



Resilience building interventions to manage climate induced livestock poverty and deaths in Southern Zimbabwe

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ABSTRACT

Livestock production in Mwenezi District (MD) has become more susceptible to effects of climatic variability and change which undermines developmental gains from livestock value chain. Climate change impacts are increasing the intensity of livestock poverty and deaths across all forms of livestock. The study examined livestock production interventions implemented to reduce livestock poverty deaths in MD. Descriptive research design which utilizes both qualitative and quantitative paradigms was used to accurately and systematically describe the phenomenon. A household survey questionnaire was administered to sampled households in MD wards 4 and 10 while interviews were conducted with purposively selected key informants from the department Agriculture Technical and Extension Services (AGRITEX), Veterinary Services Department, Rural District Council, CARE and District Development Coordinator's Office. Various interventions including construction of improved livestock structures, availing of safe drinking water for livestock, livestock feed formulation have been initiated to reduce and contain livestock poverty deaths. The study recommends that development actors should initiate more interventions to boost livestock production sector since it is the most suitable intervention in relation to climate and weather conditions experienced in MD. The research offers insights to address the complex interplay between climate change, livestock farming, poverty and resilience building. Results inform future researchers while guiding policy makers working in similar contexts on how best to support vulnerable communities. Findings lessen the burden to achieve Sustainable Development Goals namely no poverty, zero hunger amongst others. The study enlightened farmers on how to implement drought mitigation and adaptation techniques during drought periods.

Introduction

Livestock production plays multiple roles in the livelihoods of people across the globe. It provides food and nutrition, work, economic and social status and ensures environmental sustainability. Globally, livestock production contributes about 40% to the agriculture gross domestic product (GDP) and constitutes about 30% of the agricultural GDP in the developing world [1]. These estimates highlight the important contribution of livestock to sustainable agricultural development. The majority of the world's population in developing countries directly depended on livestock production for their livelihoods [2]. Beyond the important role that livestock plays in the provision of food and nutrition in people's diets, livestock has important social functions. They raise the social status of owners and contribute to gender balance by affording women and children the opportunity to own livestock [3,4]. In marginal areas with harsh environments, livestock provide a means of reducing

the risks associated with crop failure and a diversification strategy for resource poor small scale farmers and their communities [5–7]. In developing parts of the world, livestock function as an insurance policy and personal private bank account [8].

Though livestock production presents innumerable benefits and continuously accruing opportunities of livestock farming, the sector is significantly and adversely threatened by climate change and variability such as shifting rainfall patterns and more extreme and unpredictable weather events [9]. The increasing risk and uncertainty related to climate change associated with shock, has aggravated livestock poverty and deaths across the globe [10]. The deaths are occurring due to insufficient pastures for grazing, high diseases outbreak for example Trypanosomosis in West Africa, East Coast Fever (ECF) in Eastern, Central and Southern Africa, and other common diseases like Foot and Mouth Disease (FMD), New Castle and Anthrax [11]. Other small scale livestock farmers are incapacitated financially due to their

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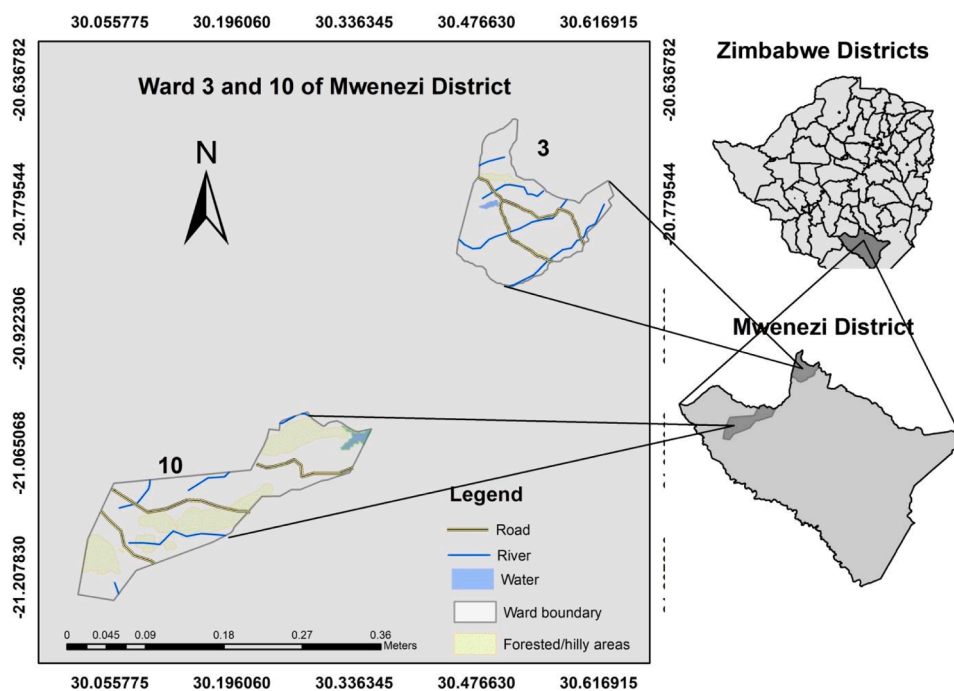


Fig. 1. Map of Mwenezi District ward 3 and 10.

Source: Authors

socio-economic status, they are failing to manage livestock diseases due to unavailability of funds to purchase vaccines to control diseases. Threats posed by external forces to the livestock production sector have attracted attention of various individual farmers, groups, organisations whose livelihoods are directly dependant upon livestock production [12]. Particularly in developing parts of the world who capitalize on livestock and living in areas more suitable for livestock production, measures were put in place to reduce livestock poverty and deaths. Some of the measures range from breed management, protein supplementation, livestock shelter improvement and disaster risk management and control.

In India and Nigeria, livestock dependant livelihoods adopted a measure to reduce livestock deaths induced by food scarcity; they introduced effective ways to address food scarcity by enhancing feed availability [13]. Knowledge was disseminated to farmers to grow fodder trees for making livestock feeds to use during late dry seasons. Farmers grew fodder trees namely; ficus (*ficus paacellie*), Hibiscuss (*Hibiscus tilleacius*) and Lannea (*Lannea corromandilicia*) [14]. Farmers benefitted with a 31% increase in farm income, their cattle gained 90% more live weight. This intervention mainly benefitted goats and cattle farmers whose livestock sustained lives during dry seasons. In West Africa, researchers and scientists collaborated to manage a disease known as Trypanosomosis which was transmitted by tsetse flies [2]. Before the invention of trypanocide many livestock deaths were recorded and farmers who solely depended on livestock farming had their main livelihood source being negatively compromised. Researchers and scientists who collaborated worked and improvised an option which quantitatively and qualitatively improved livestock production.

In Zimbabwe, livestock production is an integral part of crop farming and contributes substantially to household nutritional security and poverty alleviation through increased household income [1]. However, it is negatively affected by bio-physical and socio-economic factors. In Southern Zimbabwe Districts, for example, livestock production has been affected by climate change and variability [15]. Climate change and its associated impacts are increasing the intensity of livestock poverty deaths and at most all the forms of livestock owned by communities under significant threat. This has become a major concern since

livestock farming has hitherto been the most suitable type of farming in this region and is the cornerstone of the rural households' agriculture anchored economy. Due to the myriad of losses experienced in this sector, communities, households and individuals in Mwenezi district have collaborated with Government departments and NGOs (CARE, PLAN) to design and develop mechanisms to reduce livestock poverty and deaths. Despite implementation of various strategies and collaboration of numerous stakeholders, the problem of livestock loss persists. Studying resilience building interventions to manage climate induced livestock poverty and deaths in Southern Zimbabwe is essential for understanding the complex interactions between climate change, agriculture, livelihoods and sustainable development. Nevertheless, research of this nature is still at an embryonic stage in Zimbabwe as evidenced by deficiency of adequate literature related to the topic under study. Therefore, since attainment of sustainability and crafting of proper climate mitigation and adaptation strategies in livestock production require evidence based solutions and policies. In the Zimbabwean context, addressing these issues through research and practical interventions, is crucial to enhance the adaptive capacity of communities and build a more resilient future for those affected by climate variability. Results from the study have potential to facilitate attainment of various Sustainable Development Goals amongst other aspects which advocates for sustainability in Zimbabwe. It is against this background that this study assesses the effectiveness of implemented livestock production interventions to manage livestock poverty and deaths in Mwenezi District wards 3 and 10.

Study area

This was carried out in Mwenezi district focusing on ward 3 and 10. Mwenezi is a small District situated in Masvingo Province in Southern Zimbabwe (Fig. 1). It is bisected by the Mwenezi River and the main A4 highway that connects the town of Beitbridge on the border with South Africa. Mwenezi District is located in agro-ecological region five dry zones of Zimbabwe which receives mean annual rainfall of 450–600 mm. This area experiences the consequences of altered weather patterns and climate extremes. The main types of vegetation in Mwenezi District

are *Brachystegia* speciforms, *Julbernardia globiflora* woodland and *Colophospermum* by lithosols and luvisols [16]. Drought induced by extreme temperatures being experienced has increased poverty, food insecurity, malnutrition and environmental degradation across the District [17]. This is undermining socio-economic development in the District. Cereal production is generally low averaging 0.5t/ha against the potential of 2.8t/ha for agro-ecological region five. Majority of households depend on climate sensitive sectors such as agriculture, livestock production and forest resources [9]. The failure of the crop production sector due to high temperatures and low rainfalls has made households to divert to livestock husbandry. Mwenezi District is an animal husbandry district [18]. According to the Enhancing Community Resilience and Sustainability (ECRAS) Multi-Hazard Risk Assessment of 2017/2018 season, households in Mwenezi District depend on both on farm and off-farm interventions to earn a living. Some of the identified sources of livelihood include vending, cross border trade, brick moulding, casual labour sales and remittances.

Methodology

The research adopted the descriptive research design to gather data that described events through the use of both qualitative and quantitative paradigms aiming to accurately and systematically describe a phenomenon [19], in this case the effectiveness of livestock production interventions to reduce poverty death. Qualitative data collection instruments used included open-ended questions, key informant interviews and observations [20]. Quantitative data was obtained mainly from closed ended questions with numbers, percentages and measurable figures. The research targeted 1622 households in ward 3 and 1528 in ward 10 of Mwenezi District. Mwenezi District was targeted because it is in agro-ecological region five which is not suitable for crop production and as a result households have shifted to animal husbandry. The research also targeted stakeholders (NGOs and Government Departments) operating in Mwenezi District enhancing the livestock production sector through managing poverty deaths. The stakeholders targeted for this study include; Veterinary Service Department, AGRITEX, District Development Coordinator, Ward Councillors and Care Zimbabwe. Convenience sampling was used to select wards 3 and 10. Convenience was based on accessibility of the wards. This is because at the time the study was conducted some areas were rendered inaccessible due to poor roads and flooded rivers.

A 10% sampling frame provides a workable sample and reliable results [21], hence it was used in this study to determine the proportion of questionnaire respondents. As a result, 160 were selected in ward 3 and 150 in ward 10. The researchers adopted systematic random sampling to distribute questionnaires to the total number of selected respondents. Systematic random sampling made every tenth house qualify to participate as a questionnaire respondent. Purposive sampling, a technique based on the researcher's judgement to select a participant who could provide reliable results was adopted to select key informants [22]. Six key informants were selected each from the department of AGRITEX, Veterinary Department, Ward 3 Councillor, Ward 10 Councillor, Care Zimbabwe and District Development Coordinator's office. Quantitative data obtained from closed ended questions was cleaned, coded and fed into SPSS version 22.0 for analysis. Descriptive statistics obtained were presented on graphs and charts for easy interpretation by end users. Qualitative data from interviewees, observations, and open-ended questions was subjected to content analysis. Stories presented by people in different contexts were analysed to complement quantitative data. Respondents were guaranteed confidentiality of their contributions. Researchers explained that findings from this study were purely for academic purposes and as such no names of respondents were captured during the data collection process.

Study limitations

The study primarily focuses on Southern Zimbabwe, which may limit the generalisability of the findings to other regions experiencing similar climate induced challenges since climate impacts and livestock production systems can vary significantly across different geographical locations. The study does not discuss the long term sustainability of the proposed interventions. The resilience building measures suggested in the research may not be sustainable in the long run due to various factors such as limited resources, lack of institutional support and changing climatic conditions. Owing to inadequate resources and different perceptions of people, methods used in the research such as data collection techniques or analytical approaches may have limitations that affect the reliability and accuracy of the results. However, to overcome a number of research limitations various methods of data collection and sources were utilised while analysis was also done using different approaches.

Areas of future research

The study acts as a bedrock for future research since it encompasses some of the major aspects related to effectiveness of implemented livestock production interventions to manage livestock poverty and deaths. Nevertheless, no single research can suffice the demands of issues linked to livestock production and climate change therefore, future researches are required to unearth questions surrounding the topic. Future researchers can put much emphasis on exploring strategies to enhance community engagement and participation in resilience building efforts. A study related to innovative climate smart livestock management practices to enhance their resilience when impacted by climate change effects is essential. Most importantly, there is a need for future researchers to examine the role of policy frameworks, institutional arrangements and governance structures in facilitating or hindering effectiveness of resilience building efforts in the livestock sector.

Results and discussions

The findings section highlights the various causes of livestock poverty deaths being experienced in Mwenezi District selected wards. It further examines the contribution of NGOs and Government Departments to enhance livestock production and alleviate poverty deaths. Finally, it explored the effectiveness of implemented resilience interventions on managing livestock poverty deaths.

Causes of livestock poverty deaths in Mwenezi district

Research findings revealed that causes of livestock poverty deaths can be categorized broadly into 2 major categories. These are namely; climate induced causes and economic upheavals.

Climate induced causes

Mwenezi District experiences convectional rainfall with heavy storms and strong winds. These have a bombarding effect on the ground causing extensive overland flow and mud accumulation in low lying cattle kraals and goat pens. Extensive mud accumulation in livestock housing structures has ignited an outbreak of livestock diseases mainly foot rot on goats and cattle. A view upheld by Fesseha [23] and Zanolari et al., [24] that the presence of mud increases the risk of foot rot, a bacterial infection that affects the hooves of goats and cattle. This situation significantly impacts the well-being of the livestock hence requires immediate attention to prevent disease outbreaks and potential economic losses for the farmers. Heavy convectional rainfall has also opened up deep gullies. The Crops and livestock specialist reported that the widened and deepened gullies have caused deaths and serious injuries to cattle and goats which occasionally fall into these death traps. Ward 3 councillor reported 2 beasts which fell into a deep gully in the

Table 1
Type of disease by livestock category.

Type of livestock	Identified diseases
Poultry	<ul style="list-style-type: none"> • New castle • Infectious coryza • Coccidiosis • Chibhubhu • Chipfawu
Goats	<ul style="list-style-type: none"> • Chindee • Red water • Chihudha • Foot rot • Chinzuwe nzuwe • Heartwater
Cattle	<ul style="list-style-type: none"> • foot and mouth disease (FMD) • black leg • Anaplasmosis • Anthrax

2017/2018 season. Gullies which are essentially large erosional channels pose a serious threat to animals that may accidentally fall into them [25,26]. One of the primary reasons why cattle and goats fall into these gullies is due to their natural grazing behaviour since they often roam freely in search of food and unknowingly wander too close to the edge and fall in.

Low rainfall and high temperatures

Mwenezi District is in agro-ecological region five which experiences extreme climatic conditions. The low rainfall and extreme temperature conditions being experienced in Mwenezi District are causing accelerated pasture depletion and failure and drying up of open water bodies. This has a negative impact on the availability of livestock grazing and safe livestock watering. Similarly, climate change induced prolonged dry spells is worsening shortage of green pastures for livestock including goats, cattle, donkey and sheep in Ethiopia [27] and Nkayi district in Zimbabwe [28]. The Veterinary Services department Officer in ward 10 reported that dirty water on cattle and goats can result in diseases such as red water. This results in livestock poverty deaths. Considering this, results illustrated that adverse weather conditions are leading to accelerated pasture depletion, failure and drying up of open water bodies in the area, translating to decrease of livestock population. This is supported by Kgosikoma and Kgosikoma [29] that adverse impacts of climate change reduce the number of domesticated animals at large and small scale farms in Botswana.

Economic shocks

The sampled respondents highlighted that high commodity prices on the market has increased the severity of poverty deaths across the district. Livestock vaccines to curb diseases became too expensive for the reach of many households. As a result households have failed to buy vaccines to control diseases affecting their livestock. The multi-currency system prevailing in Zimbabwe also presented obstacles to farmers to purchase livestock vaccines. Vaccines were charged in three currencies: the scarce USD, South African Rand and the local bond note. Prices pegged in local currency varied depending on whether one paid in RTGS or through Ecocash. Many farmers failed to manage their livestock because of unaffordable prices of vaccines and other livestock utilities. As a result of inadequate vaccination livestock becomes more susceptible to illnesses, which lead to increased mortality rates and decreased productivity. Findings concur with Jarvis and Valdes-Donoso [30] and Waithanji et al., [31] that several factors including unaffordable prices of vaccines and other essential utilities hinder farmers' ability to manage their livestock effectively. Livestock diseases outbreak caused extensive losses of livestock as explained by sampled respondents during the study. The prevailing climatic conditions have caused high livestock diseases to outbreak. Research findings revealed a range of diseases

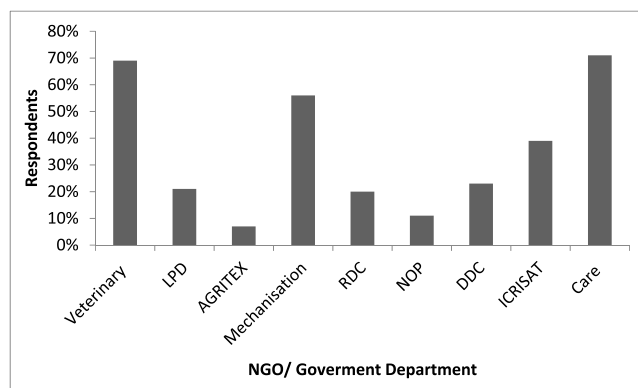


Fig. 2. NGOs and Government Departments in Mwenezi District.

affecting goats, cattle and poultry (chickens, guinea fowls and turkeys) (Table 1). Some of the identified diseases were controllable as articulated by the Veterinary Services Officer while others have caused serious livestock deaths. This suggests that livestock in the district are susceptible to diseases that can be managed through proper veterinary care, vaccination programs, quarantine procedures, and biosecurity practices on farms but ailments which are difficult to control cause severe illness and death before appropriate interventions can be implemented. Results are in line with Naylor et al. [32] and Baker et al., [33] that different types of domestic animals are affected by diseases which are manageable although some diseases are difficult to suppress. Proper management practices including vaccination programs, biosecurity measures, hygiene protocols and prompt treatment of livestock is essential to prevent outbreak of diseases and minimise livestock loss.

Table 2
Roles and Activities by Organisation to manage livestock poverty deaths.

Organisation/ Department	Roles/ Activities
1. Veterinary Department	<ul style="list-style-type: none"> • Treatment and vaccination of livestock • Diseases control • General farmer training on basic livestock management • Monitoring livestock movement.
2. LPD (Livestock Production Department)	<ul style="list-style-type: none"> • Offers advice to farmers on problems arising since livestock production is the main source of livelihood.
3. Department of Mechanization	<ul style="list-style-type: none"> • Assisting farmers to construct/ improve structures to manage diseases • Constructions of livestock drinking sources (water troughs) • Weir construction for storing livestock drinking water.
4. AGRITEX	<ul style="list-style-type: none"> • General farmer trainings • Trained farmers to grow fodder crops
5. RDC (Rural District Council) (Ward Councillors)	<ul style="list-style-type: none"> • Design policies which permit extensive development • Creating an enabling environment which allow smooth operation of NGOs
6. NOP (National Organic Produce)	<ul style="list-style-type: none"> • Supplied boschveld chickens to farmers • Supplied livestock food
7. ICRISAT	<ul style="list-style-type: none"> • Introduced the Kalahari goats • Assisted with materials for raised goat structures • Conducted farmer training on livestock management.
8. Care Zimbabwe	<ul style="list-style-type: none"> • Facilitated fodder preservation in communities • Facilitates uptake of livestock drinking water through drilling boreholes and renovation of old boreholes • Facilitates responsible authorities to move across the district disseminating extension advisory to manage livestock poverty deaths.

Contribution of NGOs and government departments in alleviating livestock poverty deaths in Mwenezi district

Extensive livestock production challenges and heightened poverty deaths attracted the intervention of NGOs (Care Zimbabwe and Plan International) and Government Departments to deal with the causal factors. This was under the Zimbabwe Resilience Building Fund (ZRBF) through the Enhancing Community Resilience and Sustainability (ECRAS) project. NGOs and Government engaged communities and designed innovative tools to address livestock production challenges in a bid to manage the precarious poverty deaths. Enhancing communities' capacities to manage prevailing livestock production challenges requires a multi-stakeholder and integrated approach to design long term commitments for managing identified risks [34]. This explains why NGOs and Government departments collaborated to design mechanisms to help communities manage livestock poverty deaths. NGOs and Government departments were ranked according to their contribution to management. In the studied communities, sampled households highlighted that; Veterinary services department contributed 69%, Livestock Production Department (LPD) 21%, AGRITEX 7% and Department of mechanization 56% to manage livestock poverty deaths (Fig. 2). However, it is essential to recognise the collaborative efforts of these departments in addressing issues related to livestock health and welfare. Therefore, by understanding their respective contributions, policy-makers can allocate resources effectively and prioritise interventions that have a tangible impact on reducing livestock poverty deaths within communities.

Interviewed key informants were asked to outline their specific roles and contributions of stakeholders in Mwenezi District on managing livestock poverty deaths. Table 2 summarizes key roles by organisations targeting to manage livestock poverty deaths.

Fodder production and preservation

The Veterinary services department being supported by Care Zimbabwe under the ZRBF trained farmers to preserve fodder. Fodder was preserved to manage pasture shortage and unavailability, which was being experienced in the District due to high temperatures and extremely low rainfall. Fodder preservation is crucial for ensuring a stable food supply for livestock during periods of scarcity since preserved fodder provides a nutritious feed source that can sustain livestock through challenging times when fresh pastures are limited, including in Ukraine [35].

Of the total farmers selected for this study, over 70% prepared and preserved fodder for their livestock to use during the dry season which is associated with grazing pasture shortage. Pasture unavailability caused livestock failure and eventually deaths. Therefore, the availability of sufficient and nutritious fodder for livestock is crucial to their survival since it ensures that animals have access to nutritious feed even when grazing pasture is scarce. According to Petrychenko et al., [35] by preparing and preserving fodder in advance, farmers can mitigate the impact of pasture unavailability and safeguard their livestock against malnutrition and starvation. According to the Crops and Livestock Specialist report for the period 2018/ 2019 season, farmers were taught to preserve fodder using locally available resources to most farmers. During field work, the researchers observed the basic procedure of making and preserving fodder using locally available resources. Two forms of fodder were identified; 1) fodder prepared using urea, and 2) fodder prepared using molasses.

Basic procedure of preparing fodder using urea

Requirements.

- ü Stover, for example, maize stover.

- ü Urea fertilizer
- ü Water
- ü Mixing container (buckets)
- ü Can with a sprinkler
- ü Silage pit
- ü Plastic sheet black

Production process.

- ü Cutting stover into 5 cm pieces
- ü Mix urea fertilizer with water (Ratio is 1:4 for urea and water respectively)
- ü Long plastic sheet in the pit to protect fodder from mixing with soil
- ü Put a layer of cut stover in the pit
- ü Spray the urea fertilizer +stover mixture on top of a 15 cm thick layer
- ü Compress the material after every layer
- ü Add another stover layer in the pit and sprinkle the mixture then compress
- ü Repeat the process until the pit is full up to the heaped level to avoid water stagnating on the pit
- ü Cover the stover with overlapping plastic and cover with soil on top to avoid direct sunlight and to keep air out.
- ü Stover will be ready after 3 to 4 weeks
- ü Stover taken from the pit to be fed to livestock after 30 min while stored under shade.

Basic procedure of preserving fodder using molasses

Requirements.

- ü Molasses
- ü Green crop stover
- ü Plastic bag
- ü Pit

Production process.

- ü Green crop material is chopped into 5 cm pieces
- ü Mix molasses with water in the ratio 1:3 (molassis and water respectively)
- ü Spray the mixture on the chopped plant material

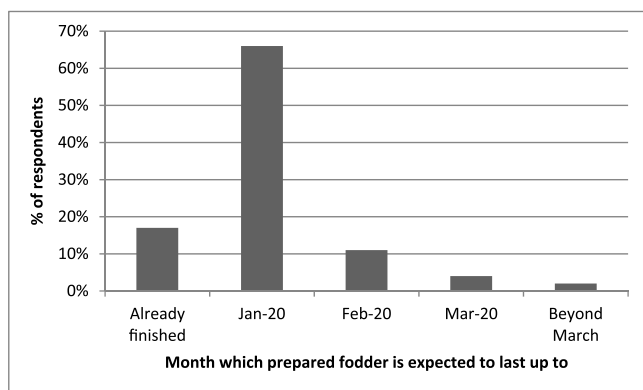


Fig. 3. Months up to which prepared fodder was expected to last.



Plate 1. Three cross sectional kraal in Mwenezi ward 3.

- ü Put the material in the silage pit or in black plastic bags
- ü Preserved fodder will be ready after 3 to 4 weeks
- ü Only quantities to be fed to livestock per given time is removed from the silage pit or plastic bag and then closed (air tight)

The proportion of farmers who preserved fodder managed to reduce loss/ failure of livestock induced by grazing pasture shortage and scarcity. Farmers who managed to preserve fodder indicated that they sustained their livestock until they reached the 2019/2020 season. This intervention helped farmers manage livestock poverty deaths, improve cattle quality and it enabled farmers to get an opportunity to sell their livestock to reputable buyers than exploitative local butcheries. The researchers established estimates of months the preserved fodder prepared by farmers was expected to last. Majority (61%) of respondents had fodder created in May 2019 just after harvesting, which lasted up to January 2020, deep in the wet (summer) season when pastures were already rejuvenating, while 9% had fodder which lasted up to February 2020 (Fig. 3). The Veterinary Services Officer highlighted that the fodder production initiative was successful as it enabled farmers to sustain their livestock during times of pasture stress. Considering this, results show that the timing of fodder production plays a crucial role in ensuring livestock sustainability, especially during periods of pasture stress. A view supported by Maleko et al., [36] that strategic timing and managing of fodder production is essential so that farmers can mitigate the impact of seasonal variations on pasture quality and availability as

evidenced by studies carried out in Tanzania.

Improved livestock structures

The District Crops and Livestock specialist explained that some of the livestock diseases being experienced in the District were due to poor and sub-standard livestock housing structures. The situation has made the Veterinary Services Department, with support from Care Zimbabwe and LPD train farmers to construct improved livestock structures. Of the sampled respondents, 63% constructed improved chicken structures, 36% raised goat pens while 24% have constructed three cross-sectional kraals. The interviewed Veterinary Officer explained that the improved chicken structure helped to reduce the occurrence and severity of diseases, for example, infectious coryza and *chibhubhu*, for goats and foot rot for cattle (Plate 1 and Plate 2). The measure was successful as it improved livestock quality and livestock production, the most viable agricultural sector supporting livelihoods in Mwenezi District. The intervention also reduced livestock poverty deaths. Improvement in the structure of chicken housing, cattle kraals coupled by proper management practices have several benefits that contribute to disease prevention and control [37,38].

Borehole rehabilitation and construction of livestock drinking water facilities

Some of the cases of livestock deaths as explained by the crops and livestock officer were due to unavailability and limited access to clean and safe livestock drinking water. Lack of clean water for livestock leads to various health issues and ultimately results in fatalities amongst animals [39]. In Mwenezi District, through the ECRAS project, boreholes were rehabilitated and this increased accessibility of livestock drinking water as many boreholes became functional. The project further installed solar pumps on boreholes and this intervention increased water uptake from the subsurface, making it accessible to livestock (Plate 3). This goes in line with Aliyu et al., [40] that solar pumps are an environmentally friendly and sustainable solution for pumping water from boreholes by utilising solar energy.

The project further assisted communities to manage livestock poverty deaths through construction of livestock drinking troughs at boreholes sites. The intervention helped to reduce the outbreak of diseases attributed to drinking dirty water. Implementation of livestock drinking troughs projects is instrumental in addressing poverty related deaths amongst livestock in drought prone areas in Botswana [41]. A typical livestock drinking trough constructed was observed in ward 3 (Plate 4).

The veterinary officer explained that the borehole rehabilitation scheme increased water availability for livestock drinking and reduced livestock deaths. It reduced the outbreak of diseases such as red water and heart water. Both the District Development Coordinator (DDC) and Ward Councillors lauded the borehole rehabilitation scheme and installation of the solar system as an effective measure which enhanced water availability in the studied areas for livestock drinking.

Village savings and lendings (VS&L)

VS&L was mentioned as one of the critical interventions implemented in Mwenezi District wards which enhanced livestock production. Farmers formulated small groups of members not exceeding twenty-five per group. In these groups they made monthly contributions to save their money. The money was loaned to willing individuals who would pay back at an agreed interest per month. Farmers got an opportunity to enhance their livestock because they took these loans at cheap rates to purchase livestock vaccines for controlling diseases. This reduced severity of livestock diseases as some were controlled through the use of proceeds generated from the VS&L scheme. More so, farmers took loans from VS&L groups to purchase materials for constructing



Plate 2. Raised goat pen in Mwenezi Ward 10.



Plate 3. Solar pump installed at a borehole in ward 10 Mwenezi District.

improved livestock structures and also to purchase fodder preparation and preservation requirements. VS&L, therefore helped to support livestock production and minimized poverty deaths.

Conclusion

Livestock poverty deaths in Mwenezi District have been intensified by climate variability and changes being experienced. Climate change impacts manifestations have impacted on various aspects that are key to survival of livestock. A combination of high temperatures and little/ low rainfall have caused pasture shortage and scarcity in all reserved cattle grazing lands. The consequences of climate change and variability have increased disease outbreak, for example, Foot and Mouth Disease (FMD), foot rot, infectious coryza and red water. The identified diseases compromised livestock health and eventually caused deaths. The occurrence of livestock production challenges hit hard the majority of households and individuals in the community as their lives are largely centred on livestock production. Increased rates of livestock poverty deaths prompted the design of many measures. Some of the measures include construction of improved livestock structures, disease control through vaccination. These measures enhanced livestock quality and quantity across the district.

Recommendations

Livestock production is the most suitable livelihood source in Mwenezi District which is experiencing serious problems due to dire climatic conditions and the two decades old negative economic



Plate 4. Livestock drinking trough in ward 3 of Mwenezi District.

performance of the country hence development actors should design and implement more mechanisms that boost livestock production in Mwenezi District. This will help manage livestock poverty deaths. Multi-stakeholder approach is critical in managing livestock diseases and maintaining livestock health. This will allow knowledge sharing and collaboration of ideas that will enhance livestock sector outputs and manage the troubling poverty deaths.

Data availability

Available from primary author on reasonable request.

CRedit authorship contribution statement

Rameck Defe: Writing – original draft, Methodology, Formal analysis, Conceptualization. **Mark Matsa:** Writing – review & editing, Supervision, Formal analysis. **Takunda Shabani:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing interest.

Data availability

Data will be made available on request.

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