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Building climate resilience to enhance attainment of welfare Sustainable Development Goals (SDGs) in Southern Zimbabwe

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A B S T R A C T

The study sought to assess the effectiveness of climate resilience approaches implemented in Mwenezi District towards enhancing attainment of welfare SDGs. The researchers targeted 4228 Enhancing Community Resilience Project Beneficiaries (ECRAS) in wards 2, 4, 7 and 10 in Mwenezi District. ECRAS Project implementing partners (Care International Monitoring and Evaluation Officer, Department of AGRITEX District Head and Extension Officers, Department of Veterinary Services District Head, District Development Coordinator and Ward Councillors were purposively selected. Sample size for the 4228 ECRAS beneficiaries selected from selected wards 2, 4, 7 and 10 was calculated using Raosoft online calculator at 95 % confidence level and it translated to 352 households. Quantitative data (descriptive statistics) were subjected to SPSS version 22.0 for analysis while qualitative data were subjected to content analysis and presented to complement descriptive statistics. The findings revealed that building climate resilience helps rejuvenate life support systems and environments of the households in Mwenezi District which are the basis for activities that accelerate attainment of SDGs. The study recommends scaling up such climate resilience approaches as a strategy to support global and national efforts to attain sustainable development. This is important since climate change has posed significant impacts on community activities that are critical for ensuring sustainable development.

1. Introduction

Climate change is increasing the frequency and intensity of extreme weather events that are affecting all countries (Thomas, 2010; Gupta et al., 2019). Climate hazards increase poverty, exacerbate food insecurity and cause health problems, among other hardships which may reverse years of development progress in some countries (Middleton & Sternberg, 2013; Mora et al., 2018). Disaster risk reduction and disaster management, social protection and adaptation strategies (climate resilience) must all be part of a broader development framework that incrementally leads the way in attaining multiple international SDGs. In many developing and developed countries community-based initiatives are emerging as promising approaches to lessen the impacts of climate change. The initiatives are also empowering people and bolstering community resilience (Kirkby et al., 2017).

In the context of communities, resilience is a measure of the sustained ability of a community to utilize available resources to withstand and recover from adverse situations (Magis, 2010; Koliou et al., 2020). Resilient communities are better able to preserve their basic social

structures, functions and to restore them when displacement does occur, so reducing the associated risks. Building resilience requires different sector partners to create the right policies, plans, and infrastructure investment businesses. The investments will help ensure the functioning of economic systems, social systems, and environmental systems (sustainability) (Miles, 2018; Pyke et al., 2018). The mutually advantageous partnerships can strengthen the ability of vulnerable populations to adapt to change, improve their well-being, and contribute to social development and economic growth.

Natural hazards, disasters, and risks are undermining countries' efforts toward reaching Sustainable Development Goals (SDGs) (Shim & Kim, 2015; Raile et al., 2019). Resilience building and climate change adaptation strategies by countries and donors help ensure that SDGs are not undercut by the impacts of hazards and extreme weather events (Fernández and Ceacero-Moreno, 2021). Achieving the SDGs will require a radical rethink of how we manage risks, including climate change impacts.

The realization of the economic and societal burdens which are due to natural shocks and stressors made World Food Programme (WFP),

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country Governments and donors to collaborate and initiate innovative tools to reduce and mitigate risks from stressors and shocks (Carletto et al., 2015; Tanner et al., 2017). Development actors, communities, households, and individuals have developed strategies to overcome hunger, achieve food security, and enhance resilience from global shocks and stressors. The initiatives designed target to achieve United Nations Sustainable Development Goals, (SDGs) and achievement of the 2030 Agenda for Sustainable Development.

Africa is one of the most vulnerable regions in the world due to widespread poverty, limited coping capacities, and its highly variable climate (Madzwamuse, 2010). Zimbabwe is particularly vulnerable due to its heavy dependence on rain-fed agriculture and climate-sensitive resources. Extreme weather events, notably drought, flood, and tropical storms are also likely to threaten development gains across a variety of sectors and intensify existing natural hazard burdens for at-risk populations while presenting risks to lives and livelihoods. Hence climate change adaptation through resilience building is a principal development in Zimbabwe that would minimise the impacts of climate change while enhancing the struggle of achieving the global SDGs.

Climate variability and change have increasingly contributed to extreme events in the form of rising temperatures (warmer spells and heat waves), and changing precipitation patterns (flash floods), in Mwenezi District (IPCC, 2013). In Mwenezi District, the impacts of climate change have contributed to extreme poverty, environmental degradation, infrastructure damage (houses, bridges, and granaries), livestock loss, and human injuries and death. The majority of households' lives are largely dependent on the agriculture sector which is being affected by climate change adversities. The agriculture sector is the basis of all life support systems in Mwenezi District that promote the efforts of attaining SDGs in the District.

In an attempt to address the above-mentioned climate change adversities, building climate resilience is essential to achieve welfare SDGs (1; 2; 3; 6; 11; 13). In Mwenezi District, some inroads have been done through joint efforts of NGOs, communities, and government departments. Resilience-building interventions have been implemented through the Enhancing Community Resilience and Sustainability (ECRAS) Project (ZRBF, 2019). The project's envisaged outcomes were to manage climate change impacts guided by the UN Sustainable Development goals. This research will be guided by the following specific objectives; identify challenges hindering attainment of multiple welfare SDGs; establish interventions implemented to attain welfare SDGs and assess the effectiveness of implemented interventions towards attaining multiple welfare SDGs in Mwenezi District.

2. Methodology

2.1. Study setting

Mwenezi District is in the Southern part of Masvingo Province in Southern Zimbabwe (Fig. 1). It 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. The district has a total land area of 1 339 657 ha made up of communal areas, intensive conservation areas for wildlife, and old resettlement areas (Chikodzi et al. 2013). Riverine forests, shaped by edaphic and micro-climatic conditions are found on the fringes of rivers in Mwenezi District. The most common tree species are marula (*scherocaya birrea*), baobab (*adansonia digitata*), and Mopane (*colophospermum mopane*) (Mamombe, 2017). Mwenezi District is characterized by a flat and undulating area around 300 m altitude (Mando et al., 2019). The area comprises complexly deformed gneisses and granules and rare exposures of enderbites and dioritic gneisses deposited as various sediments, limestone, and volcanic rocks but now intensely deformed and metamorphosed (Howarth & Harris, 2017; Mavhura, 2021).

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 (Mamombe, 2017; Mando et al., 2019). Soil erosion rate has become more extensive and deepened poverty as the 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. Cereal crop production yields are generally low, averaging 0.5 t/ha against the average yield potential of 2.8 t/ha for agro-ecological region V. Such environmental conditions hinder the attainment of multiple SDGs in the District.

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, 2012). There is an imbalance between the number of males and females which suggests that there are some households led by
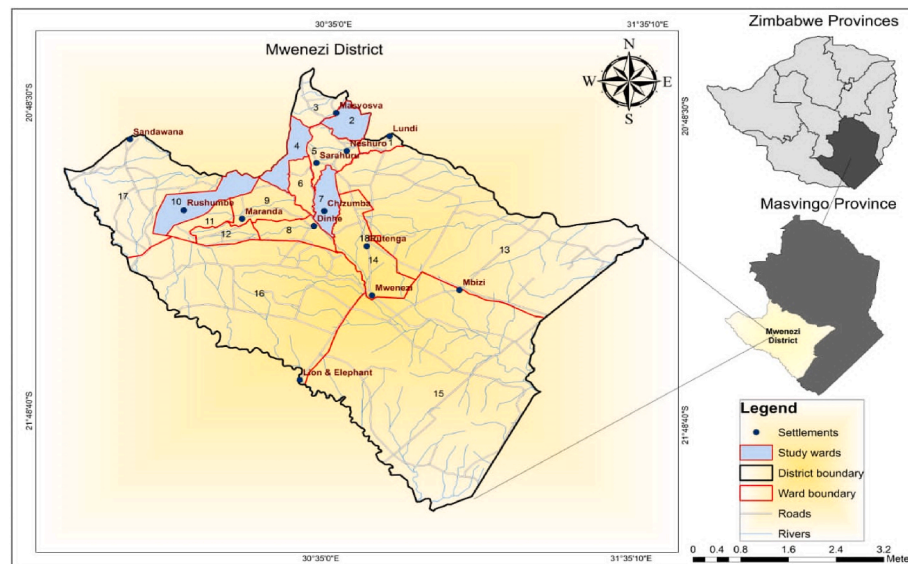

Fig. 1. GIS produced map for Mwenezi District of Southern Zimbabwe.
Source: Designed by Authors (2024)

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 (Tembo, 2017; Muchacha & Mushunje, 2019; Matsa, 2021). The dependency of communities on climate sensitive sectors also retards achieving sustainable development goals.

The majority of youth and middle-aged men in Mwenezi District migrate to neighbouring countries mainly South Africa and Mozambique (Tembo, 2017; Chiweshe, 2018; Scoones et al., 2019). 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 researchers adopted a mixed-method approach which depended on both qualitative and quantitative approaches. The quantitative approach used in this study depended on Household closed-ended questionnaires and inferential statistics through cross-tabulations using SPSS version 22.0. The qualitative approach is concerned with understanding a problem from the participant's view-point (Creswell, 2015; Shuttleworthy, 2017). The qualitative techniques in this study involved focus group discussions, interviews, and direct field observations. The qualitative methods were used to generate data on the contribution of resilience-building interventions towards attaining SDGs.

The research targeted 4228 Enhancing Community Resilience and Sustainability (ECRAS) project beneficiaries in 4 wards of Mwenezi District (ZRBF Crisis Modifier 3, 2019). Each ward has a total of 1057 ECRAS beneficiaries. The Enhancing Community Resilience and Sustainability Project implemented various interventions aimed at enhancing community resilience through managing climate change impacts. Therefore, the researchers assessed the contribution of such interventions toward attaining SDGs in Mwenezi District. The research also targeted stakeholders operating in Mwenezi District pioneering projects that build community resilience. Stakeholders targeted include Non-Governmental Organisations (Care, PLAN International, ICRISAT) and Government Departments (AGRITEX, Veterinary department, Mwenezi Rural District Council, District Development Coordinator).

The sample size for the household questionnaire survey was calculated using Raosoft sample size calculator at a 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 in 4 wards respectively. A purposive sampling technique was used to select key informants from the organisations involved in the resilience projects in Mwenezi District that is, Care, Rural District Council, District Development Coordinator, AGRI-TEX, Veterinary Service department, Ministry of Youth and Women Affairs. These were targeted to obtain information on the successes of the implemented resilience building initiatives towards attaining multiple welfare SDGs.

Qualitative data collection tools used in this study included key informant interviews, focus group discussions, literature review, direct field observations, and open-ended questionnaires. Eight focus group discussions were held in the selected 4 wards, that is, 2 per ward disaggregated by gender. Each focus group discussion comprised of people of different ages. Results from FGDs were used to complement data gathered through household survey questionnaires, interviews and observations. The questionnaires were administered to 352 ECRAS beneficiaries to gather information on the various resilience initiatives to manage climate change impacts and their contribution towards attaining SDGs. Questionnaires were administered to household heads who are responsible for securing household needs. Before going to the field, the researcher obtained a research clearance letter from the Department of Geography and Environmental Studies at Midlands State University as a permit for the data collection process. During data collection in the field, the information from respondents was treated with high level of confidentiality. The researcher reiterated to his respondents that their responses will be kept private and confidential.

Qualitative data obtained from open-ended questionnaires, interviews, and focus group discussion narratives were 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 data. Coding of responses presented by people in different contexts helped to develop more meaningful data to end users. Qualitative results were presented to enhance quantitative data. Quantitative data analysis was done so as to deduce meaning from numerical values. The researcher subjected quantitative data to SPSS version 22.0 for analysis. Descriptive statistics included the calculation of frequency and percentages of respondents. A 92 % response rate was reached during the data collection phase. Some of the respondents were not found at their homes during the data collection phase and this explains why a 100 % response rate was not obtained. The reliability analysis conducted using Cronbach Alpha to test the reliability of analysis revealed that all objectives had coefficients above 70 %, indicating that the findings were reliable.

2.2. Study limitations

The primary limitation of the study results is generalization of the findings. Mwenezi District has ward with different characteristics. However the findings obtained have been generalized across the District assuming that the whole district falls under the same agro-ecological region in the same Province of Zimbabwe. Another limitation is that the researcher worked with a sample size and as a result a limitation may arise from the fact that, sample used can be overestimated to represent the entire population of Mwenezi District.

3. Results and discussion

3.1. Demographic information of respondents

This section presents socio-demographic information of selected questionnaire respondents in the studied wards with the Enhancing Community Resilience and Sustainability Project (ECRAS) beneficiaries. The socio-demographic variables presented in this section include; gender, age, marital status, education levels, household size, and education status. Of the selected questionnaire respondents, females

Table 1
Demographic information of respondents.

Variable	Respondents	Percentage
Gender of participants	Males	33 %
	Females	67 %
Age of respondents	15–25	4 %
	26–35	14 %
	36–45	33 %
	46–55	22 %
	56–65	21 %
	66+	14 %
Marital status	Single	2 %
	Married	75 %
	Widowed	16 %
	Separated	4 %
	Divorced	3 %
Household size	1–5	23 %
	6–10	61 %
	11–15	14 %
	16+	2 %
Education	None	13 %
	Primary	36 %
	Ordinary level	31 %
	Advanced level	19 %
	Tertiary	5 %

dominated their male counterparts (67 %, and 33 %) respectively (Table 1).

The findings obtained revealed that selected respondents had varied forms of education. Education qualifications of respondents range from none formal education to those who hold tertiary education. The levels of education for households were found to be an important factor in determining their perception, attitude and behaviour towards climate change impacts and adoption of resilience interventions to attain SDGs (Liyala, 2020).

3.2. Challenges hindering attainment of multiple SDGs in communal areas of Southern Zimbabwe

Sustainable development agendas are critical for attaining community welfare. As a result, all development prospects should be aligned towards attaining welfare Sustainable Development Goals (SDGs) in communities. The study findings revealed that there were some challenges in communal areas that hindered the attainment of welfare SDGs in Southern Zimbabwe's Mwenezi District. The respondents highlighted that all life support systems that accelerate the attaining of SDGs were being compromised by external forces. The identified challenges are namely; poverty (73 %), cultural beliefs (11 %), livestock deaths (31 %), poor resilience infrastructure (69 %), poor agriculture technology (44 %), population pressure on resources (31 %), diseases (27 %) (For both livestock and humans), drought (27 %), climate change and variability (71 %) (Fig. 2).

3.2.1. Poverty
The findings obtained revealed that 73 % indicated that poverty was affecting all life support systems in the District that would contribute to attain SDGs. The researchers have categorized the most prevalent poverty forms in Mwenezi District which are namely; food poverty and financial poverty.

3.2.1.1. Food poverty. The findings revealed that over 50 % of the respondents in communal areas of Mwenezi District experience food shortages. The researchers established that food poverty being experienced was largely attributed to the failure of the agriculture sector (both livestock and crop production) which are the main livelihood options. These sectors were said to be significant contributors to food availability in Mwenezi District. A scale was used to calculate the food poverty status of the sampled respondents before the Enhancing Community Resilience and Sustainability Project (ECRAS). The following findings were obtained; before the project, 23 % were under extremely high food poverty, 39 % were under moderate food poverty, 19 % high food poverty, 7 % average food poverty status, 1 % were not sure of their

status, 15 % were better, 19 % moderately good and 14 % very good (Fig. 3).

The situation was further explained by the Department of Agriculture Technical and Extension Services (AGRITEX) District Head who articulated that, '*the reduction of the crop production sector's potential has the affected food poverty status of many households*'. This has contributed significantly to hindering the attainment of SDG 1 (ending poverty). ZimVac 2017 report outlined that 70.5 % of the rural population was poor whilst 29.3 % were deemed extremely poor. In the ZimVac report, it was mentioned that poor agriculture production and a decline in livestock production and markets made households in rural areas even poorer. The findings obtained from the ZimVac report supported the situation in Mwenezi District before the ECRAS project.

3.2.1.2. Financial poverty. Households in Mwenezi District are experiencing financial poverty. To build community resilience and alleviate poverty, financial stability is key for all households. Sampled respondents indicated that there are some factors compromising the income-generating project that would enable them to be financially stable. According to the ZimVac report of 2022, there is a large financial gap to support and accelerate the attainment of SDGs. The report highlighted that of all households in rural areas of Zimbabwe, 55 % need good health and well-being SDG support/fund, 39 % need Water, Sanitation and Health (WASH) projects fund, and 93 % need support for quality education. The respondents mentioned that the failure of livestock and crop production (main livelihood options) at the community level has hindered their capacity to withstand financial crises and work towards ending poverty (SDG 2). They noted climate change and variability effects as major causes of failure of these critical sectors.

3.2.2. Climate change and variability
The selected respondents highlighted the impacts of climate change on attaining SDGs in Mwenezi District. The District Development Coordinator explained that, '*climate change is the overlaying factor contributing to community failure to attain SDGs as it undermines the potential of interventions that contribute to SDGs*'. A total of 81 % of households in Mwenezi District have highlighted that their major livelihood options are largely dependent on climate attributes (temperature, rainfall). The respondents in a focus group discussion at Rata in ward 10 indicated that rainfall variability and high temperatures are undermining crop and livestock production which are the main community livelihood options. A total of 69 % in the studied wards highlighted climate change issues of incessant rains, high temperatures, and at times low rainfall as having sparked the outbreak of livestock diseases. Similarly, Chanza and Gundu-Jakarasi (2020) find out that, climatic events such extreme temperatures, increase in frequency of extreme weather
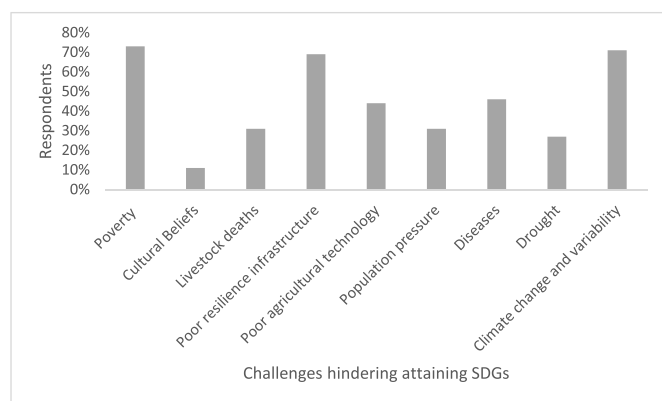
Fig. 2. Challenge that hindered attainment of welfare SDGs in Mwenezi District.
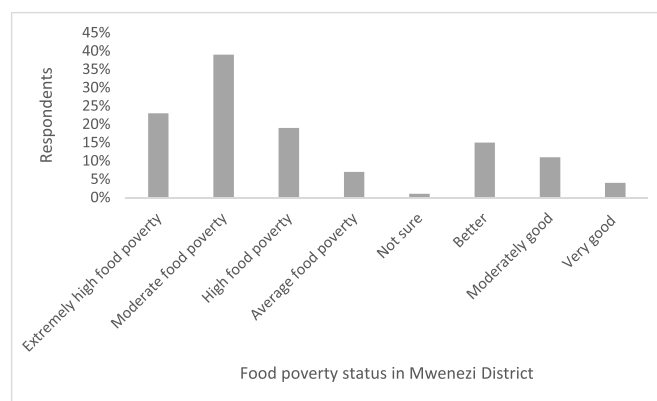Source: Field data (2024)

Fig. 3. Food availability situation in Mwenezi District before the ECRAS project.
Source: Field data (2024)

events, and rainfall variability are projected to affect agriculture in many ways and the noticeable impacts being felt are increased crop failures, pests, crop diseases and the degradation of land and water resources. This affected livestock production and at the same time undermined the communities' capacity to build resilience and attain SDGs such as ending hunger, poverty, good health and well-being. The attainment of these SDGs largely depends on proceeds generated from the livestock production sector.

3.2.3. Poor agriculture infrastructure

A total of 69 % of the households selected in Mwenezi District wards blamed poor agriculture infrastructure as a major factor contributing to failure of the agriculture sector to cope with the changing climate. The respondents highlighted the unavailability of irrigation infrastructure to supplement the water scarcity situation, poor seed varieties, and poor technologies for seed breeding to prepare for prevailing climatic conditions. The consequences of poor agriculture infrastructure combined with other factors undermine the crop production sector to yield its full potential. As a result, SDGs, for example, poverty eradication, zero hunger, good health and well-being, and climate action were seen as difficult to attain.

3.3. Interventions implemented to support attainment of welfare SDGs

The interventions implemented in Mwenezi District to accelerate the rate of attaining SDGs can be categorized into the following categories; Disaster Risk Management Structures and Systems, Community safety nets establishment and strengthening, Low cost sustainable productive water technologies, and promotion of fuel-efficient cook stoves. Implementation of resilience interventions could achieve benefits locally in Zimbabwe that align with multiple sustainable development goals and greenhouse gas emission reduction (Sithole et al., 2023). The following table summarizes interventions implemented in Mwenezi District in line with specific SDG targets (Table 2).

3.3.1. Disaster risk management structures

The interventions on disaster risk management structures were based on realization that disasters (natural, social, and economic) are compromising the attainment of multiple welfare SDGs. The Monitoring and Evaluation Officer from CARE explained that "*deliberations on disaster risk management were based on significant changes which occurred across the District namely drought, late rainfall onsets*". The Monitoring and Evaluation Officer further explained that Disaster Risk Reduction

Table 2
Interventions implemented and SDGs supported.

SDG number	SDG narration	Interventions implemented
1	End poverty	Market linkages, Village Saving and Lendings, Livestock production trainings, fish ponds
2	Zero hunger	Small grains production, Nutrition gardens, post-harvest trainings,
3	Good health and well-being	Clean water through borehole drilling, WASH projects, community safety nets
4	Quality education	Village Savings and Lendings, market linkages
5	Gender equity	VSL groups including both males and females, Community trainings for all irrespective of gender
6	Clean water and sanitation	Borehole rehabilitation, WASH projects
7	Affordable clean energy	Biogas and Tsotso stoves
11	Sustainable Cities and Communities	Nutritional gardens, Disaster Risk Reduction committees
13	Climate action	Small grains, fodder production, and livestock structures.

themes mainstreamed resilience-building programmes and developed appropriate information systems for coordination, early warning, and promotion of knowledge and awareness.

Disaster Risk Reduction committees were formed and operated in communities of Mwenezi District. According to the District Development Coordinator, Disaster Risk Reduction committees are responsible for initiating community-based programmes, and monitoring farmers' responses to the effects brought my late rains. The interventions by Disaster Risk Reduction Committees sought to enhance communities' efforts to attain zero hunger, poverty eradication, climate action, good health, and well-being.

3.3.2. Community safety nets

The ECRAS project formed assisted communities to form Village Savings and Lendings groups. Of the total groups formed in Mwenezi, 22 % were males while 78 % were females. One hundred and ninety groups were formed in total across the District. The CARE International Monitoring and Evaluation Officer reported that the high participation of women was based on the prior existing data that women were the most disadvantaged in terms of monetary resources. As a result, women's empowerment has been identified as means for reducing poverty, enhancing economic growth and supporting the attainment of SDG 5 (Gender equity). In 2022, VSL groups managed to contribute a total of R314 761. Of the selected households in the studied wards, 79 % expressed overall satisfaction with the VSL methodologies as an economic tool that generated income to reduce poverty and enhance the life-support systems of households.

The ECRAS project further strengthened community safety nets by initiating establishment of grain banks in the studied communities. The project leaders explained that they demonstrated to households in the studied communities by setting up 4 metal-made grain banks. The research participants indicated that the grain banks constructed have reduced food poverty induced by grain decomposers such as stalk borer and bacteria. With this initiative people could store their agricultural produce for a minimum of 5 months without it being destroyed by external decomposers.

3.3.3. Crop production

The ECRAS project through the Department of AGRITEX promoted uptake of conservation agricultural practices in the communities studied. The report obtained from the Monitoring and Evaluation Officer indicated that for the 2022–2023 season, 55 % of the farmers had practiced intercropping as a method of live mulching to control pests and diseases which is an indication of smart agriculture practices. This was corroborated by the District AGRITEX Head who revealed that on average 2 ha per farmer is planted for small grains. As a result, the interventions have increased food production and availability thereby contributing to the attainment of SDG 2 (end hunger).

More so, nutritional gardens were developed in the District. The gardens are monitored for production and functionality for them to contribute towards food security and income generation. The researchers observed that gardens had fair diversification with green leafy vegetables, tomatoes, okra, and bio-fortified crops such as tubers and maize. In a focus group discussion held at Muzezegwa Garden, the respondents explained that they are selling surplus okra to sustain themselves economically. Therefore, it has been established that nutritional gardens are contributing to multiple SDGs, for example, ending hunger, poverty eradication, good health, and well-being. Some of the respondents (61 %) highlighted that they are using proceeds generated from vegetable sales in nutritional gardens to sustain children's education and enhance dietary diversity.

3.3.4. Low-cost-sustainable water harvesting technologies

The Enhancing Community Resilience and Sustainability Project trained and supported implemented low-cost-sustainable water harvesting technologies. In the studied wards, the Monitoring and

Evaluation Officer of Care highlighted that 44 low-cost water harvesting structures were constructed (11 roof-top water harvesting structures, 5 surface run-off underground tanks, 13 pans, 11 deep wells, and 4 rock outcrops) (Fig. 4A and B). Water harvesting structures were used to capture water for irrigation purposes. Respondents in a focus group discussion at Ward 7 centre highlighted that water harvesting structures have supported fish farming and horticulture gardening. The researchers have observed that well-structured water harvesting structures have increased farmers' access to clean, safe, and protected water for humans, hence complimenting the national efforts to attain SDG 6 (clean water and sanitation).

3.3.5. Fuel efficient cook stoves

The findings obtained revealed that the ECRAS project supported adoption of fuel efficient cook stoves (tsotso stoves). The District Development Coordinator (DDC) highlighted that, '*on cook stoves emphasis was on reducing the production of smoke, and harmful gasses within households and reduced carbon dioxide emissions*'. The project leaders demonstrated 4 doom-shaped biogas digesters. The biogas intervention supported the Government's efforts to attain SDG 7 on affordable clean energy supply. Resilience-building interventions contribute significantly to speeding up the rate of attaining welfare SDGs.

3.4. Effectiveness of the implemented interventions towards attaining welfare SDGs in Mwenezi District

The researchers assessed the effectiveness of the interventions implemented in Mwenezi District to attain welfare SDGs. Respondents were asked to evaluate their perceptions of how the interventions contributed to the selected SDGs. The SDGs selected are SDG 1 Poverty eradication, SDGS 2 end hunger, SDG 3 Good health and well-being, SDG 11 Sustainable communities, SDG 6 Clean water and sanitation, SDG 13 climate action. In the studied district, 74 % indicated that the interventions implemented contributed to climate actions, 71 % indicated good health and well-being, and 61 % poverty eradication (Fig. 5).

The research findings obtained revealed that the interventions implemented to enhance the crop production sector contributed significantly to improve the food availability status of the households in the studied communities. The crop varieties introduced, for example, sorghum (*Macia) and* pearl millet *(Okashana)* are high-yielding and drought tolerant hence more adaptable to the dry regions of Mwenezi when compared to maize. More so, the *okashana* variety has iron and zinc which are important elements towards enhancing nutrition for pregnant and lactating women. Since the adoption of these varieties, households have been producing an average of 0.6 tons/hectare for sorghum and 0.6 tons/hectare for pearl millet. These averages obtained
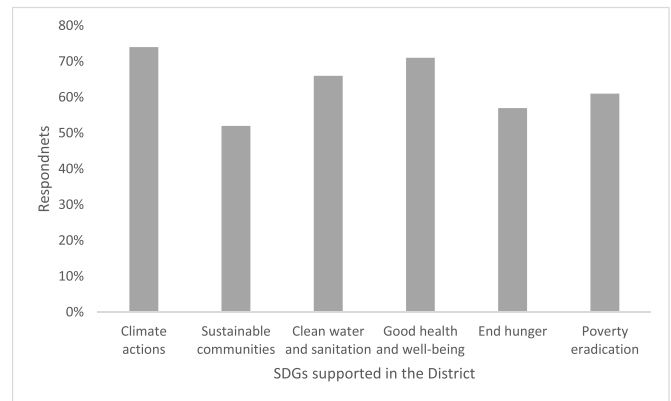
Fig. 5. Households' evaluation on interventions' contribution to SDGs. Source: Field data (2024)

were deemed to be sufficient enough to sustain families of 6 for a period of 9 months according to the WFP standards. The varieties are also resilient and are able to cope with food insecurity induced extreme weather events such as mid-season dry spells. Therefore, the interventions implemented have accelerated the potential of attaining SDG 1 Poverty eradication, SDG 2 End hunger, SDG 3 Good health and well-being and SDG 13 on Climate Actions.

Furthermore, the nutrition gardens established through the ECRAS project contributed to income generation. Nutrition gardens have contributed to income generating for the members and contributed towards the smoothening of income levels especially during lean season periods. They also contributed towards the food, nutrition, and income security of members which is important for their capacity to absorb and adapt to shocks such as drought. Resilience interventions implemented has emerged as approaches to end food security and promote sustainable development while at large addressing climate change issues (Behnassi et al., 2014). Due to constant water availability, nutrition gardens made farmers increase crop diversification into the production of legumes, and bio-fortified crops such as orange maize, orange-fleshed sweet potatoes, and tubers to enhance the household nutrition requirements. During field visits in February 2023, participants were selling surplus leafy vegetables and tomatoes to other community members, and on average each farmer earned R225 per month.

3.4.1. Relationship between adoption of small grains and food security status of households

H0. There is no significant relationship between the small grain production scheme and food security status of households. (P > 0.05)

A   *B*

Fig. 4A and 4B. Water harvesting structures from a rock outcrop in ward 10. Source: Field pictures captured by authors (2024)

Table 3

Chi square tests on the relationship between adoption of small grains and food security status of households.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.944[a]	3	0.040
Likelihood Ratio	2.928	3	0.034
N of Valid Cases	352		

H1. There is a significant relationship between the small grain production scheme and food security status of households. ($P < 0.05$)

Chi square results on the relationship between households' adoption of the small grains and food security status of households reveal that the p value was 0.04 which is less than 0.05(margin of error) (Table 3). This reflects that there is a significant relationship on adoption of small grains and food security status of households. The findings obtained supported the assertion that small grains' ability to withstand extreme climatic conditions being experienced in Southern Zimbabwe has increased communities' food availability status.

4. Conclusion and recommendations

The research sought to analyse the contribution of resilience building interventions to attainment of welfare SDGs in Southern Zimbabwe. Resilience building in Mwenezi District has presented opportunities for attaining multiple welfare SDGs. Stakeholders have collaborated and implemented interventions to manage climate change impacts. Some interventions were implemented through the ECRAS project collaborating with Government departments and communities. The interventions mentioned supported the attainment of SDG 1 End poverty, SDG 2 End hunger, SDG 3 Good Health, and Well-being, SDG 6 Clean Water and Sanitation, SDG 11 Sustainable Cities and Communities, SDG 13 Climate Action. From the findings obtained, it can be concluded that the interventions implemented significantly contributed to attainment of SDGs in Mwenezi District. The resilience building projects have supported all life support systems of the households in Mwenezi District. In light of these findings obtained, the study recommends that resilience-building approaches should be scaled up to national levels. This is because they have presented opportunities for dealing with climate change and its adversities and have paved a supporting platform for attaining the global targets that are Sustainable Development Goals. More so, the study recommends more training and awareness campaigns to be launched in different communities around Zimbabwe. The training will help household's anticipation of shocks and stressors which could impact their perception of the uptake of resilience-building interventions to build supportive environments that allows the attainment of SDGs.

CRediT authorship contribution statement

Defe Rameck: Writing – original draft, Methodology, Conceptualization. **Matsa Mark:** Methodology. **Mavugara Roberta:** Supervision, Formal analysis.

Ethical statement

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.

Data availability statement

Data used to develop this manuscript may be made available upon request.

Funding

Declaration of the use of AI assisted technologies

During the preparation of this work the author(s) used Grammarly to check grammar on the sentences generated. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

The authors declare no conflict of interest.

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