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Households' perceptions on resilience building interventions towards enhancing community socio-economic development in Southern Zimbabwe

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ABSTRACT

The study assessed households' perceptions on the contribution of climate resilience interventions to attain community socio-economic development in Southern Zimbabwe. The researcher adopted a mixed method design which utilized both qualitative and quantitative paradigms. Data was collected from 352 households from the 4 Enhancing Community Resilience and Sustainability Projects (ECRAS) wards. Qualitative data was subjected to content analysis while quantitative data was subjected to SPSS version 22.0 for analysis. Climate change and variability impacts in Mwenezi District of Southern Zimbabwe have contributed to failure of the livestock production sector and crop production sector which are the main livelihood options of households in the District. Eventually this retarded community socio-economic development. In response, Government departments, Non-Governmental Organisations and communities collaborated to initiate interventions to manage climate change impacts on community socio-economic development. The efforts made by the stakeholders have evidenced that building climate resilience is contributing significantly to community socio-economic development. The interventions initiated have contributed to food security and dietary diversity, clean water availability, enhanced livestock production and improvement on the community sanitation and hygiene. The households interviewed and some stakeholders' perceived resilience building as a panacea to climate change induced impacts in communities since households largely depend on climate sensitive sectors. The study therefore recommends adoption of climate smart interventions for all development agendas since majority of households in Southern Zimbabwe largely depend on climate sensitive sectors.

1. Introduction

Climate change and its related disasters have escalated around the world causing serious threat to the existence of humans and their livelihoods [1,2]. Developing countries across the globe are vulnerable to the impacts of climate change because of their high dependence on natural resources and their limited capacity to cope with these impacts. Climate change is exacerbating impacts such as droughts, floods, extreme weather events and sea level rise, which may contribute to food shortages, infrastructure damage and the degradation of natural resources which livelihoods depend on [3–5]. This has jeopardized development gains achieved through development co-operation and make more difficult the achievement of development objectives including the globally agreed Sustainable Development Goals (SDGs) [3]. The impacts of climate change are hitting poor people and poor countries disproportionately. As a result, adaptation to climate change will involve specific dedicated measures and integration of adaptation considerations into existing development processes and activities.

Integrating climate resilience into growth and development planning is vital to reduce the costs of variations in the current climate conditions, while preparing for the future effects of climate change [4,6,7]. Climate change is affecting many different economic sectors directly and indirectly and the characteristics of economic systems will play an important role in determining community resilience [8]. Community resilience can be understood as "the social survival processes that occur within a place, that are put into action by local communities in order to address the negative social and economic impacts they perceive as common problems during crises". Planning and implementing sustainable interventions requires skills in understanding, managing, and enhancing community resilience. Building community resilience is considered key to enhancing community development outcomes, especially in vulnerable areas.

Africa and Sub-Saharan in particular, rank among the most vulnerable regions to climate variability and change [8,9]. Under current

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conditions these regions have naturally high levels of climate variability and rain -dependency, high reliance on climate sensitive activities, regular food crises and water scarcity, rapid population growth and limited economic and institutional capacity to cope with and adapt to climate variability and change [10]. In addition, it is probable that, due to climate change, they will face projected increases in mean annual temperatures, greater unpredictability of rainfall that is likely to exacerbate existing water shortages, very likely reductions of cereal crop productivity, and surges in disease, pest and weed pressure on crops and livestock. Southern Zimbabwe has not been spared from the impacts of climate change and variability. Traditionally, the region was in Zimbabwe's natural region 5 receiving between 350 and 500 mm of rainfall per year [11]. However, global change in climatic conditions and weather patterns have seen southern Zimbabwe receive below normal rainfall and ravaged by persistent heatwave. These climate extremes have had impacts on agricultural activities including crop production and animal rearing which have for long been the predominant source of livelihood for these rural communities. Within the region, climate change has also affected both surface and groundwater sources a situation which has been noted in areas that include Rutenga District. These impacts of climate change on traditional livelihood sources have consequently influenced increased migration of household heads and other young people into neighbouring South Africa as they seek alternative forms of livelihood opportunities. Whilst this may seem like a present solution, it is not a sustainable long-term solution. Hence, the need for the adoption of resilience mechanisms to reduce their vulnerability of traditional livelihoods to climate change.

Resilience is a concept that has gained widespread use among international humanitarian agencies, policymakers, and development practitioners as a framework for sustainable development [12]. It is often employed in response to the perception that various shocks, including those related to climate change, present significant challenges to development efforts. Despite these challenges, resilience is increasingly being used in development and humanitarian communities to guide their activities and create interdisciplinary connections [13,14]. With growing international commitments and programs dedicated to resilience building, measuring impact and tracking resilience on the ground is necessary.

Poorer developing countries are especially vulnerable to climate change because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors [15,16]. People exposed to the most severe climate-related hazards are often those least able to cope with the associated impacts, due to their limited adaptive capacity [16,17]. Within this context, there is growing recognition of the potential role of building climate resilience as a response to the multiple risks and short and long-term shocks and stresses associated with climate change.

Resilient communities are capable of bouncing back from adverse situations. They can do this by actively influencing and preparing for economic, social and environmental change. When times are bad they can call upon the myriad of resources that make them a healthy community. In Southern Zimbabwe particularly in Mwenezi District, resilience building initiatives have been implemented through the joint efforts of Non-Governmental Organisations (Care International, Plan and ICRISAT) and Government departments (Department of Agriculture Technical and Extension Services, Department of Veterinary Services, Ministry of Youth and Mwenezi Rural District Council). The interventions implemented targeted to manage climate change, enhance attainment of multiple welfare sustainable development goals and ensure community development. The interventions ensured community development since climate change has undermined all community development aspects across the District. Therefore, the research assessed households' perceptions on resilience building interventions towards enhancing community socio-economic development in Mwenezi District of Southern Zimbabwe. The main objective shall be supported by the following specific objectives: To establish the impacts of climate change on community socio-economic development; Examine the contribution of resilience building initiatives towards community socio-economic development in Mwenezi District and to analyse households' perceptions on resilience building interventions towards enhancing community socio-economic development.

1.1. Description of study area

This study was undertaken in Mwenezi District originally known as Nuanetsi, situated in south eastern Zimbabwe. The district is located in Masvingo Province, one of Zimbabwe's ten provinces. Mwenezi derives its name from the Mwenezi River, which provides irrigation water to the sugarcane plantations in and around the Rutenga Business Center.

1.2. Physical description of the study area

Mwenezi District has a total land area of 1339,657 hectares, made up of Communal Areas, Intensive Conservation Areas for wildlife, large- and small- scale commercial farms, and old resettlement areas. Mwenezi District is in agro-ecological region V (a) which is characterized by high temperatures and low erratic rains ranging between 450 and 650 mm (ZINGSA, 2020). The average annual highest temperature in Mwenezi is 36.7 °C and the average annual lowest temperature is 9.8 °C.

Mwenezi District is dominated by low fertile sand or sandy loamy soils with limited moisture retention capacity which is continuing to decline due to increased scarcity of natural alternatives like anthill and manure [18]. Soil erosion rate has become more extensive and deepened poverty as majority of the households depend on interventions that are supported by good soil. Successive droughts in Mwenezi District have resulted in increased food insecurity, malnutrition and environmental degradation (UNDP, 2019). Cereal crop production yields are generally low, averaging 0.5t/ha against the average yield potential of 2.8t/ha for agro-ecological region V.

1.3. Socio-economic description of the study area

Mwenezi is divided into 18 wards with a total population of 97 013 males and 112 314 females with an average household size of 4 persons (ZIMSTAT, 2022). There is an imbalance between the number of males and females which reveals that there are some households led by females. Livelihoods of the poor majority are largely dependent on climate sensitive sectors such as agriculture, livestock production and forestry resources for household energy, food security and water supply [19–21]. Diarrhoea cases have been reported in Mwenezi District due to poor hygiene and sanitation.

Majority of youth and middle aged men in Mwenezi District migrate to neighbouring countries mainly South Africa and Mozambique [21]. The proportion working in South Africa and Mozambique remit goods and cash which is one of the livelihood activities households in Mwenezi District depend on. Some are involved in cross border trade whereby they migrate to neighbouring countries to buy commodities to sell back home (Chingarande et al., 2020; Chauke et al., 2021). The proceeds generated from cross border trading are sustaining other livelihood interventions, for example, the crop production and livestock sectors. Livestock production, one of the major livelihood options in Mwenezi District is being challenged by pasture unavailability which is continuing to deteriorate due to climate change. Livestock production is also affected by livestock diseases such as Foot and Mouth Disease (FMD), lump skin and heart water.The nature of agricultural production as the main livelihood activity in Mwenezi prompts the need to develop a Climate Smart Village Framework that will anticipate and cushion the effects of climate change amongst households.

1.4. Research methodology

The nature of the objectives and the components of the research philosophy adopted prompted the researcher to adopt a mixed method

research design. The choice of mixed methods was based on the phenomenological constructivist belief that problems are best solved from multiple sources because there are multiple and legitimate sources of knowledge. The qualitative approach used involved use of focus group discussions and interviews while quantitative approach involved use of Household closed ended questionnaires, inferential statistics through cross tabulations using SPSS version 22.0.

The research targeted 4228 affecting ECRAS project beneficiaries in 4 wards of Mwenezi District [22]. The ECRAS Project implemented various interventions aimed at enhancing community resilience through managing climate change impacts. Four wards were purposively, wards (2; 4; 7; 10) (Fig. 1) based on the intensity of implemented resilience building interventions. The 4 wards were selected because of all the ECRAS project sites, these four wards still have existing projects. In addition, to the best of our knowledge there have been no studies that have documented the perceptions of these for particular communities regarding the resilience building initiatives implemented by ECRAS.

The sample size for the household questionnaire survey was calculated using Raosoft sample size calculator at 95 % confidence level with an error margin of 5 % (www.raosoft.com). With Raosoft, only households from the ECRAS project formed the sampling frame. The sample size translated to 352 households and the number was equally distributed amongst the 4 wards. During the survey, the researcher identified the respondent's beneficiary status from the list created by ECRAS project managers.

Households which benefited from the ECRAS project within the selected wards as well as stakeholders operating in Mwenezi District pioneering projects that build community resilience were targeted for this study. Stakeholders targeted include Non-Governmental Organisations (Care, PLAN International, ICRISAT) and Government Departments (AGRITEX, Veterinary department, Mwenezi Rural District Council, District Development Coordinator). Purposive sampling technique was used to select key informants from the organisations involved in the resilience projects in Mwenezi District.

Household questionnaires were used to obtain information from the beneficiary households in the selected wards of Mwenezi District. The questionnaire was administered to gather data on the various resilience initiatives to manage climate change impacts, analysing the perceptions of communities on the contribution of interventions towards attaining community socio-economic development. The questionnaire comprised both closed ended and o pen ended questions since the objectives of the study required factual data as well as views and perceptions of respondents regarding resilience building initiatives contribution to community socio-economic development. A total of 352 questionnaires were administered to selected beneficiaries from wards 2; 7; 4 and 10. The questionnaire used was designed according to the specific objectives. The questionnaire survey was conducted over a two week period in between 6 and 19 February 2024. This period allowed for the administration of questionnaires whilst giving respondents enough time to respond to the survey questions.

Semi-structured interview technique was adopted to gather data from the purposively selected key informants namely Monitoring and Evaluation Officer from Care International, District Head from the department of AGRITEX, AGRITEX Extension Officers (AEO), District Veterinary Officer, Ward livestock Officers from Veterinary services department, 4 Ward Councillors from the selected wards, District Development Coordinator, Women and Youth Officer and Project facilitator from ICRISAT. Interview questions were designed according to specific objectives and the discussions were guided by the interview guides designed per each key informant. The interviews allowed the researchers to gain in-depth understanding of phenomenon under investigation on the ground.

The FGDs were conducted using a discussion schedule with questions about perceptions, attitudes, beliefs, opinions or ideas to building community resilience against the impacts of climate change in Mwenezi District. Information obtained from focus group discussions was used to generate households' perceptions of resilience interventions towards community socio-economic development. Eight focus group discussions were held in the selected 4 wards, that is, 2 per ward disaggregated by gender. Each focus group discussion comprised people of different ages.

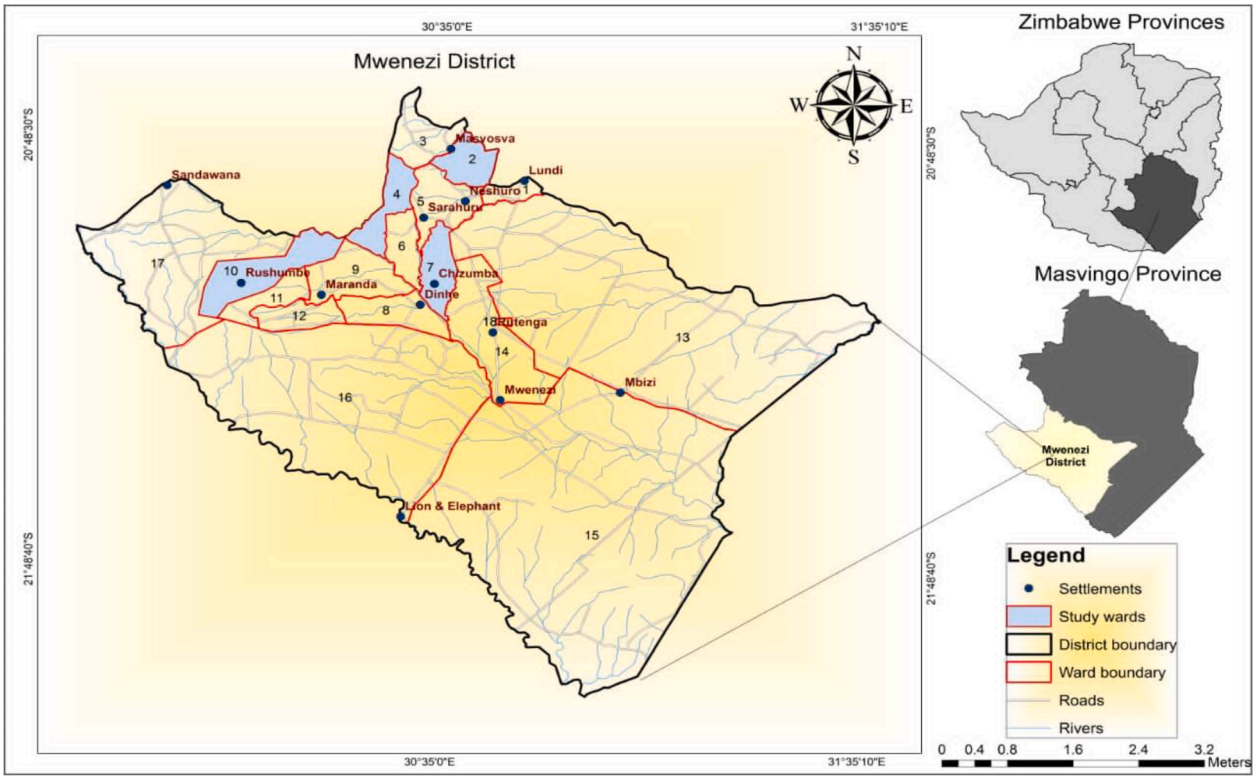

Fig. 1. Map of Mwenezi District.

Results from FGDs were used to complement data gathered through household survey questionnaires and interviews. FGDs were disaggregated by sex so as to allow the female counterparts to feel free and fully explain their views of resilience building initiatives as mixing them with males usually result in indifference to explain their views. Focus group discussions were conducted in February 2024 and ran concurrently with the questionnaire survey.

Qualitative data obtained from open-ended questionnaires, interviews and focus group discussion narratives was subjected to content analysis whereby emerging themes, patterns and relationships were identified. This was done through the following steps:

Defining prior codes or theme categories; formulating preliminary codes; coding of data. Coding of responses presented by people in different contexts helped to develop more meaningful data to end users. Quantitative data was subjected to SPSS version 22.0 for analysis. Descriptive statistics included calculation of frequency and percentages of respondents. Cronbach's alpha was used to test the reliability and validity of the data obtained to answer the specific objectives of the study. The Mann-Whitney U test was used to compare differences between two independent groups that is males and females on their perceptions with regards to building community resilience to enhance community socio-economic development.

To maintain human rights, privacy, as well as policies, rules and regulations of research heads of departments where the study was done were informed a month before the study. Participants signed consent forms to register their willingness to participate in the study. All the secondary data sources used in this research were acknowledged using Harvard Reference System. All research participants were informed that results from the study were purely for academic purposes.

2. Results and discussion

A total of 352 questionnaires were distributed equally in the selected wards. The average response rate from the 4 studied wards was 92 %. The following table summarises the response rate per ward and the proportion of males and females (Table 1). A reliability analysis was conducted using Cronbach's Alpha to calculate coefficients of all objectives to test the reliability of analysis. The findings showed that all objectives had coefficients above 70 %, indicating that the findings were reliable.

2.1. Climate change impacts on community socio-economic development

The findings revealed that, climate change is linked to socio-economic decline in the selected wards. The extreme weather events being experienced in Mwenezi District were identified as exacerbating community vulnerability. The Department of Agriculture Technical and Extension Services records revealed that, highest temperatures are ranging between 43 and 45° while rainfall is below 450 mm. The low rainfall combined with the scorching temperatures which are characteristic of the selected wards make the production of maize crop, the national staple, difficult.

Some of the identified challenges induced by climate change include; diseases (both livestock and people), food shortages, water scarcity, forced displacement, infrastructure damage, school drop outs and failure of income sources. Similarly, Sereenonchai, and Arunrat, [23] highlighted that, climate change has contributed to changes in surface temperatures, and precipitation fluctuations.

Table 1
Response rate and proportion of males.

Ward	Questionnaires distributed	Returned	Response rate	% Males	% females
2	88	77	87.5	32 %	68 %
4	88	82	93	33 %	67 %
7	88	83	94	32 %	68 %
10	88	81	92	31 %	66 %

A Mann-Whitney *U test* was conducted to determine the impacts of climate change on community socio-economic development between males and females. The findings revealed that $p = 0.001$ ($p < 0.05$) meaning that there is no significant difference on the impacts of climate change on community socio-economic development between males and females. This means both males and females perceived similar views regarding the impacts of climate change on community development hence justifying the rationale for building community resilience.

The agriculture sector is an important sector among rural communities in the global south. However, its reliance on unpredictable precipitation and temperature makes the sector particularly susceptible to climate change. Climate change will affect food production among small scale farmers over the next decade a feature which has become a familiar characteristic in Mwenezi District. Agriculture is not only a source of food for rural community but is also a source of income. Within the four ECRAS beneficiary wards crop production and animal rearing are the traditional income sources. However changing climate means a potential loss in possible income streams and the local gross domestic product (GDP). This will ultimately delay the achievement of multiple welfare SDGs including goals 1 and 2.

2.2. Extreme weather events

Heatwaves are being experienced in Mwenezi District. One of the Agriculture Technical and Extension (AGRITEX) Officer highlighted that, most significant heatwaves are being experienced in the month of October. A combination of high temperatures, low rainfall and heatwaves are contributing to crop failure which is the main livelihood option. High temperatures are increasing evapotranspiration rates, intensifying the drying up of grazing pastures. This is hindering socio-economic development since in Mwenezi the development is centred on crop and livestock production. According to Barlow et al. [24], temperatures considerably influence the crops by affecting several physiological injuries like leaf abscission, scorching, senescence, root and shoot growth limitation that subsequently leads to reduction in yield.

The District Development Coordinator also mentioned the effects of climate change on lowering the water table. Lowering the water table affects the community garden initiative. This is because 63 % of the selected respondents indicated that they use water from wells and community boreholes to irrigate their gardens. The availability of water in these wells is highly determined by the level of the water table. Hence lowered community gardens pose challenges on sustaining community gardens.

2.3. Livestock diseases and death

Of the selected respondents, 69 % mentioned livestock diseases in Mwenezi District. The respondents explained that, livestock diseases are due to pasture poverty (Fig. 2). The research was conducted at the middle of the rain season when pastures are expected to be available, however the researcher observed that grounds were bare and livestock pastures were unavailable. The Veterinary Services Officer highlighted that, low rainfall, environmental degradation and depletion of soil fertility has denied rejuvenation of pastures. This has increased pasture unavailability and development of bare grounds. Consequently, this has reduced livestock production, one of the livelihood options hindering socio-economic development.

A total of 71 % respondents mentioned livestock diseases as one of the challenges induced by climate change. The identified categories of livestock diseases are namely; cattle diseases (foot and mouth, anthrax, red water), goat diseases (Salmonellosis, fever, red water and foot rot), chicken diseases (infectious coryza, coccidiosis, new castle, avian influenza). The respondents further explained that some of the diseases

Fig. 2. Bare grounds for livestock grazing in ward 10.
Source: Field data (2024).

occurred during the rainy season and these diseases are attributed to excessive rains. Excessive rains result in mud accumulation in livestock structures which would cause foot rot on goats and cattle. Climate change significantly impacts livestock health and diseases by increasing heat stress, altering disease vector distributions, and affecting the survival and transmission of pathogens. These effects can lead to metabolic disruptions, immune suppression, and increased susceptibility to infections in livestock, ultimately impacting animal production and public health. In a review of literature Magiri et al., (2024) indicated that in the global south increasing in temperatures had direct links with oxidative stress among livestock and immune suppression which ultimately cause increased disease susceptibility and death. Similarly, this trend has been observed in the 4 ECRAS wards in Mwenezi District where livestock farmers have lost cattle and goats due to diminishing feedstock.

2.4. Migration of young boys and girls

Climate change is contributing to increased migration of young boys and girls to neighbouring countries to search for employment. In a focus group discussion (FGD), the elderly highlighted that young and energetic youths are moving out to search for employment. The District Development Coordinator who articulated that this massive migration is contributing to brain drain of skilled labourers. Some young boys found present during the data collection period explained that they are moving to neighbouring countries to search for livelihood sources since their usual option (crop production and livestock production) is no longer viable and yielding very low results due to climate change. In another FGD, constituted by females, it was raised that these migrations are contribution to abandonment of married females by husbands and family break ups.

2.5. Destruction of houses

In Mwenezi District, there were some cases of flash floods recorded accompanied by strong winds. The ward 4 councillor highlighted that strong winds destroy houses and put people at risk. During the 2022–2023 rainy season in ward 4, five houses' roofs were removed as a result of strong winds. The councillor therefore recommended the construction of houses with parapet roofs which are considerably resistant to strong winds. Feola [25] highlighted that extreme weather events being faced by many people across the globe have resulted in damage of social infrastructure in the form of houses, community access roads and communication systems.

2.6. Contribution of resilience building initiatives to sustainable community socio-economic development

The study examined the contribution of resilience building initiatives towards attaining sustainable socio-economic development. It was established that, all selected respondents have benefited socially and economically from the implemented interventions and as such their livelihoods have been transformed. The benefits obtained from the implemented resilience interventions were categorized as follows:

1. Skills development and empowerment
2. Food security and dietary diversity
3. Clean water availability
4. Enhanced livestock production
5. Community Sanitation and hygiene
6. Innovation

2.7. Skills development and community empowerment

The findings revealed that 93 % of the selected respondents have received skills development and empowerment trainings. The trainings contributed to resilience and capacity building of households through enhancing knowledge banks of skills to minimize and manage shocks and stressors hindering community development. The households in a focus group discussion at ward 4 centre indicated that before the launch of resilience-building initiatives, households lacked skills, knowledge and expertise to implement sustainable interventions. The District Development Coordinator explained that trainings contributed to resilience and capacity building of households through enhancing knowledge banks of skills to minimise and manage shocks and stressors hindering community development. The trainings engaged stakeholders from AGRITEX, Veterinary Services Department, Ministry of Youths, Ministry of Women Affairs, Gender and Community Development, Care, Plan International, ICRISAT and Civil Protection Unit.

The households selected indicated that they received the following trainings; Village Savings and Lendings Training (VS&L) (61 %), Disaster Risk Management training (47 %), Fodder Production and Preservation Training (54 %), Small grain production Training,

Postharvest management training (61 %), Chicken Production training (44 %)Sugar Bean Production Training (29 %), Improved livestock housing structures (63 %) and Community Adaptation Action Planning Training (41 %) (Fig. 3).

The trainings were reported to be of fundamental importance as they laid a foundation on farmers on how to sequentially layer their activities to continuously enhance their critical livelihood capacities. A critical analysis of the trainings launched revealed that the knowledge gained from trainings benefited socially and economically in the communities. The knowledge and skills obtained combined with other community-based interventions such as beer brewing, cash crop sales, vegetation production enhanced community sources of income were critical in improving resilience in the era of climate chance. Murwendo et al., (2015) indicated that, trainings are critically important as they increase knowledge banks of trained individuals and this will eventually aid the decision making process.

2.8. Livestock feed production and preservation training

Livestock feed formulation is important amongst households in the District. After the training, findings revealed that some farmers collectively formed groups to preserve fodder for their livestock to use during stress times (Fig. 4). One of the livestock specialists highlighted that livestock feed preservation improved livestock quality as livestock could access better food all year round. This benefitted the communities as they enabled them to sell their beasts at higher prices.

2.9. Food security and dietary diversity

The interventions implemented enhanced the food security status and dietary diversity of households in Mwenezi District. Prior the trainings, the households used to grow maize as their main cereal crop. However due to decline of soil fertility, enhanced temperatures and low rainfall amounts, maize production declined. As an adaptation strategy, small grains were adopted to replace (or be co-produced with) maize. During the data collection time in February 2023, a total of 39 % had planted red sorghum, 44 % had planted pearl millet, 10 % rapoko and 51 % white sorghum. Rainfall variability and high temperatures were affecting crop production significantly. The AGRITEX department promoted small grains and short seasoned varieties that could survive in the prevailing climatic conditions.

The dietary diversity status of households in Mwenezi District was established. Three categories were used to rank dietary diversity that are; low diet, medium diet and high dietary diversity (Table 2). A combination of interventions influenced the status of households' dietary diversity. The ECRAS project with its interventions changed the dietary diversity status of households in the studied wards in Mwenezi District. According to Zimvac assessment for the period 2016–2017 before the ECRAS project, 68 % of the households were reported to have a poor diet in Mwenezi District. Various factors were attributed to the dietary diversity status of households, and some of the factors include; high frequency of shocks and stressors, inflation and financial instability.

The ECRAS project in Mwenezi District implemented nutritional gardens across the district. The household heads explained that in the nutritional gardens, various crops were grown due to availability of water for, example onions, tomatoes, cabbages, carrots and rape (Fig. 5). As a result, the households regarded the nutritional garden scheme as an initiative that also enhanced diet of households while also generating income after selling the products.

2.10. Community sanitation and hygiene

The interventions implemented in Mwenezi strengthened communities' capacities to manage diseases such as cholera and diarrhoea. Of the sampled respondents, 53 % had constructed double-holed latrines, 44 % had constructed single-holed latrines while only 3 % had not constructed though they indicated that they had been trained on how to construct them. Projects that generated income allowed communities to improve households' sanitation through constructing toilets and drilling protected wells. The District Development Coordinator explained that the interventions reduced the spread of diseases such as cholera, and contributed to community development through improved health.

2.11. Innovation in Mwenezi District

The trainings in Mwenezi District inspired majority of households to be innovative using locally available resources. Research findings revealed that the fodder production training inspired households to prepare fodder using the locally available resources. This innovation benefitted the communities through availing livestock feed that had potential of improving livestock quality.

Furthermore, the households initiated the water harvesting structures as a strategy to promote water availability for use during water

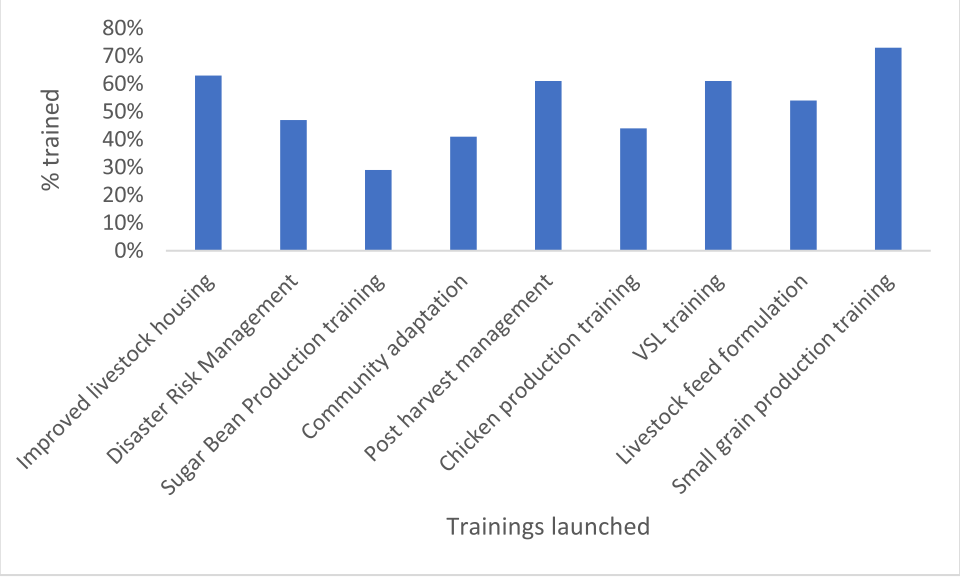

Fig. 3. Trainings launched in Mwenezi.

Fig. 4. Livestock feed being stored collectively in ward 7.
Source: Field data (2023).

Table 2
Dietary diversity statuses in the studied wards.

	Dietary diversity categories		
Ward	Low diet	Medium diet	High diet
2	11 %	43 %	46 %
4	7 %	49 %	44 %
7	4 %	41 %	56 %
10	12 %	31 %	57 %

scarcity times. The researcher observed that water harvesting structures are developed from the roof into water reservoirs. Communities are also employing the flies trap concept where black soldier flies are captured for chicken feed. The intervention was commended for promoting chicken production since the feed obtained from the black soldier fly concept is of high nutritional value for chickens.

2.12. Households' perceptions on adoption of resilience building interventions to enhance sustainable community socio-economic development

The study assessed the perceptions of households on building community resilience to obtain sustainable socio-economic development. Community perceptions on resilience interventions implemented through the ECRAS project such as small grain production, livestock production interventions, awareness and trainings were assessed.

A Mann Whitney *U test* was used to test whether there is a significant difference in perceptions between males and females on community resilience as a factor towards community socio-economic development. The following hypothetical claims were made:

H0: There is no significant difference regarding building community resilience to attain socio-economic development between males and females.

H1: There is a significant difference regarding building community resilience to attain socio-economic development between males and females.

Fig. 5. Tomato garden in Ward 2, Mwenezi District.

The findings revealed no significant difference between and females with $p = 0.033$ ($p < 0.05$). This showed that both males and females in the studied area have realized building community resilience as an ingredient for socio-economic development. Therefore, we reject null hypothesis and accept alternative hypothesis that is there is no significant difference regarding building community resilience amongst males and females to attain community socio-economic development.

3. Conclusion

Building climate resilience is a critical component of enhancing community socio-economic development in South Eastern Zimbabwe arid and semi-arid areas. Climate change and climate variability is undermining developmental gains accrued by communities. Majority of the households in Zimbabwe's livelihoods are largely centred on agro-based activities as reflected by the findings obtained. They depend on climate sensitive interventions which have been compromised by climate adversities. As a result, climate solutions to build resilience are ideal for community socio-economic development.

In Mwenezi District various interventions have been implemented to manage climate change impacts. Some of the critical interventions initiated include; small grains production, livestock production, disaster risk management trainings and post-harvest management trainings. The interventions enhanced community anticipation of shocks and stressors and the decision making ability to go for interventions that enhance community development. Some of the interventions enhanced community food security status, community sanitation and income generation. As a result, all the selected respondents in Mwenezi District perceived community resilience as a strategy to enable socio-economic transformation.

4. Recommendations

Resilience building interventions should be led by the communities receiving support from different stakeholders. This would allow projects to last longer since a sense of ownership will be instilled in communities by allowing them to lead the project. Different stakeholders assisting vulnerable communities should gather local information. This will help stakeholders to support projects that best suit the prevailing conditions. More youth should be involved in the projects that can accelerate attainment of community socio-economic development. This will help reduce the risk of loss of skilled and energetic labourers. Youth are the moist energetic labourers who are key to offer the required labour force to develop their communities. Climate smart interventions should be at the core of all development agendas. This is because climate change and variability impacts are retarding community socio-economic development. Hence there is need for designing and implementing interventions that manage climate change adversities.

5. NBS impact and implications

There is a multitude of innovative nature-based solutions (NBS) projects and initiatives, garnering great benefits to their surroundings in Europe. Under the NetworkNature coordinated European Commission *NBS Task Force 2: Nature-based Solutions Impact Evaluation Framework*, experts from these projects have gathered to create a **handbook that outlines a robust NBS impact assessment framework**. To enhace wider application of the framework, the indicators have been developed collaboratively with the European Environment Agency and the EU Joint Research Centre.

The NBS Impact Assessment Framework enables cities and regions assess NBS, and help them choose suitable ones for their context and anticipate challenges and opportunities associated with specific NBS, enabling the sustainability of the solutions in the long-term. The handbook allows policy makers to gain an understanding of specific NBS ability to reach desired outcomes. Readers will learn how to create scientifically sound monitoring and evaluation plans for NBS.

Ethical approval

Ethical approval committee- Not applicable

This article does not contain any studies with human participants performed by any of the authors

Informed consent

The research involved human participants during the data collection phase. All participants were informed and asked to sign consent forms for them to participate in this research.

All authors contributed to the production of the manuscript

CRediT authorship contribution statement

Defe Rameck: Methodology, Formal analysis, Conceptualization. **Matsa Mark:** Resources, Project administration, Writing – review & editing, Supervision. **Mavugara Roberta:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

References

[1] G.M. Filippelli, J.L. Freeman, J. Gibson, S. Jay, M.J. Moreno-Madriñán, I. Ogashawara, F.S. Rosenthal, Y. Wang, E. Wells, Climate change impacts on human health at an actionable scale: a state-level assessment of Indiana, USA, Clim. Change 163 (2020) 1985–2004.

[2] S.S. Mugambiwa, H.M. Tirivangasi, Climate change: A threat towards achieving 'Sustainable Development Goal number two'(end hunger, achieve food security and improved nutrition and promote sustainable agriculture) in South Africa, Jàmbá: J. Disaster Risk Stud. 9 (1) (2017) 1–6.

[3] N. Arunrat, S. Sereenonchai, W. Chaowiwat, C. Wang, Climate change impact on major crop yield and water footprint under CMIP6 climate projections in repeated drought and flood areas in Thailand, Sci. Total Environ. 807 (2022) 150741.

[4] S. Huang, V. Krysanova, F. Hattermann, Projections of climate change impacts on floods and droughts in Germany using an ensemble of climate change scenarios, Reg. Environ. Change 15 (2015) 461–473.

[5] C.H. Magadza, Climate change impacts and human settlements in Africa: prospects for adaptation, Environ. Monit. Assess. 61 (2000) 193–205.

[6] A. Amran, S.K. Ooi, C.Y. Wong, F. Hashim, Business strategy for climate change: an ASEAN perspective, Corp. Soc. Responsib. Environ. Manag. 23 (4) (2016) 213–227.

[7] Y. Yang, H. Xu, J. Wang, T. Liu, H. Wang, Integrating climate change factor into strategic environmental assessment in China, Environ. Impact. Assess. Rev. 89 (2021) 106585.

[8] S. Parnell, R. Walawege, Sub-Saharan African urbanisation and global environmental change, Glob. Environ. Change 21 (2011) S12–S20.

[9] O. Serdeczny, S. Adams, F. Baarsch, D. Coumou, A. Robinson, W. Hare, M. Schaeffer, M. Perrette, J. Reinhardt, Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions, Reg. Environ. Change 17 (2017) 1585–1600.

[10] S.A. Ofori, S.J. Cobbina, S. Obiri, Climate change, land, water, and food security: perspectives from Sub-Saharan Africa, Front. Sustain. Food Syst. 5 (2021) 680924.

[11] O. Mupepi, M.M. Matsa, J. Hove, A geographic information system and analytic hierarchy process drought risk analysis approach in arid south-western Zimbabwe: Prospects for informed resilience building. Nature-Based Solutions 6, 2024, p. 100149.

[12] S.H. Jore, Is resilience a good concept in terrorism research? A conceptual adequacy analysis of terrorism resilience, Stud. Confl. Terror. 46 (1) (2023) 1–20.

[13] G. Mangalaraj, S. Nerur, R. Dwivedi, Digital transformation for agility and resilience: an exploratory study, J. Comput. Inf. Syst. 63 (1) (2023) 11–23.

[14] McCleary J. and Figley C., 2017. Resilience and trauma: expanding definitions, uses, and contexts.

[15] Béné C., Frankenberger T. and Nelson S., 2015. Design, monitoring and evaluation of resilience interventions: conceptual and empirical considerations.

[16] B.J. Jesse, H.U. Heinrichs, W. Kuckshinrichs, Adapting the theory of resilience to energy systems: a review and outlook, Energy Sustain. Soc. 9 (1) (2019) 1–19.

[17] F. Denton, Climate change vulnerability, impacts, and adaptation: why does gender matter? Gend. Dev. 10 (2) (2002) 10–20.
[18] V. Mamombe. 4. Effects of the 2015/2016 El Niño on Zimbabwe Rainfall. *Impact of El Niño on Biodiversity, Agriculture, and Food Security 23-24 February 2017*, Haramaya University, Ethiopia, 2017, p. 51.
[19] M. Matsa, Impact of climate change in Zimbabwe. Climate Change and Agriculture in Zimbabwe, Springer, Cham, 2021, pp. 21–30.
[20] M. Muchacha, M. Mushunje, The gender dynamics of climate change on rural women's agro-based livelihoods and food security in rural Zimbabwe: implications for green social work, Crit. Radic. Soc. Work 7 (1) (2019) 59–72.
[21] S.S. Tembo, Livelihood strategies for communities in drought prone areas: a case of Mwenezi district Zimbabwe. The humanitarian and development sector, Sustainability (2017).
[22] ZRBF, (2019). High frequency monitoring report. Available at www.zrbf.co.zw accessed on 10/08/2021.
[23] S. Sereenonchai, N. Arunrat, Fishers' decisions to adopt adaptation strategies and expectations for their children to pursue the same profession in Chumphon Province, Thailand, Climate 7 (2) (2019) 34.
[24] K.M. Barlow, B.P. Christy, G.J. O'leary, P.A. Riffkin, J.G. Nuttall, Simulating the impact of extreme heat and frost events on wheat crop production: a review, Field Crops Res. 171 (2015) 109–119.
[25] Feola G. (2015) Societal Transformation in response to global and environmental a change: a review of merging concepts. 44 (5) p. 387, Ambio.