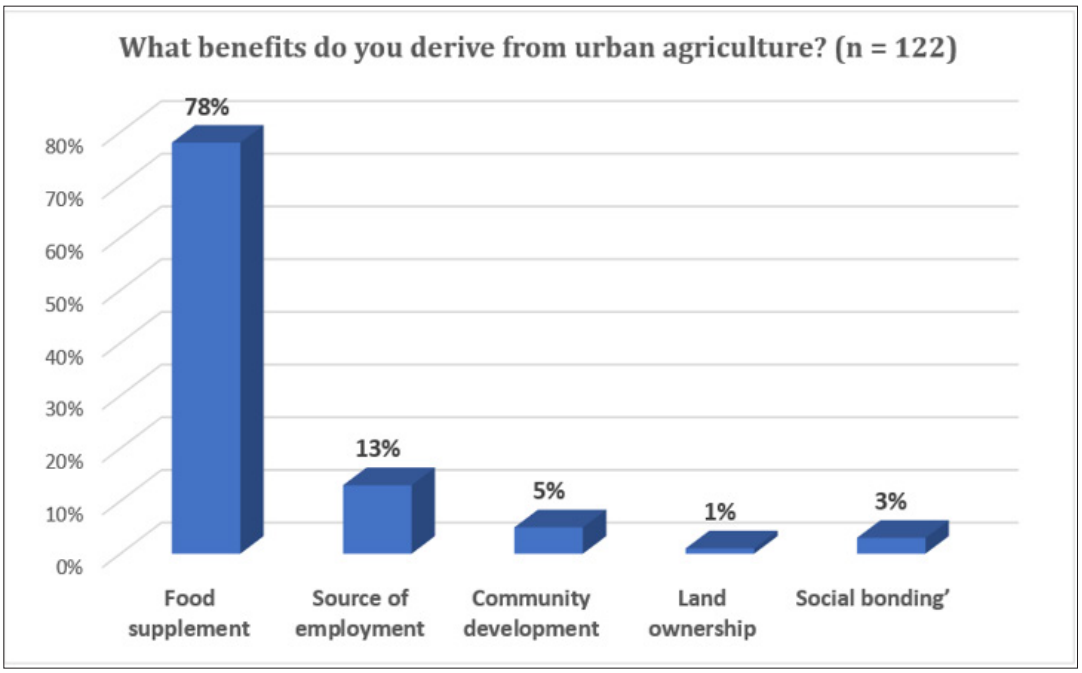

Figure 2: Benefits derived from urban agriculture practice. (Fieldwork March 2020).

Participants in FGDs further added that they are actively engaged in urban CSA with technical and financial assistance from Caritas Mutare which is the development arm of the Catholic Church, Mutare diocese. According to Gwetsayi et al. [32], households in Mutare urban engage in horticulture as strategies that sustain livelihoods. Participants revealed that they practice precision agriculture techniques in their backyard gardens to supplement their income. Precision agriculture has been growing in the last decade with more countries in the developing world embracing the practice [62]. The practice entails more precise and controlled cultivation of crops [63]. Participants said that they are practicing horticulture where they apply techniques such as soil mapping and drip irrigation. They further stated that they apply 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 the high unemployment influence the increase of urban farming. Besides supplementing food requirements, 13% household participants indicated urban agriculture as source of employment. Through employment creation, many urban agriculture projects engage youth to manage gardens which provide them with income and skills training [64].

Agroforestry and related activities

This study established from the interview participants and questionnaire respondents that sustainable forestry is practiced to reap benefits that include timber, wood fuel, wood craft products and livestock fodder among others. Sustainable forestry can provide a reliable source of income through the supply of timber and other wood craft products [65]. The interview participants and questionnaire respondents explained that tree species, shrubs and grass are important during drought because they are browsed on by livestock which in turn improve the quality of meat and increase milk production. Some participants expressed that draughts animals benefit from the tree fodder such as leaves, small branches, seeds, pods and fruits. The participants opine that they use wood fuel for cooking, warming and lighting their houses. The study area is rich in miombo woodlands which support different livelihood outcomes [66]. Trees that provide source of energy and fruits included a mixture of *Brachystegia spiciformis, Jubenardia globorora, Brachystegia boehmii, Brachystegia tamarinodoide* and *Uapaca kirkianaand* [67]. The findings indicate that forestry farmers are growing eucalyptus *globulus* and *pinaceae* for commercial purposes.

Participants lamented the socio-economic practices that negatively impact sustainable forestry in Mutare district. They commented that people are turning to commercial timber poaching for survival. Inappropriate use of fire such as for hunting is damaging their woodlands. In addition, the participants stated that continued use of wood as wood fuel is pressurising their woodlands. The unavailability of electricity in rural communities and the unreliability of electricity supply in urban communities increases the demand for wood fuel.

Conclusion

The findings of this study revealed that rural and urban communities in Mutare district have embraced CSA practices that withstand impacts of extreme events and significantly increase agriculture adaptation, productivity and environmental

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stewardship. Results indicate that the communities employ a variety of CSA practices that include crop, livestock and forestry farming as advocated for in Zimbabwe. CSA has increased synergies among food production systems that have resulted in improved food security. The study findings demonstrate that CSA has significantly produced surplus quantities that are 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 that included elders submitted that CSA is not entirely a new agriculture strategy but is a practice that require refinement and intensification through technical and financial support. The study established that through CSA practices, rural and urban smallholder farmers can meaningfully increase productivity and build resilience of livelihoods. The study advocate for level social, economic and political playing field that remove impediments that lead to agriculture inputs being distributed on partisan grounds.

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