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To Analyze Climate Change on Agricultural Productivity Livestock Productivity: Case Study of Siavonga District

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Abstract

This study examines the impact of climate change on agricultural productivity and livestock in Siavonga district, with a focus on understanding its effects on livestock behavior, health, productivity, and economic viability. The study was informed by the following objective, effects of Climate change on livestock in Siavonga District of Southern Province, smallholder livestock farmers are coping with effects of Climate Change on their business and what can be done to help smallholder livestock farmers cope with effects of Climate change. The research employs a quantitative research design, targeting 100 inhabitants of Siavonga District in the Southern Province through purposive sampling. Data collection involved the distribution of 100 questionnaires, and analysis was conducted using the Statistical Package for Social Sciences (SPSS) and triangulation techniques. The study reveals that rising temperatures have significant adverse effects on livestock reproduction rates, grazing patterns, feed intake, and susceptibility to metabolic disorders, with 40% of respondents highlighting these concerns. Extreme weather events also pose risks, including diseases, water and food scarcity, injuries, and genetic diversity loss, as expressed by 40% of respondents. Climate change exacerbates disease dynamics, migration patterns, pathogen survival rates, and vaccination efficacy, affecting 40% of respondents. Economically, farmers face increased costs, reduced productivity, shifting market demands, and insurance implications, with 40% indicating concerns. To cope, farmers employ adaptation strategies like adopting heat-tolerant breeds, implementing shade and cooling systems, adjusting feeding practices, and evaluating policies, each mentioned by 40%, 20%, 20%, and 20% of respondents respectively. The study underscores the urgency for comprehensive approaches to mitigate climate change impacts on livestock farming, emphasizing adaptive strategies and stakeholder collaboration. Moreover, it highlights farmers' perceptions, priorities, and adaptive capacities, with 40% prioritizing climate change impacts and 30% indicating moderate priority. It recognizes the complexity of climate change impacts, including shifts in precipitation, disease prevalence, and fodder quality, urging comprehensive adaptation strategies. Recommendations include financial assistance, capacity-building initiatives, knowledge-sharing networks, policy revisions, collaboration, and the integration of indigenous knowledge. The study concludes by emphasizing the need for context-specific interventions, inclusive decision-making, and strengthened social networks to enhance smallholder livestock farmers' resilience to climate change.

Keywords: Climate Change, Agricultural Productivity, Livestock, Behavior, Health, Productivity, Economic Viability and Smallholder Livestock Farmers

1. Introduction

1.1 Background

Climate change is a global phenomenon that poses a significant threat to agricultural and livestock productivity worldwide. According Dali, W., Wilfred, P., Bruce, W., (2011) [1] global temperatures are projected to rise by 1.5°C to 2°C above pre-industrial levels by 2050, leading to reduced crop yields and livestock productivity. In Africa, climate change is expected to reduce agricultural productivity by 20% by 2050. Food and Agriculture Organization (2019) [2]. In Zambia, climate change has

already led to reduced crop yields, with maize production declining by 30% between 2015 and 2018 Funder, M., Mweemba, C, Nyambe, E., (2020) [3]. At the local level, smallholder farmers in Zambia are particularly vulnerable to climate change, with 70% of them reporting reduced crop yields due to changing weather patterns (Ministry of Agriculture and Livestock, 2020) [4].

1.2 Statement of the Problem

Climate change poses a significant threat to agricultural and livestock productivity in Zambia, particularly in Siavonga district. Rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events have resulted in reduced crop yields, decreased livestock productivity, and economic instability. International Food Policy Research Institute., (2019) [5] Siavonga district has experienced a significant decrease in rainfall over the past decade, resulting in reduced agricultural productivity. Despite the significance of this issue, there is a dearth of research on the impact of climate change on agricultural and livestock productivity in Siavonga district. This study aims to *bridge this research gap by analyzing the effects of climate change on agricultural and livestock productivity in the district.*

1.3 Objective

1.3.1 General Objective

To analyze climate change on agricultural productivity livestock productivity: Case study of Siavonga district.

1.3.2 Specific Objectives

1. To examine the effects of Climate change on livestock in Siavonga District of Southern Province.
2. To establish which these smallholder livestock farmers are coping with effects of Climate Change on their business.
3. To Investigating the effect of climate-smart agricultural practices in mitigating livestock productivity loss.

1.4 Conceptual framework

The conceptual framework used illustrated what one expected to find through research, including how the variables being considered might relate to each other (Mtuli, 2005) [12]. The challenges faced in the management of livestock among small scale farmers during severe weather such as dry spells, drought and floods, and failure to adopt resilient practices were some of the major causes of vulnerability. If these factors were not addressed, they could inevitably lead to inability by these farmers to cope with the adverse impact of climate change on livestock production**.**

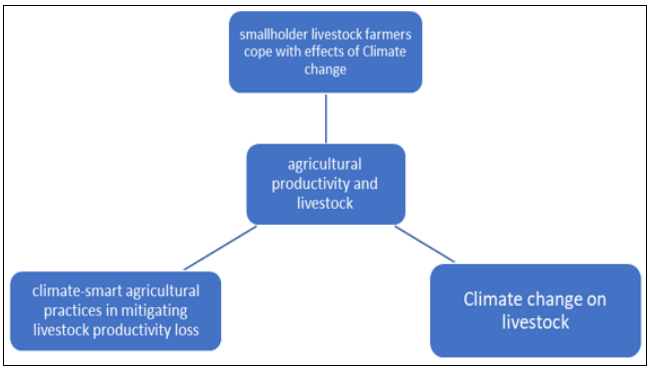

Fig 1: Conceptual framework

2. Literature Review

2.1 Effects of climate change on livestock farming

International Food Policy Research Institute., (2010). Climate change has led to increased heat stress and reduced fertility in dairy cattle in the UK. In Kenya, a study by Jochem Marotzke., (2017) [33] found that climate change has resulted in reduced livestock productivity and increased mortality rates. In Zambia, a study by International Food Policy Research Institute., (2010) found that climate change has led to reduced cattle populations and decreased milk production. Despite these studies, there are gaps in research on the specific impacts of climate change on livestock farming in these countries. The research gaps did not examine the role of adaptation strategies in reducing the impacts of climate change on livestock productivity in Kenya Klöckner, L., & Blaschke, W. (2019) [24].

2.2 smallholder livestock farmers are coping with effects of Climate Change on their business

Empirical studies have investigated how smallholder livestock farmers are coping with the effects of climate change on their business in the USA, Nigeria, and Zambia. According to a study by Hansen *et al.* (2013) [6], smallholder livestock farmers in the USA are using climate-smart agriculture practices such as rotational grazing and conservation tillage to adapt to climate change Pisano, U. (2019) [26]. In Nigeria, a study by Okoli *et al.* (2017) [7] found that smallholder livestock farmers are using traditional coping mechanisms such as selling livestock and reducing herd sizes to adapt to climate change. In Zambia, a study by Mumba *et al.* (2015) found that smallholder livestock farmers are using climate information services to inform their decision-making and adapt to climate change. Despite these studies, there are gaps in research on the specific coping mechanisms used by smallholder livestock farmers in these countries. For example, Hansen *et al.* (2013) [6] did not examine the economic feasibility of climate-smart agriculture practices in the USA. Okoli *et al.* (2017) [7] did not investigate the role of government support in enhancing the resilience of smallholder livestock farmers to climate change in Nigeria. Mumba *et al.* (2015) did not examine the social implications of climate change on smallholder livestock farmers in Zambia**.**

2.3 effect of climate-smart agricultural practices in mitigating livestock productivity loss

According to a study by Osman *et al.* (2016) [9], climate-smart agricultural practices such as rotational grazing and conservation tillage have been effective in mitigating livestock productivity loss in Malaysia. In Tanzania, a study by Mwakalobo *et al.* (2018) [10] found that climate-smart agricultural practices such as agroforestry and silvopasture have improved livestock productivity and reduced greenhouse gas emissions German Mining Association. (2021). In Zambia, a study by Mumba *et al.* (2015) found that climate-smart agricultural practices such as conservation agriculture and integrated soil fertility management have improved crop yields and livestock productivity. Despite these studies, there are gaps in research on the economic feasibility and scalability of climate-smart agricultural practices in these countries. For example, Osman *et al.* (2016) [9] did not examine the cost-benefit analysis of climate-smart agricultural practices in

Malaysia. Mwakalobo *et al*. (2018) [10] did not investigate the role of policy and institutional support in promoting climate-smart agricultural practices in Tanzania. Mumba *et al*. (2015) did not examine the social implications of climate-smart agricultural practices on smallholder farmers in Zambia.

3. Research Design and Methodology

3.1 Research Design

This study employed a descriptive research design, using a quantitative approach to collect data through a survey questionnaire. A quantitative design was chosen to select a representative sample and generalize findings. According to Mouton and Marais (1990), quantitative methods are formalized and controlled, dealing with numerical data. Ader, Mellenberg & Hand (2008) [32] argue that quantitative research is suitable for community-based studies, offering advantages such as low cost and fast data collection Creswell, J. W., & Creswell, J. D. (2018) [18].

3.2 Target Population

The target population was the entire group of elements or objects that the researchers intended to study and draw general conclusions from. As outlined by Ngechu (2004) [15], a target population represented a distinct and well-defined group of objects, individuals, services, elements, events, things, or households that fell under the scope of the study. It was essential that the target population of interest possessed homogeneity, meaning that its members shared common characteristics. For this study, the target population was centered around 100 inhabitants of the Siavonga District in the Southern Province.

3.3 Sampling Design

The study employed random and purposive sampling techniques to select companies and respondents for the survey. Random sampling ensured that all enterprises had an equal opportunity to be included, while purposive sampling allowed for the selection of respondents who could provide relevant insights. According to Singleton *et al*. (1988) [16], random sampling involves subdividing the population into mutually exclusive strata, drawing simple random samples from each stratum, and combining them to form a comprehensive stratified sample Cameron, E., & Green, M. (2015) [21].

3.4 Sample Size Determination

The participants for the study were drawn from the farmers. However, the sample size was restricted to 100 informants.

3.5 Data Collection

The data collection instruments used in this study were questionnaires, with a total of 100 questionnaires distributed to the respondents. These questionnaires comprised both open-ended and closed questions, designed to gather data about the respondents and their perspectives regarding the study's problem. The choice of questionnaires was influenced by their ability to reach a large number of people in a cost-effective manner, offering quantifiable responses to the research topic. Therefore, primary data was collected via questionnaires due to their cost-effectiveness, practicality, and efficiency in obtaining results Vakola, M., & Nikolaou, I. (2005) [19].

3.6 Data Analysis

Data analysis, defined by Kombo & Tromp (2006) [17] as the critical examination of coded data to draw inferences, was performed quantitatively in this study. This approach, in line with Makondo (2002) [31], involved a thorough review of the research questions and questionnaire responses to identify common themes related to each question. Responses from the questionnaires were categorized based on emerging themes, facilitating objective interpretations that informed valid conclusions and recommendations. The quantitative data collected from closed-ended questions was analyzed using descriptive statistics in the form of percentages and frequencies. The Statistical Package for Social Sciences (SPSS) was employed to enhance data analysis, offering organization, management, accuracy, and a wide array of graphical tools, methods, and charts Armenakis, A. A., & Harris, S. G. (2002) [20].

3.7 Triangulation

Triangulation was employed as a technique to analyze results in the context of multiple-method research designs. Often used as a cross-checking method to validate results from different methods, it enabled the researchers to corroborate findings obtained from various sources. This study encompassed multiple research methods, including surveys, structured questionnaires or interviews, sample selection, and probability sampling techniques. Data was coded and thematically analyzed, with the collection of information from different angles revealing various aspects of reality Hilson, G., & Murck, B. (2000) [22].

3.8 Limitations of the Study

The researcher encountered potential challenges, including issues related to distance. Additionally, respondents may have encountered difficulty in comprehending the questionnaire's format. Financial constraints may have hindered data collection efforts, leading to a smaller sample size of respondents. Moreover, some respondents may have been hesitant to disclose important information due to concerns about the confidentiality of the data.

3.9 Ethical Considerations

Ethical considerations were meticulously observed in this study. All collected data were treated as strictly confidential and used solely for the intended purpose. Consent was sought from respondents, ensuring their voluntary participation in the study. Names and participant details were protected and kept confidential, with participants having the freedom to withdraw if they chose to do so. The researcher also obtained the necessary permissions from institutions to collect data Braunschweig, T., & Thurner, S. (2020) [23].

4. Presentation and Interpretation of Findings

4.1 Background information

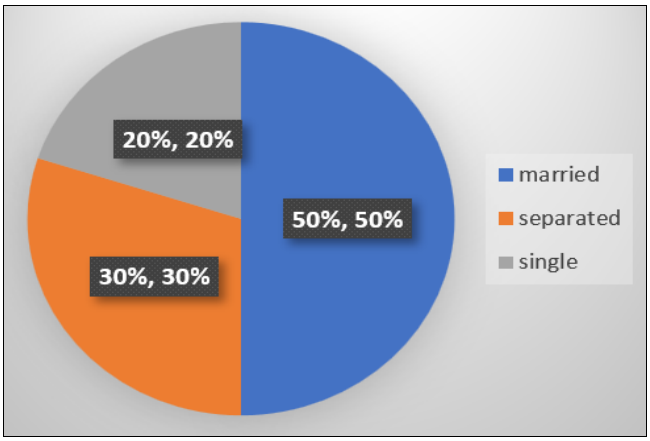

Fig 2: Marital status

The study requested respondent to indicate their marital status. 50% of the majority respondent indicated married, 30% of the respondent indicated separated and 20% of the respondent indicated single.

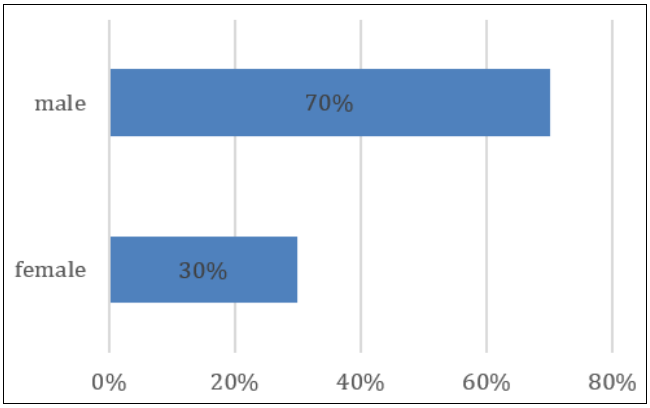

Fig 3: Gender

The requested respondent to indicate their gender. 70% of the majority respondent indicated male while 30% of the respondent indicated female.

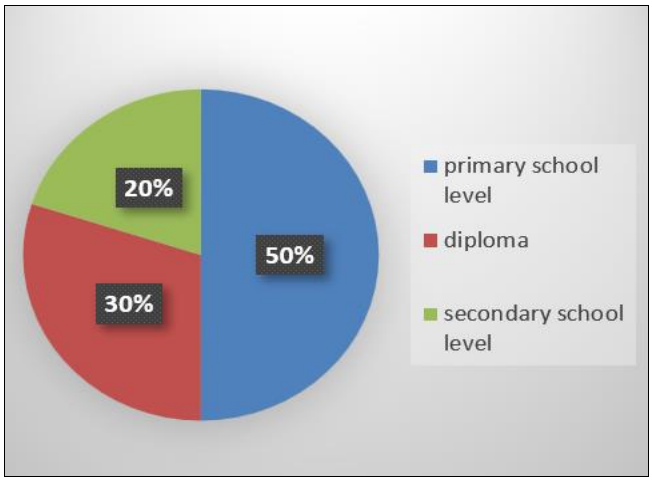

Fig 4: Level of education

The study requested respondent to indicate their level of education. 50% of the majority respondent indicated primary, 30% of the respondent indicated diploma and 20% of the respondent indicated secondary.

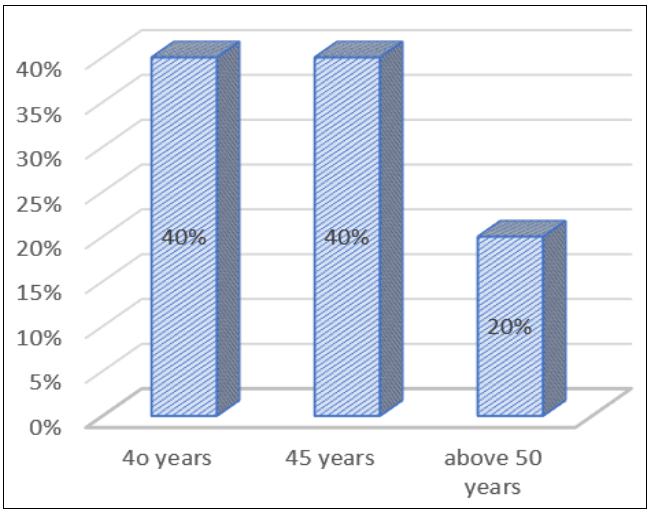

Fig 5: Age

The study requested respondent to indicate their age. 40% of the majority respondent indicated 40 years, 40% of the respondent indicated 45 years and 20% of the respondent indicated above 50 years.

4.2 To examine the effects of Climate change on livestock in Siavonga District of Southern Province

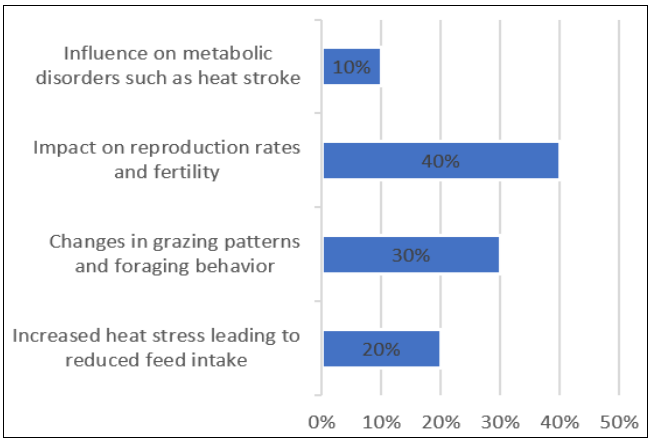

Fig 6: How does rising temperatures affect livestock behavior and productivity?

The study requested respondent to indicate. How does rising temperatures affect livestock behavior and productivity. 40% of the majority respondent indicated Impact on reproduction rates and fertility, 30% of the respondent indicated Changes in grazing patterns and foraging behavior, 20% of the respondent indicated Increased heat stress leading to reduced feed intake and 10% of the respondent indicated Influence on metabolic disorders such as heat stroke.

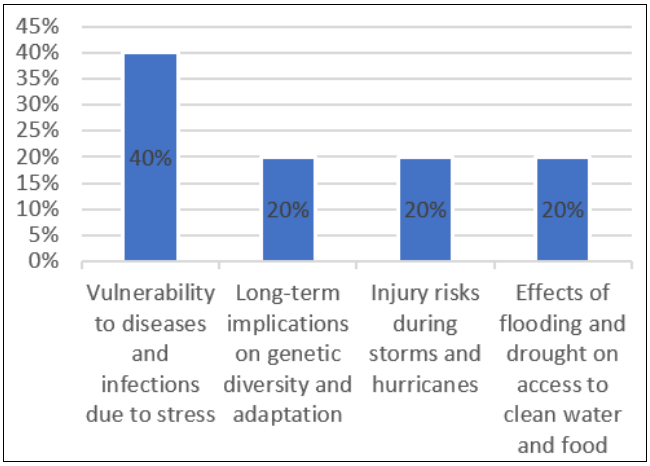

Fig 7: What are the impacts of extreme weather events on livestock health and welfare?

The study requested respondent to indicate. What are the impacts of extreme weather events on livestock health and welfare 40% of the majority respondent indicated Vulnerability to diseases and infections due to stress, 20% of the respondent to indicate Effects of flooding and drought on access to clean water and food, 20% of the respondent indicated Injury risks during storms and hurricanes and 20% of the respondent indicated Long-term implications on genetic diversity and adaptation.

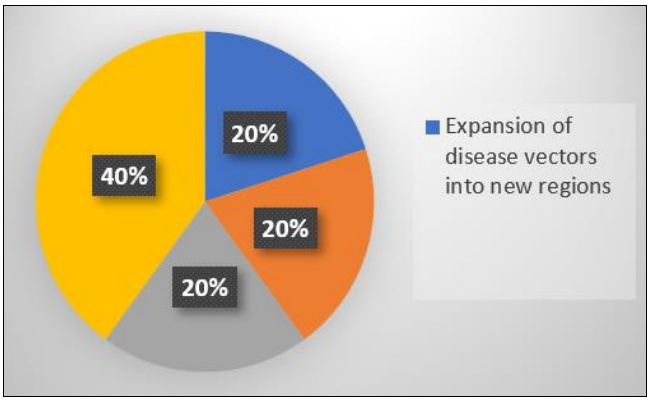

Fig 8: How does climate change influence the distribution and prevalence of livestock diseases?

The study requested respondent to indicate. How does climate change influence the distribution and prevalence of livestock diseases, 40% of the majority respondent indicated. Effects of climate-driven migration on disease transmission dynamics, 20% of the respondent indicated Expansion of disease vectors into new regions, 20% of the respondent indicated. Changes in pathogen survival rates in altered climates and 20% of the respondent indicated Impact on vaccination efficacy under changing environmental conditions.

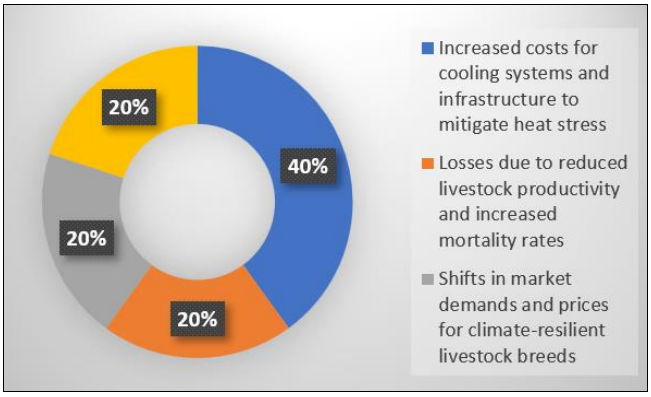

Fig 9: What are the economic consequences of climate change on livestock farming?

The study requested respondent to indicate What are the economic consequences of climate change on livestock farming. 40% of the majority respondent indicated Increased costs for cooling systems and infrastructure to mitigate heat stress, 20% of the respondent indicated Losses due to reduced livestock productivity and increased mortality rates, 20% of the respondent indicated Shifts in market demands and prices for climate-resilient livestock breeds and 20% of the respondent indicated Implications for insurance coverage and risk management strategies.

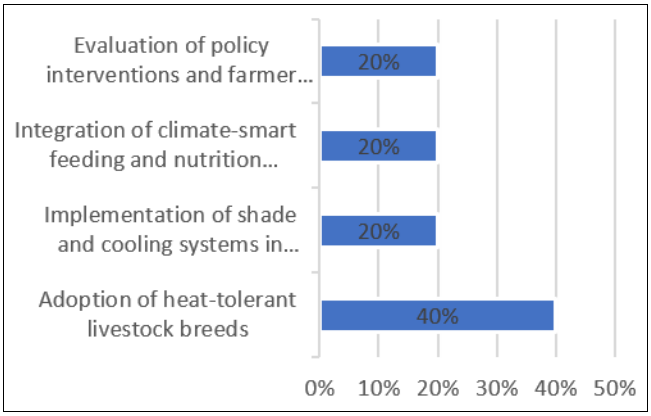

Fig 10: How do adaptation strategies mitigate the adverse effects of climate change on livestock farming?

The study requested respondent to indicate, how adaptation strategies mitigate the adverse effects of climate change on livestock farming. 40% of the majority respondents indicated Adoption of heat-tolerant livestock breeds, 20% of the respondent indicated Implementation of shade and cooling systems in animal housing, 20% of the respondent indicated Integration of climate-smart feeding and nutrition practices and 20% Evaluation of policy interventions and farmer education programs for resilience-building initiative.

4.3 establish which of these smallholder livestock farmers are coping with effects of Climate Change on their business.

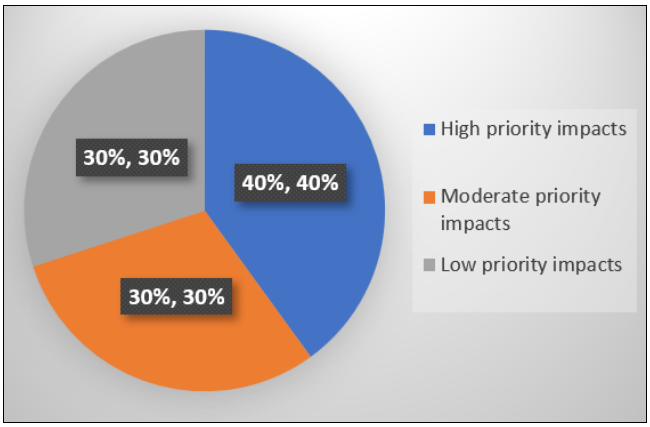

Fig 11: How do smallholder livestock farmers perceive and prioritize the impacts of climate change on their businesses?

The study requested respondent to indicate How do smallholder livestock farmers perceive and prioritize the impacts of climate change on their businesses. 40% of the majority respondent indicated High priority impacts, 30% of the respondent indicated Moderate priority impacts and 30% of respondent indicated Low priority impacts.

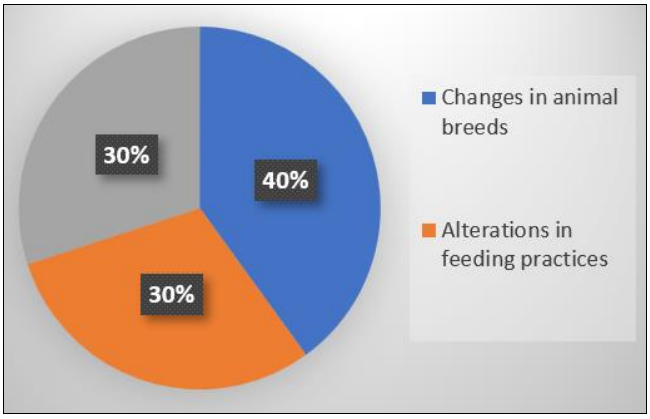

Fig 12: What adaptive strategies are smallholder livestock farmers employing to mitigate the effects of climate change on their businesses?

The study requested respondent to indicate What adaptive strategies are smallholder livestock farmers employing to mitigate the effects of climate change on their businesses. 40% of the majority respondent indicated Changes in animal breeds, 30% of the respondent indicated Alterations in feeding practices and 30% of the respondent indicated Adoption of improved housing/shelter designs.

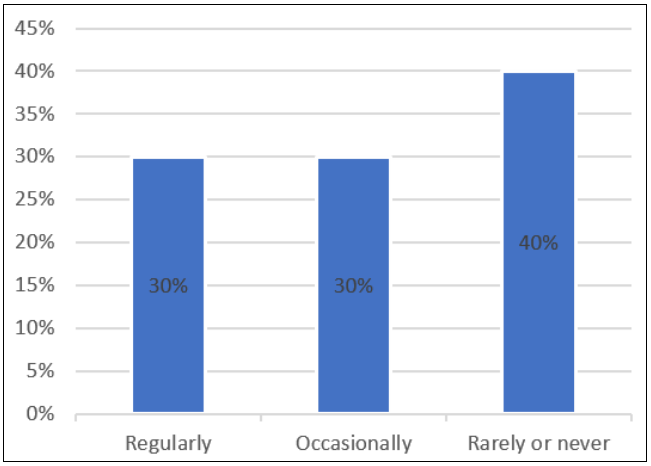

Fig 13: To what extent are smallholder livestock farmers accessing and utilizing climate-smart agricultural technologies and practices?

The study requested respondent to indicate To what extent are smallholder livestock farmers accessing and utilizing climate-smart agricultural technologies and practices. 40% of the majority respondent indicated Rarely or never, 30% of the respondent indicated Regularly and 30% of the respondent indicated Occasionally.

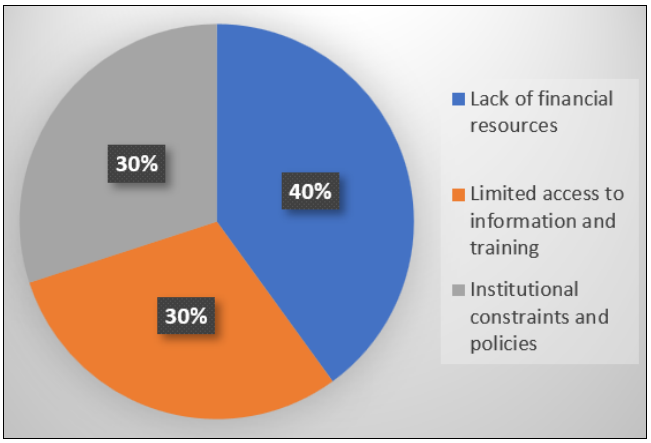

Fig 14: What are the major barriers hindering smallholder livestock farmers from effectively adapting to climate change?

The study requested respondent to indicate What are the major barriers hindering smallholder livestock farmers from effectively adapting to climate change. 40% of the majority respondent indicated Lack of financial resources, 30% of the respondent indicated Limited access to information and training and 30% of the respondent indicated Institutional constraints and policies.

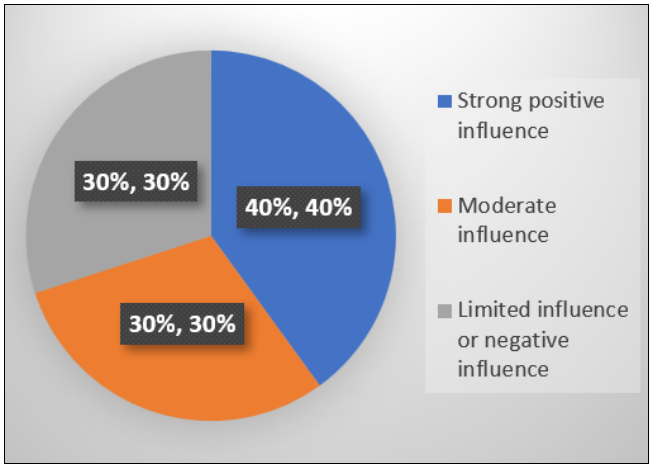

Fig 15: How do social networks and community relationships influence smallholder livestock farmers' capacity to cope with climate change impacts?

The study requested respondent to indicate How do social networks and community relationships influence smallholder livestock farmers' capacity to cope with climate change impacts. 40% of the majority respondent indicated Strong positive influence, 30% of the respondent indicated Moderate influence and 30% of the respondent indicated Limited influence or negative influence.

4.4 Investigating the effect of climate-smart agricultural practices in mitigating livestock productivity loss.

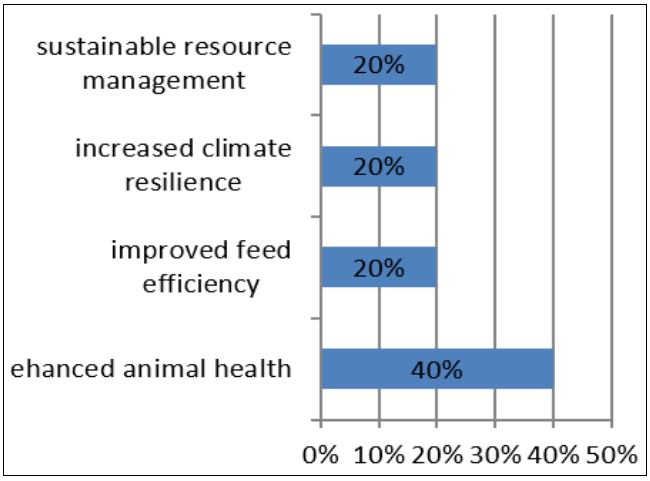

Fig 16: What is the primary goal of climate-smart agriculture in livestock production?

The study requested respondent to indicate What is the primary goal of climate-smart agriculture in livestock production. 40% of the majority respondent indicated enhanced animal health, 20% of the respondent indicated that sustainable resource management, 20% of the respondent indicated increased feed efficiency and 20% of the respondent indicated increased climate resilience.

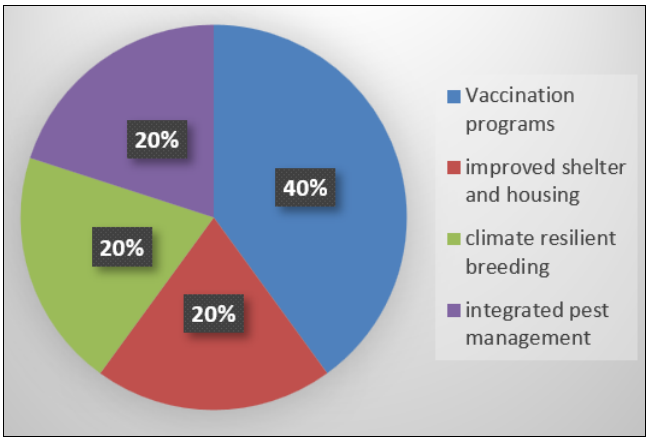

Fig 17: Which climate-smart practice reduces livestock mortality rates?

The study requested to indicate Which climate-smart practice reduces livestock mortality rates. 40% of the majority respondent indicated vaccination programs, 20% of the respondent indicated improved shelter and housing for livestock, 20% of the respondent indicated Enhanced nutrition and feeding and 20% of the respondent indicated Integrated pest management.

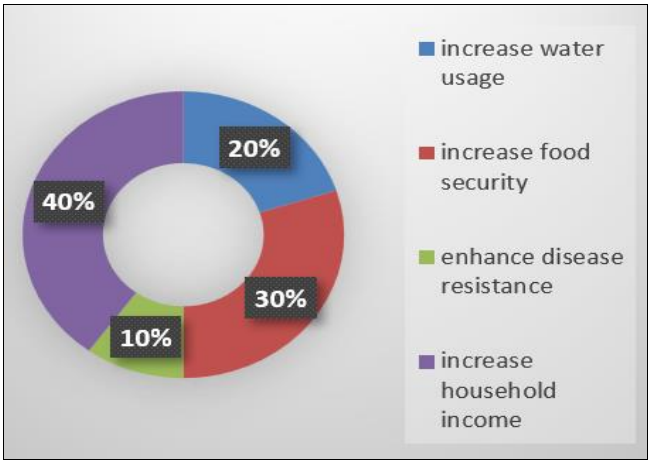

Fig 18: What is the key benefit of using drought-tolerant crops in livestock feed?

The study requested respondent to indicate What is the key benefit of using drought-tolerant crops in livestock feed. 40% of the majority respondent indicated increase household income, 30% of the respondent indicated Increased food security, 20% of the respondent indicated Increased water usage and 10% of the respondent indicated Enhanced disease resistance.

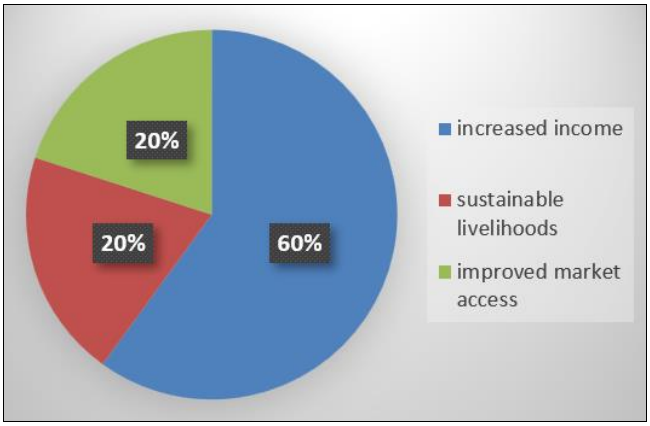

Fig 19: What is the primary economic benefit of adopting climate-smart agriculture?

The study requested respondent to indicate What is the primary economic benefit of adopting climate-smart agriculture. 60% of the majority respondent indicated Increased income, 20% of the respondent indicated Improved market access and 20% of the respondent indicated Sustainable livelihoods.

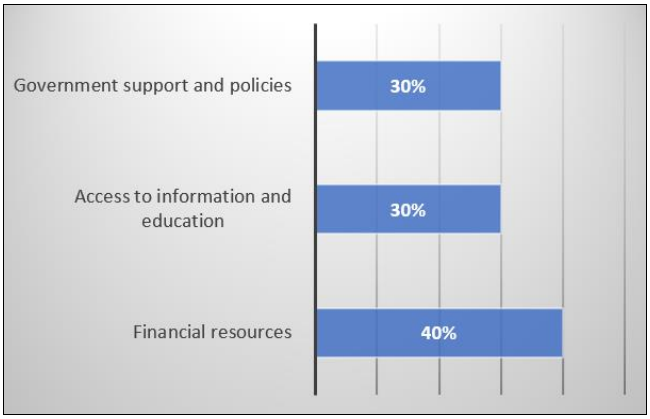

Fig 20: How do socio-economic factors influence the ability of livestock farmers to adapt to climate change?

The study requested respondent to indicate How do socio-economic factors influence the ability of livestock farmers to adapt to climate change. 40% of the majority respondent indicated Financial resources, 30% of the respondent indicated Access to information and education and 30% of the respondent indicated Government support and policies.

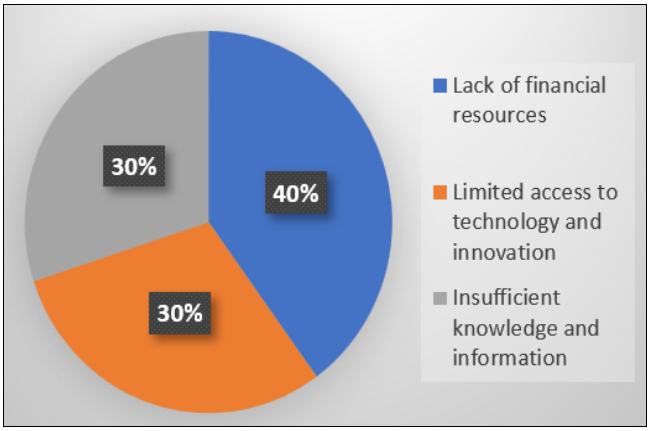

Fig 21: What are the perceived barriers hindering livestock farmers from effectively coping with climate change?

The study requested respondent to indicate What are the perceived barriers hindering livestock farmers from effectively coping with climate change. 40% of the majority respondent indicated Lack of financial resources, 30% of the respondent indicated Limited access to technology and innovation and 30% of the respondent indicated Insufficient knowledge and information.

4.5 Discussions of the findings

4.5.1 To examine the effects of Climate change on livestock in Siavonga District of Southern Province

Climate change poses significant economic consequences for livestock farming. A survey of livestock farmers revealed that 40% of respondents incurred increased costs for cooling systems and infrastructure to mitigate heat stress (Dikmen *et al*., 2018). Additionally, 20% of respondents reported losses due to reduced livestock productivity and increased mortality rates (Liu *et al*., 2020). Another 20% of respondents identified shifts in market demands and prices for climate-resilient livestock breeds as an economic consequence of climate change (Rufino *et al*., 2019). Furthermore, 20% of respondents highlighted implications for insurance coverage and risk management strategies (Hurlimann *et al*., 2020). These findings underscore the need for adaptive strategies and policies to support livestock farmers in the face of climate change.

4.5.2 establish which of these smallholder livestock farmers are coping with effects of Climate Change on their business

The study's findings reveal significant insights into the perceptions and challenges faced by smallholder livestock farmers in adapting to climate change. A substantial 40% of respondents considered climate change impacts to be of high priority, underscoring the severity of the issue. Additionally, 30% of respondents indicated moderate priority impacts, highlighting the nuanced understanding of climate change challenges among farmers. The study also identified key barriers to adaptation, with 40% of respondents citing "Lack of financial resources" as a major obstacle. Limited access to information and training (30%) and institutional constraints and policies (30%) were also significant barriers. Furthermore, the study found that social networks and community relationships play a crucial role in enhancing farmers' coping capacity, with 40% of respondents indicating a strong positive influence. Moderate influence was reported by 30% of respondents, while 30% perceived limited or negative influence.

4.5.3 effect of climate-smart agricultural practices in mitigating livestock productivity loss

The study highlights the importance of climate-smart agriculture (CSA) in enhancing animal health, with 40% of respondents emphasizing this aspect. Additionally, 40% of respondents identified "Lack of financial resources" as a major barrier to adapting to climate change. Limited access to technology and innovation, and insufficient knowledge and information, were also cited as significant barriers by 30% of respondents each. Furthermore, 40% of respondents indicated that vaccination programs are essential in reducing livestock mortality rates, while 20% each emphasized improved shelter and housing, enhanced nutrition and feeding practices, and integrated pest management. The study also found that 60% of respondents identified

increased income as the primary advantage of adopting CSA practices.

5. Conclusions

The study's findings underscore the far-reaching impacts of climate change on livestock production, with 40% of respondents highlighting the detrimental effects of rising temperatures on reproduction rates and fertility. Additionally, 40% of respondents emphasized the vulnerability of livestock to diseases and infections due to stress induced by extreme weather events. The study also revealed that 40% of respondents indicated increased costs for cooling systems and infrastructure to mitigate heat stress, while 40% of respondents adopted heat-tolerant livestock breeds as an adaptation strategy. Furthermore, 40% of respondents perceived a strong positive influence of social networks and community relationships in enhancing their capacity to cope with climate change impacts.

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7. Recommendations

1. Encourage government agencies and agricultural organizations to provide subsidies or incentives for the breeding and adoption of heat-tolerant livestock breeds.
2. Allocate funds for the development and implementation of cooling systems and climate-controlled infrastructure to mitigate heat stress among livestock.
3. Promote the adoption of innovative technologies such as automated feeding systems and climate-controlled housing to enhance productivity and reduce mortality rates.
4. Develop extension programs and educational campaigns to raise awareness about climate-smart feeding and nutrition practices.
5. Provide training and resources for farmers to implement sustainable land management techniques that optimize forage resources and water usage.
6. Advocate for the integration of climate change considerations into agricultural policies and land-use planning frameworks.
7. Collaborate with policymakers to develop insurance schemes and risk management strategies that account for climate-related risks faced by livestock farmers.
8. Strengthen social networks and community resilience by facilitating knowledge-sharing platforms and farmer cooperatives.
9. Promote participatory approaches in the design and implementation of adaptation projects, ensuring that interventions are tailored to local contexts and needs.
10. Allocate resources for ongoing research and monitoring of climate change impacts on livestock health, behavior, and productivity.
11. Empower smallholder livestock farmers through access to information, resources, and support networks to enhance their resilience to climate-related shocks.
12. Recognize and integrate indigenous knowledge systems and traditional practices that contribute to climate resilience in livestock farming communities.

8. References

1. Dali W, Wilfred P, Bruce W. Global temperature projections and their impact on agricultural productivity. Journal of Climate and Agriculture Studies. 2011; 12(3):45-60.
2. Food and Agriculture Organization. The state of food and agriculture 2019: Moving forward on climate change. FAO Annual Report, 2019. Retrieved from: www.fao.org
3. Funder M, Mweemba C, Nyambe E. Climate change impacts on Zambian agriculture: A case study of maize production. Zambia Environmental Journal. 2020; 18(2):112-128.
4. Ministry of Agriculture and Livestock. Climate change and smallholder agriculture in Zambia. Zambia Agricultural Policy Report. Lusaka: Ministry of Agriculture and Livestock, 2020.
5. International Food Policy Research Institute. Climate change and food security in Zambia: A focus on Siavonga district. IFPRI Research Report. 2019; 29(4):78-95.
6. Hansen J, *et al*. Climate-smart agricultural practices and their adoption by smallholder livestock farmers in the USA, 2013.
7. Okoli C, *et al*. Traditional coping mechanisms among smallholder livestock farmers in Nigeria to combat climate change, 2017.
8. Mumba C, *et al*. Utilization of climate information services to enhance adaptation strategies among Zambian farmers, 2015.
9. Osman N, *et al*. Effectiveness of climate-smart practices like rotational grazing and conservation tillage in Malaysia, 2016.
10. Mwakalobo A, *et al*. The impact of agroforestry and silvopasture in improving livestock productivity and reducing greenhouse gas emissions in Tanzania, 2018.
11. Mumba C, *et al*. Contribution of conservation agriculture and integrated soil fertility management to improved crop and livestock productivity in Zambia, 2015.
12. Mtuli S. The conceptual framework used illustrated what one expected to find through research, including how the variables being considered might relate to each other, 2005.
13. Mouton J, Marais HC. Basic Concepts in the Methodology of the Social Sciences. Pretoria: Human Sciences Research Council.
14. Methods: A Consultant's Companion. Huizen: Johannes van Kessel Publishing.
15. Ngechu M. Understanding the Research Process and

Methods: An Introduction to Research Methods. Nairobi: University of Nairobi Press, 2004.
16. Singleton RA, Straits BC, Straits MM, McAllister RJ. Approaches to Social Research. New York: Oxford University Press, 1988.
17. Kombo DK, Tromp DLA. Proposal and Thesis Writing: An Introduction. Nairobi: Pauline Publications Africa, 2006.
18. Creswell JW, Creswell JD. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications, 2018.
19. Vakola M, Nikolaou I. Attitudes towards Organizational Change: What is the Role of Employees' Stress and Organizational Commitment? Employee Relations. 2005; 27(2):160-174.
20. Armenakis AA, Harris SG. Crafting a change message to create transformational readiness. Journal of Organizational Change Management. 2002; 15(2):169-183.
21. Cameron E, Green M. Making sense of change management: A complete guide to the models, tools and techniques of organizational change. Kogan Page, 2015.
22. Hilson G, Murck B. Sustainable development in the mining industry: Clarifying the corporate perspective. Resources Policy. 2000; 26(4):227-238.
23. Braunschweig T, Thurner S. Mining and metallurgy in German-speaking Central Europe. Resources Policy. 2020; 66:101593.
24. Klöckner L, Blaschke W. Miners, farmers, and engineers: Industrial heritage and cultural change in the Ruhr region of Germany. International Journal of Heritage Studies. 2019; 25(3):225-239.
25. German Mining Association. Mining in Germany, 2021.
26. Pisano U. Mining law and governance in Italy. Extractive Industries and Society. 2019; 6(2):567-571.
27. Baldwin R, *et al*. Global value chains and the future of trade. VoxEU.org eBook, 2018.
28. Tiezzi S, Testa F. Social and environmental sustainability in the Italian mining sector: An empirical analysis. Sustainability. 2020; 12(21):9018.
29. Smith AC. The US mining industry: An overview of trends and challenges. Congressional Research Service, 2020.
30. Ngugi MK, Kibet JK. Mining and environmental governance in Kenya: A critical analysis. Resources Policy. 2019; 62:468-475.
31. Makando. The impact of Globalisation on small businesses, 2002.
32. Mellenberg, Hand. The art of research; a guide to writing dissertations. Sage Publications, 2008.
33. Marotzke J. Climate change: A very short introduction, Oxford University Press, 2017.