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MA RESEARCH PROJECT



LIVESTOCK MANAGEMENT AND ENVIRONMENTAL SECURITY IN EASTERN

AFRICA: A CASE STUDY OF KENYA

HENRY K. NGENOH

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SUPERVISOR: DR SHAZIA CHAUDHRY

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DECLARATION

I hereby declare that this research project is entirely my own original composition. It has not been presented in any other University.

Henry K. Ngenoh

R/50/35345/2019

Signature.....

Date.....

This research project has been submitted for examination with my approval as the officially designated University Supervisor.

Dr. Shazia Chaudhry

Institute of Diplomacy and International Studies

Signature.....

Date.....

DEDICATION

A very special dedication to my loved ones, starting with my wife Alice and daughters Gloria and Melissa for their understanding and support during the entire study period. To my extended family also, who walked with me in prayers throughout the journey. Additional dedication goes to my good friends, colleagues, associates and support team.

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TABLE OF CONTENTS

TITLE.....	i
DECLARATION	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS.....	v
ABSTRACT.....	vii
LIST OF ABBREVIATIONS.....	viii
CHAPTER ONE	1
INTRODUCTION TO THE STUDY	1
1.0 Introduction.....	1
1.1 Background of the Study	1
1.2 Statement of the Research Problem	4
1.3 Objectives of the Study.....	5
1.4 Research Questions.....	5
1.5 Literature Review.....	6
1.6 Justification of the Study	14
1.7 Theoretical Framework.....	15
1.8 Hypothesis of the Study	16
1.9 Research Methodology	17
1.10 Outline of the Study	19
CHAPTER TWO	20
EMERGING LIVESTOCK MANAGEMENT CHALLENGES IN EAST AFRICA	20
2.0 Introduction.....	20
2.1 Trends in Livestock Production in Africa.....	20

2.2	Emerging Livetsock Challenges in Esat Africa	23
2.3	Lifestock Economy in Esatern Africa.....	26
2.4	Innivative Lifestock Production.....	28
2.5	Chapter Summary	31
CHAPTER THREE		32
THE LINKAGE BETWEEN LIVESTOCK MANAGEMENT AND ENVIRONMENTAL SECURITY IN KENYA.....		32
3.0	Introduction.....	32
3.1	Ecological Challenges and Environmenatl Security	32
3.2	Livestock Production and the Environment in East Africa	35
3.3	Livestock Management and Environmenatl Security	37
3.4	Adaptation to Livestock Production and the Environment.....	40
3.5	Chapter Summary	42
CHAPTER FOUR.....		43
THE KEY ACTORS AND STRATEGIES OF EFFECTIVELY ADDRESSING LIVESTOCK MANAGEMENT CHALLENGES IN KENYA		43
4.0	Introduction.....	43
4.1	Respondents Profile	43
4.2	Environmental Security and Livestock in Kenya	52
4.3	The Key Actors of Addressing Livestock Management Challenges	54
4.4	The Key Strategies of Addressing Livestock Management Challenges	55
4.5	Chapter Summary	57
CHAPTER FIVE		58
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....		58
5.0	Introduction.....	58

5.1	Summary.....	58
5.2	Conclusions.....	59
5.3	Recommendations.....	61
	BIBLIOGRAPHY.....	63
	APPENDICES.....	66

ABSTRACT

It is generally accepted that the general production and consumption gap for the major food commodities has widened across many continent in the world. It is worth noting that the livestock as a sector is responsible for the fight against hunger, especially at the household level, animal products are considered critical for nutritional support, food security, livelihoods and general resilience of hundreds of millions of persons in the world today. Thus this research aims to establish the livestock management and environmental security in Eastern Africa using a case study of Kenya. It is worth appreciating that livestock outputs indirectly contribute to food production (mainly crops but also recycled inputs to livestock, for example, cultivated animal feed, bone meal, poultry litter) contribute the remaining one-third. This research utilized Maslow's theory which was developed in 1943 about the hierarchy of human needs. This study employed case study as a research design, and in addition the research utilized both primary and secondary data. The primary data was harvested through the use of a key informant interview guide of the key stakeholders in livestock and national security matters. In addition secondary data was gathered from books, journals, articles and periodicals, then analyzed using document and thematic analysis with full relevance to the objectives of the study. It is worth mention that this research adhered to all the ethical considerations and also research permission and permit was sought where necessary during the study. This research found that climate change will have a direct effect on the livestock by affecting development and fertility and also an indirect effect by affecting the environment around the animals. This study concludes that the effects of environmental change and associated extreme weather events threaten sustainable development and impacts negatively on the livestock sector. This research finally recommends that both state and non-state actors in the agricultural sector to practice and encourage climate-smart forms of agriculture. This research finally acknowledged that there was no simple solution to effectively mitigation of livestock greenhouse emission, and therefore recommended further and deep research in this area to address emerging issues.

LIST OF ABBREVIATIONS

APPs	Applications
ART	Assisted Reproductive Technologies
ASAL	Arid and Semi-Arid Lands
ASF	Animal-Source Foods
AU	African Union
COVID-19	Coronavirus Disease 2019
CSA	Climate Smart Agriculture
EA	East Africa
EWS	Early Warning Systems
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GHG	Green House Gas
GoK	Government of Kenya
GS	Genomic Selection
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
KALRO	Kenya Agriculture and Livestock Organization
KCSAIF	Kenya Climate Smart Agriculture Implementation Framework
KCSAP	Kenya Climate Smart Agriculture Programme
LDC	Least Developed Countries
MoALF	Ministry of Agriculture, Livestock and Fisheries
MoE	Ministry of Environment
MOET	Multiple Ovulation Embryo Transfer
NARIGP	National Agricultural and Rural Inclusive Growth Programme

NDC-K	National Defence College-Kenya
NGO	Non Governmental Organizations
NLMIS	National Livestock Market Information System
NLP	National Livestock Policy
NRMP	Natural Resources Management Program
SDGs	Sustainable Development Goals
SDL	State Department for Livestock
SDS	Senior Directing Staff
SSA	Sub Saharan Africa
UN	United Nations
V2030	Kenya Vision 2030
WAC	World Agro-forestry Center
WB	World Bank

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.0 Introduction

This chapter starts by giving general information on livestock management and environmental security. In common parlance it is often said that climate change impacts livestock both directly and indirectly, while at the same time the livestock contributes most significantly to climate change.

1.1 Background of the Study

The livestock and environment interactions result in various phenomena such as environmental degradation, Green House Gas (GHG) emission, excess methane flow, waste, soil erosion, water pollution, forest degradation and biodiversity destabilization. Abu and Eduarda acknowledge that livestock farming can be hazardous for the environment. It usually leads to biodiversity loss, land degradation, water wastage, acid rain, coral reef degradation and deforestation.¹ The main sources of emissions are feed production and processing, and methane from most ruminant digestion.²

According to MacMillan, cattle are considered the most significant contributor to livestock production, with approximately 4.6 gigatonnes carbon dioxide equivalence, accounting for 65 percent. Poultry, small ruminants and buffalo have lower emission levels, with each contribution between 7 to 10 percent of the livestock emissions.³ This therefore points to the reality that calculating emissions from livestock systems is very complex and poorly understood and yet is considered to have a grave impact of environmental security.

¹Assem, A and Maria E. (2019). *Urbanization, livestock systems and food security in developing countries: A systematic review of the literature*, Volume 11, Issue 2, pp. 279-299.

²Ibid, (2019), p. 303.

³MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, pp. 11-13.

According to Berhanu in developing countries the livestock and agriculture industries are most fragile considering natural disasters can set Least Developed Countries (LDC) back considerably due to lack of government subsidies and it is a known fact that poor rural communities will be the most affected by Climate change. Environmental security is one of the essential components of human security and this term usually refers to the factors that pose a threat to a community's environment.⁴ Livestock contribute greatly to livelihoods and food in the African continent, yet cattle farming for instance are vulnerable to climate change and acts as a major contributor to GHG emissions, a known driver to rapid environmental change. Ironically, climate change is expected to alter the very quality and quantity of available animal feed and adversely affect livestock population.⁵

In Sub Saharan Africa (SSA) livestock is to climate change extremes. The influence of climate change is anticipated to increase susceptibility of livestock industry and reinforce the current factors that are having effects on livestock farming systems.⁶ Thus the relevance of livestock in the provision of food, employment, incomes and risk insurance is widely accepted. Similarly there is an increasing awareness that fast growth in consumption and production of livestock commodities is contributing to a variety of environmental problems, and the main concern being the livestock significant contribution to anthropogenic emissions.⁷

Emissions from livestock are the largest source of greenhouse gases in eastern Africa and the figures reported are not diminishing. And so it goes without saying that control of

⁴Berhanu, M. (2014). *Municipal Capacity and Environmental Service Delivery in Digosion Town, Amhara Regional State, Ethiopia*. Developing Country Studies, 4, pp. 68-78.

⁵MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, pp. 18-21.

⁶Ampaire, A and Rothschild, B. (2010). *Pigs, goats and chickens for rural development: Smallholder farmer's experience in Uganda*. Livestock Research for Rural Development), pp. 4-7.

⁷Anthropogenic refers chiefly to environmental pollution and pollutants originating mainly from increased human activity. MacMillan, S. (2019). World Food Security, p. 24-26.

livestock numbers is one of the most obvious ways of dealing with the problem even though there is still a lot to be learnt of the climate science behind the industry.⁸ In East Africa dwindling rainfall and increased temperature is leading to a decline in livestock productivity mainly due to malnutrition.⁹ A given animal's health and welfare are integral for environmental sustainability.

In the Kenya perspective, at the national level, a vibrant livestock sector can contribute to reduced prices of the ASF; help the overall economic growth of the state through cash incomes and foreign exchange accruing from exports. Kenya for instance can supply the East African region with sufficient and reliable supplies of meat, eggs, milk and other dairy products.¹⁰

The Kenyan perspective shows that the country's animals resource base comprises of approximately 18.3 million cattle, 25.7 million goats, 18.7 million sheep, 3.3 million camels, 40 million indigenous poultry, 4.2 layers, 3.7 million broilers, 2.2 million donkeys, game and aquatic animals.¹¹ The country is at the moment not yet self-sufficient in most livestock products and with the animal human population growth rate widening further, commensurate intervention measures need to be quickly put in place in order to bridge the gap to improve livestock management while appreciating the growing climate changes.

⁸Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁹Alarcon, P and Dominguez-Salas, P. (2015). *Livestock, livelihoods and nutrition*. Workshop Report. FAO, Dakar, pp. 7-9.

¹⁰United Nations. FAO. (2018). *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*. Rome.

¹¹Ministry of Agriculture. (2019). *Livestock and Fisheries. Statistical Report*, Nairobi, Kenya.

1.2 Statement of the Research Problem

In order to address livestock management and environmental security issues, the United Nations (UN) states that the whole livestock industry, “taking into serious account the burning of forests to create feeding grounds, fodder production and animal flatulence account for about a quarter of the world’s greenhouse gas emissions.”¹² With increasing human population therefore increase in demand for animal protein, if left unchecked, the livestock industry could account for seventy per cent of all emissions worldwide by 2050.¹³

Abu and Eduarda posit that in the African context livestock production is key to maintaining good nutrition, food security and livelihoods. But they further assert that livestock production must be done in measured degrees otherwise risking the increase in GHG, strain on natural resources and occurrence of zoonotic diseases.¹⁴

The livestock industry accounts for 42 per cent of the agricultural Gross Domestic Product (GDP) and 12 per cent GDP overall in Kenya’s economy.¹⁵ It is appreciated that a large percent of land mass in Kenya is (ASAL) Arid and Semi-Arid and Livestock is the main source of sustenance in these regions.¹⁶ It is on this background that the study aims to examine key issues regarding livestock management and environmental security nexus in East Africa by using the case study of Kenya.

¹²United Nations Environmental Programme. (2011). *Keeping Track*, pp. 7-8.

¹³Pelletier, N and Tyedmers, P. (2010). *Proceedings of the National Academy of Sciences USA*, pp. 371-371.

¹⁴Abu, H and Eduard, M. (2019). *Urbanization, livestock systems and food security in developing countries: A systematic review of the literature*, Volume 11, Issue 2, pp. 279-299.

¹⁵Ayaga, K and Njenga, M. (2005). *Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

¹⁶MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 29.

1.3 Objectives of the Study

The general objective of this study was to establish links between the livestock management and environmental security in Eastern Africa using a case study of Kenya. The specific objectives included;

- 1.3.1** To determine emerging livestock management challenges in Eastern Africa.
- 1.3.2** To analyze the linkage between livestock management and environmental security in Kenya.
- 1.3.3** To examine key actors and strategies of effectively addressing livestock management and environmental security challenges in East Africa generally, and Kenya specifically.

1.4 Research Questions

This study will be driven by the following research question;

- 1.4.1** What are the emerging livestock management challenges in Eastern Africa?
- 1.4.2** What is the linkage between livestock management and environmental security in Kenya?
- 1.4.3** Who are key actors and strategies of effectively addressing livestock management and environmental security challenges in East Africa generally and Kenya specifically?

1.5 Literature Review

This section examined scholarly literature on the topic under research in order to be able to establish the livestock management and environmental security in Eastern Africa using a case study of Kenya. Thus, theoretical literature in this section utilized a number of theories.

1.5.1 Empirical Review

Environmental security is a topic that delves into how changes in the environment may affect people of a certain community, country or region it also involves looking at how conflict between human communities may affect the environment around them or the consequences that these conflicts may have on third parties, even across borders. Evidence is present showing how environmental security studies have mapped the changes that have occurred to land vegetation over the past three to four decades.

The topic of climate change was first seriously discussed on a global platform in the Food and Agricultural Organization of the United Nations (FAO) meeting held in the early 1980s. At the present the FAO has been correlating the effects of climate change on agriculture and how this in turn affects food security for people around the world.¹⁷ Climate change as a phenomenon is said to occur when changes in earth's climate system result in new or sometimes irregular weather patterns that remain in place for an extended period of time. Human activity, notably traced to the industrial revolution, is said to have contributed immensely to global warming due to the accumulation of GHG.

Climate change has had severe effects on the socio-economic lives of various people around the world. For example, a change in rainfall patterns could mean two severe situations for people, drought or flooding, change in temperatures could compromise food security by affecting the maturation of crops, glaciers melting could mean the displacement of thousands or millions of people as land masses get drowned by the sea. A change in climate could also

¹⁷Griggs, D. (2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

mean changes in disease vectors as hotter temperatures may see the increase of insects like mosquitoes in areas that did not harbor them before. Habitats will also be affected by changes in temperature by up to 30 per cent with a 2° Celsius rise in temperature.¹⁸

In many developing parts of the world the phenomenon of climate change has long lasting effects on the socio-economic environment.¹⁹ “The disaster risks definitely pose threats for sustainable growth of the region. During the 4th IPCC conference it was noted that Africa is warming faster than the rest of the planet.”²⁰

The Constitution of Kenya (2010) under chapter 5 (69) commits to, that there is proper use and sustainable use of natural resources within the country. It also ensures that these resources can be shared equitably among its citizens. Kenya like many other nations on the continent face environmental problems such as deforestation, soil erosion, land degradation, desertification, loss of biodiversity, water scarcity and pollution from industries.²¹ The National Livestock Policy (2019) recognizes that the industry faces unique challenges mainly climate change. These unique challenges need unique solutions to ensure sustainability in the agricultural industry like, early warning and preparedness; appropriate technologies for production, fast and secure transport and processing of livestock and livestock products.²² The policy has blueprints for the intervention at both the national and county levels.

¹⁸The Intergovernmental Panel on Climate Change [IPCC] report. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, (2007), p. 2.

¹⁹Ibid, (2007), p. 29.

²⁰MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations), p. 11.

²¹Government of Kenya, (2010). *The Constitution of Kenya*, 2010. Kenya.

²²Ministry of Agriculture, (2019). *National Livestock Policy*, Kenya.

1.5.2 Livestock Production

The livestock industry over the years has been facing challenges of increased demand and many farmers, even in the developing world, are using various technologies to meet those demands.²³ Generally, the demand for livestock products in the developed world is stagnating though they have the capacity to meet demand.²⁴ Changes in demand for livestock products are usually affected by human population growth and consumption patterns.

Joelton argues that “livestock, especially cattle, offers many benefits to local individuals ranging from meat, hides or skin, milk for household consumption and sale, as well as cultural uses.”²⁵ Livestock rearing has become a viable way for people in the rural areas to improve their standards of living but also on the contrary it offers the livestock farmers a myriad of challenges.²⁶ This is why the industry must undergo a lot of challenge in the coming decades.

Livestock play a critical role in preserving balance within the ecosystems of some communities. “For instance manure they generate is critical to the soil of a region for horticulture, agriculture, domestic use, and or the animals themselves are used as beasts of burden in areas where they have low mechanization and they help in carbon sequestration and increase of biomass.”²⁷ A lot of factors have contributed to the increase in popularity of livestock rearing in developing states. “For instance, it has boosted family incomes over the years, enabled change in diet and these previous factors have boosted population growth and

²³Okello, M.(2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

²⁴Ayaga, K and Njenga, M. (2005). *Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

²⁵Joelton, A. (2009). *A review of avian influenza in different bird species*. Vet. Microbiol, pp. 3-7.

²⁶Ayaga, K and Njenga, M. (2005). *Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, p. 11.

²⁷Brookes, S. (2009). *Influenza A (H1N1) infection in pigs*. Vet. Rec., pp. 760-761.

extended longevity among people.”²⁸ The National Livestock Policy document (2019) aims to offer guidance to policy concerning livestock breeding both on a national and county level being in tandem with the goals of vision 2030. The main aim of the policy is to provide food and nutrition security, wealth creation while protecting the environment.²⁹

The Constitution of Kenya in the Fourth Schedule provides for how the livestock sector is going to be managed both at the national and county level.³⁰ The National Livestock Policy (2019) highlights the responsibilities of the two levels of Government in matters of livestock development.³¹

1.5.3 Livestock Management and Environmental Security and in Kenya

The effects of environmental security on social-natural frameworks will be experienced through both changes in mean conditions, over long-lasting scales, additionally through increments in the power and sometimes recurrence of surges, dry seasons, storms and violent winds, fires, heat-waves and scourges.³² Environmental security, “examines the effects humans have on the environment and how if any danger is posed to certain communities or individuals. It does not just deal with heterogeneous communities but it also looks at cross border environmental effect or human effects on the environment.

In the late 1980s, the environment security issue began to receive a lot of attention which resulted in publication of many academic and policy articles journals and this led to the shift from a state-centric approach and emphasize the security consequences of

²⁸MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, pp. 7-9.

²⁹Ministry of Agriculture and Livestock. (2019)*National Livestock Policy*, p. 2-5.

³⁰MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 13.

³¹Ministry of Agriculture and Livestock. (2019). *National Livestock Policy*, p. 2-5.

³²Liftin, K. (1999). *Constructing environmental security and Ecological interdependence*. Journal Volume 5, pp. 359-372.

environmental issues for individuals, communities, ecosystems and the planet as a whole.”³³

One of the key environmental degradation phenomena on grazing lands is soil erosion, which is a major problem especially in the ASALs. Numerous studies which have been carried out in Kenya indicate that the major forms of erosion include sheet, gully, rill and river-bank erosion, and that areas susceptible to gully erosion include bare land, animal tracks among others. Erosion on grazing land is mainly attributed to overgrazing, poor quality pasture and concentration of livestock around watering points and dips. Dunne estimated that, “up to 35 percent of the sediment load from sixty one catchments in Kenya came from roadside gullies and another equal amount attributed to footpaths and cattle tracks.”³⁴

In comparison, communal land generally experiences higher erosion rates than individual holdings like commercial ranches. This arises from such weaknesses like improper structures such as buildings and concentration points for livestock for such services like watering, dipping as well as domestic water supplies and inadequate control of run-off from such areas.³⁵

The resultant effect of extensive land degradation is a reduced carrying capacity in all the agro-ecological zones of Kenya, but especially so in the ASALs.³⁶ This is because the pastoral communities keep large herds of livestock for various reasons, including social and cultural as well as to serve as insurance to cushion the community during periods of drought, safeguard against crop failure, disease outbreaks and loss of herds to raids. The rise in the population of the pastoralists, coupled with increase in the number of livestock kept has means encroaching even to areas not previously reached, such as forests, resulting in severe

³³Ibid, (1999), p. 375.

³⁴Dunne, T. (1978). *Field studies of hill slope flow processes*. In: Hillslope Hydrology. Ed. M.J. Kirkby, pp. 227-293.

³⁵The Government of Kenya. *National Land Degradation Assessment and Mapping in Kenya*. Kenya.

³⁶The Government of Kenya. (2015). *Land Degradation Assessment for Sustainable Land Management in Kenya*. Kenya.

degradation and reduced livestock yields.³⁷ This has resulted in soil erosion and depletion of the natural seed banks in the soil to the extent that subsequent rains are not able to spur regeneration of the palatable grass species.

On the issue of climate change, it may be hard to accurately predict how it will affect communities in the long run but it has been observed that changes in climate could prolong pathogen life, carriers or intermediate vectors. “It has also been observed in East Africa that during the drought of 1993 pastoralists were forced to graze their cattle in wildlife sanctuaries. This resulted in cross species infections of Rinderpest occurring. It had devastating effects and it spiraled into affecting the abundance or distribution of hosts or the competitors, predators and parasites of vectors and influenced patterns of disease. Prognosis of the situation became almost impossible.”³⁸ Alleny contends that, “most environmental security issues are not restricted to a certain region because environmental degradation pertains to the global ecosystem.”³⁹

Alleny is also of the thought that regional problems should be addressed from a regional perspective. Therefore, the author feels states should “share” their sovereignty when it comes to addressing environmental issues that may be trans-boundary such as forest conservation or dealing with wildfires and so forth. Therefore, he recommends the setting up of regional units, specifically for dealing with these kinds of problems.⁴⁰

Climate change is an inauspicious reality. It is generally accepted that the world is getting hotter by the day.⁴¹ Therefore great climate events, for example, storm surges, dry

³⁷Ibid, (2015).

³⁸Catherine, M. (2009). *Climate Change Science Compendium*. United Nations Environmental Programme, p. 57.

³⁹Alleny, B., (2000). *Environmental Security*. Concept and implementation. Volume 1, p. 31.

⁴⁰Op. Cit, (2000), p. 13.

⁴¹The Government of Kenya. 2015). *Land Degradation Assessment for Sustainable Land Management in Kenya*. Kenya.

spells, heat waves and cyclones, experienced in various parts of the globe, are among the broad results of climate change, giving humans a biting preview of what more terrible may come sooner rather than later.⁴² The adaption to climate change is mandatory if there is going to be a sustainable economy on the planet in the coming few decades and agriculture will have to adapt the most, if global mitigation of climate change is going to be possible at all.⁴³ It is therefore imperative to generate specific data on the emissions of different types of livestock emit in order to know how to regulate different parts of the industry.

The Ecological systems theory was based on it having five levels. It was developed by Urie Bronfenbrenner. There is the microsystem level. This has a direct relationship to biotic and abiotic factors. It is believed that at this level it is the level closest to the person.⁴⁴ It views a child's environment as a relationship of external entities arranged in layers, all of them playing a crucial part in a child's development. At this layer, the name it has been given was changed to bio-ecological system's theory.⁴⁵ The other factors to this theory which determine an individual's development are; immediate family, community and societal landscape.⁴⁶ However, when it comes to livestock there are some factors that do not follow the model mentioned above. For instance, livestock agriculture is a big part of many a country's Gross Domestic Product (GDP) and therefore its development will be engineered regardless of the prevailing natural factors.⁴⁷ Also livestock come in different species and sub-species, all of these are affected differently by the same factors.

⁴²Ibid, (2015).

⁴³Catherine, M. (2009). *Climate Change Science Compendium*, UNEP, p. 57.

⁴⁴Bronfenbrenner, U. (1988). Foreword. In A. R. Pence (Ed.), *Ecological research with children and families: From concepts to methodology*, New York: Teachers College Press, p. 9-13.

⁴⁵Bronfenbrenner, U and Ceci, S. (1994). *Nature-nurture reconceptualized in developmental perspective: A bio-ecological model*. *Psychological Review*, 101, pp. 568-586.

⁴⁶Ministry of Agriculture and Livestock.(2019).*National Livestock Policy*, p. 2-5.

⁴⁷Ibid, (2019), p. 6.

Braden states that, “in seeking to appreciate the Regional Environmental Security Complex theory, it is crucial to take cognizance of the fact that most environmental security issues are not subject to a certain region because environmental degradation usually pertains to the planet’s ecosystem as a whole.⁴⁸ However, environmental challenges that cross borders in nature, that is, those that only cross a regional boundary should be tackled at the regional level.”⁴⁹

Climactic conditions in the Arid and Semi-Arid Areas force farmers to engage in intense agro-activities which usually put more of a strain on other environmental aspects. In many of these areas pastoralism is the key agricultural activity.⁵⁰ It is hard to accurately predict how climate change will affect communities in the long run but it has been observed changes in climate could prolong pathogen life, carriers or intermediate vectors.⁵¹

Fodder shortage will probably increase degradation of environment in conservatories and this will threaten some animals with extinction.⁵² These events could result in untold losses to the farmers and to the cultural heritage of nations. “A formal and systematic approach is required in order to; identify the best and most resilient livestock breeds, rangeland management systems, production strategies, animal disease prevention and control measures and access to animal health care, appropriate policies and institutions, efficient waste management, use of manure, intensive livestock farming systems, land use planning, research into farming methods, incentives for eco-friendly farming, efficient breeding,

⁴⁸Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁴⁹Braden, A. *Environmental Security*.(2000). Concept and implementation. Vol. No 1, p. 5.

⁵⁰Okello, M. (2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁵¹Ministry of Agriculture and Livestock. (2019)*National Livestock Policy*, p. 2-5.

⁵²Okello, M. (2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

feeding and management techniques and early warning systems.”⁵³ In the past half a decade a lot of regional and local meetings have taken place on the effects of climate change will have on livestock in arid and semi-arid regions.⁵⁴

1.5.4 Literature Gaps

It is worth restating that the literature (reviewed) available on livestock management and environmental security shows that there is a gap to what extent the economies of the East African region are dependent on livestock farming. It shows a heavy dependence but the livestock owners in this industry are usually small farmers who are completely at the mercy of changes in climate, even slight ones. Another gap found in the study is the impact to human health due to adverse effects of climate change in livestock farming.

1.6 Justification of the Study

This research is justified owing to the importance of environmental security to the survival of mankind and other flora and fauna yet animal protein forms a critical component of human diet for growth and development. Justification is discussed under the different sub-topics as seen hereunder.

1.6.1 Policy Justification

In the African context the turnaround in fortunes of the livestock sector has happened largely in part to private enterprise and initiatives. The government has had very little input in this and this has to be addressed in order to ensure sustainable growth in the event of massive environmental mishaps.⁵⁵ Thus this study aims to act as a discourse of the policy initiatives in

⁵³Katikati, A. and Fourie, S. (2019). *Improving Management Practices of Emerging Cattle Farmers in Selected Areas of the Easter Cape Province: The Role of Agricultural Extension*. Department of Agriculture, Central University, Free State, Republic of South Africa, pp. 4-11.

⁵⁴Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. *Journal of Sustainable Tourism*, pp. 54-61.

⁵⁵Ibid, (2014), p. 81.

addressing livestock management and environmental security in Africa. It aims to provide the basis for the identification of key issues that may potentially impact on the successful policy formulation of livestock management.

1.6.2 Academic Justification

This study looks to provide literature on the livestock industry and how it can be made to sustainably grow in the face of climate change challenges. This is in line with the right to food as it correlates to the Big 4 Agenda, Sustainable Development Goals aspirations and Vision 2030. It also aims to recognize the role of small scale farmers in the role of providing the country with food security.⁵⁶

1.7 Theoretical Framework

It is worth noting that theories are tested general propositions that help academia to explain or predict the various phenomena as they occur. This section delves in to theories to explain the relationship between livestock management and environmental security.

1.7.1 The Human Needs Theory

This research employed Maslow's theory which Abraham Maslow developed in 1943 about the hierarchy of human needs. It analyzed human behavior and how it affected their actions in relation to their needs and wants. It has been criticized in many quarters as being too Eurocentric or too western oriented in its outlook that it would be irrelevant in any other context. But until today it is used by many scholars as a model of study.⁵⁷ "The first two tiers of human needs are psychological and organizational respectively. The third tier is societal needs which show that the human being is not only a social animal but an organized one as

⁵⁶The Republic of Botswana. (2014). Since Independence in 1966, Botswana adopted an approach of development planning. National Development Plan 11, or NDP 11, is the eleventh in the series of NDPs. National Development Plans guide the overall development of the country. Ministry of Finance and Development Planning.

⁵⁷Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

well.⁵⁸ The combination of human resource management and his culture of organization if managed properly give Maslow's model its final two tiers which are more of wants than needs. They are self-esteem and actualization. An important point to note about human behavior is that consumption increases in proportion to supply."⁵⁹

Even though basic human needs are primal as humanbeings advance into the future, first, in developed nations, other considerations will come to the fore within the livestock (sector) industry. These needs will be such as animal welfare, product quality, disease resistance and turning around the damage already done to the environment.⁶⁰ Kenyan context small scale livestock farming is disadvantaged by the threat of climate change.⁶¹ This makes many of these farmers and pastoralists to get stuck in a vicious cycle of poverty due to the ravages of this phenomenon.⁶²

1.8 Hypotheses of the Study

1.8.1 Effective livestock management reduces climate change damage in East Africa.

1.8.2 Livestock mismanagement adversely affects environmental security in Kenya.

1.8.3 There is no dedicated actor addressing livestock management challenges in Kenya.

⁵⁸Ibid, (2014), p. 64.

⁵⁹Ayaga, K and Njenga. M. (2005).*Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

⁶⁰Ibid, (2005), p. 14.

⁶¹Katikati, A. and Fourie, S. (2019). *Improving Management Practices of Emerging Cattle Farmers in Selected Areas of the Easter Cape Province: The Role of Agricultural Extension*. Department of Agriculture, Central University, Free State, Republic of South Africa, pp. 4-11.

⁶²Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

1.9 Research Methodology

This section elaborates the approaches necessary in identifying, processing, selecting and analyzing information that will be studied in this research.

1.9.1 Research Design

This study employed case study as a research design. Case studies are often done in the subject's real-world context, in their natural set up, which gives researchers a good view of what they are really like. This will help in assessing the current situation under study and advancing theoretical ideas by using both qualitative and quantitative research approaches.

1.9.2 Target Population

It is worth noting that the study participants were chosen based on their work, knowledge and experience in the field on matters of livestock, livestock management, climate change and national security. The participants' acted as the key informants with regards to establishing the links between the livestock management and environmental security in Eastern Africa with reference to Kenya. Therefore the Ministry of Agriculture and Livestock, Kenya Agricultural and Livestock Research Organization (KALRO), National Intelligence Service, Kenya Wildlife Service, Academia, Research Experts, Ministry of Environment, International Livestock Research Institute (ILRI), World Agro-forestry Centre (WAC), Non-governmental Organizations (NGO), various stakeholders and other key multi-agencies.

1.9.3 Data Collection

The research mixed both qualitative and quantitative study approaches, by the use of both primary and secondary data sources. The primary data source was collected via a dedicated key informant guide. The key informant method was undertaken through a structured questionnaire and used to generate data from various livestock and environmental security experts, and they included, both state actors, non-state actors involved in livestock and

environmental security matters. In addition, the secondary data sources were mainly harvested from books, journals, articles and periodicals in the research subject matter.

1.9.4 Data Analysis and Presentation

The field data gathered was analyzed using document, content and thematic analysis with full relevance to the objectives of the study. Narratives were employed as a way to present the data. The study observed all formal protocols of such a study such as this one and the chosen participants were informed of any situation that may limit the researchers' discretion. The final research analysis and the study findings were ultimately presented in the form of pie charts, bar graphs, frequency tables and narratives.

1.9.5 Ethical Consideration

It is worth restating that this study adhered to all the appropriate research procedures as clearly stipulated by the higher learning institutions, research agency and all the sources of information were adequately acknowledged where possible. It is critical to also appreciate that before the research instrument key informant interview guide (questionnaire) was administered, consent was sought, the participants were informed of their rights and additionally they were assured of full confidentiality and privacy of their details and information generated.

1.9.6 Study Limitations

This section notes that in seeking to understand the possible limitations of the study, it is important to acknowledge that this research initially faced the limitation of finding vast subject matter experts (research participants)), owing to the sensitive and technical nature of the research study. This was mitigated by focusing and liaising with the key departments dealing with the research area.

1.10 Outline of the Study

The outline of the study takes the following sequence: Chapter 1 is the introduction to the Study; Chapter 2 looks at the emerging livestock management challenges in Eastern Africa; Chapter 3 studies the linkage between livestock management and environmental security in Kenya; Chapter 4 looks at the key actors and strategies of effectively addressing livestock management challenges in Kenya while Chapter 5 provides the Summary, Conclusions and Recommendations from the study.

CHAPTER TWO

EMERGING LIVESTOCK MANAGEMENT CHALLENGES IN EAST AFRICA

2.0 Introduction

This section articulates and critically assesses the emerging livestock management challenges in East Africa, coming in the wake of the demand for livestock products heavily moderated by social, commercial, political and environmental factors such as human health concerns and changing socio-cultural values.

2.1 Livestock Production in Africa Key Trends

The livestock market is a big one and in the developed world it is even bigger.⁶³ Ironically, Sayer and Cassman opine that in developed countries, demand for livestock products is slowing down, and processing plants are becoming more aware of sustainable methods of production.⁶⁴ In the modern era, changes in the livestock industry have occurred because of factors such as increase in human population, urbanization, increase in people's income and science and technology which has led to the development of livestock systems that have made the chain of distribution of livestock products very fast and efficient.⁶⁵

Alexandratos posits that, "at the moment livestock production in Africa is increasingly being affected by the lack of sufficient land and water resources; the scarcity of food and need for the animals and the ever pressing need of SDG for a cleaner and greener farming environment."⁶⁶ Nevertheless breeding and nutrition continue to play a key role in

⁶³Dube, L. Pingali, P and Webb, P. (2012). *Paths of convergence for agriculture, health and wealth*. Proc National Academy Science, pp. 91-104.

⁶⁴Sayer, J. and Cassman, K. (2013). *Agricultural innovation to protect the environment*. Proc National Academy of Science, America, p. 824.

⁶⁵Dube, L. and Webb, P. (2012). *Paths of convergence for agriculture, health and wealth*. Proc National Academy Science, pp. 91-104.

⁶⁶Alexandratos, B. (2013). *World Agriculture towards 2030/2050: The 2012 Revision*. Food and Agriculture Organization of the United Nations, Rome, p. 91.

fight for stronger gene pools and longevity.⁶⁷ Thornton is of the opinion that productivity in livestock rearing will have to face constraints from the clamor for cleaner farming and governments enacting “pro-green” legislation.⁶⁸

Katikati and Fourie are of the opinion that in the past twenty years livestock production in Africa has been mediocre compared to the major food brands of the West.⁶⁹ So far, a lot of this has been caused by technical constraints which seem to be lacking from private hands and public funding.⁷⁰

Fynn posits that meat and milk are a major business in Africa just like anywhere else around the world.⁷¹ Livestock output does contribute indirectly to about a third of food production in Africa.⁷² Foster argues that local demand for livestock and its products is far outweighed by the production.⁷³ This is a worrying trend for many African governments as constant imports are gravely affecting their balance of payments.⁷⁴ But on the contrary, it is quite apparent to all governments that uncontrolled livestock production may be harmful to the environment and or the climate.⁷⁵ Science and technology have made it possible for

⁶⁷Ibid, (2013), p. 835.

⁶⁸Thornton, P. (2018). *Livestock production: Recent trends, future prospects*. Philos Trans R Soc Lond B Biol Sci 365), pp. 2853-2867.

⁶⁹Katikati, A. and Fourie, S. (2019). *Improving Management Practices of Emerging Cattle Farmers in Selected Areas of the Easter Cape Province: The Role of Agricultural Extension*. Department of Agriculture, Central University, Free State, Republic of South Africa, pp. 4-11.

⁷⁰Pienaar, L. and Traub, L. (2015). *Understanding the smallholder farmer in South Africa: Towards a sustainable livelihood Classification*. Department of Agriculture, Central University, Free State, Republic of South Africa, p. 27.

⁷¹Fynn, R. (2015). *Functional resource heterogeneity increases livestock and rangeland productivity*. Rangeland Ecological Management, pp. 319-329.

⁷²Ibid, (2015), p. 335.

⁷³Foster, K. (2015). *The profitability and production of a beef herd on transitional Cymbopogon – Themeda veld receiving three different levels of supplementation*. D Tech Thesis, Central University of Technology, p. 97.

⁷⁴Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁷⁵ Ibid, (2014), p. 65.

farmers to take better care of their animals by means of nutrition and health care.⁷⁶ Though different states use different veterinarian systems to assess and diagnose the nutritional health of their animals.⁷⁷

The relationship between livestock and environment can be demonstrated in more frontiers than one. Being herbivores, ruminant livestock rely on vegetation, mainly grasses and browses, for their survival. This therefore calls for a balance between the number of animals in a given ecosystem and the capacity of the said area to support the forage demand for the animals. This forms the basis of the concept known as the *carrying capacity*, which refers to the maximum population size of a biological species that can be sustained. The term *stocking rate* on the other hand refers to the actual number of stock per unit area at a particular time.⁷⁸

It is worth emphasizing that, “these concepts are mainly relevant to the ASALs in developing economies where little investments have been made to bring in feeds from outside to supplement what grows in the area. About 70 per cent of all livestock in Kenya are found in the ASALs, which are also described as ecologically fragile. Livestock farming in medium to high potential areas of Kenya is characterized by a significant level of off-farm feed reliance so that a farmer can keep a large number of livestock units in a comparatively small area.”⁷⁹

⁷⁶ Foster, K. (2015). *The profitability and production of a beef herd on transitional Cymbopogon – Themeda veld receiving three different levels of supplementation*. D Tech Thesis, Central University of Technology, p. 97.

⁷⁷ Pienaar, L. and Traub, L. (2015). *Understanding the smallholder farmer in South Africa: Towards a sustainable livelihood Classification*. Department of Agriculture, Central University, Free State, Republic of South Africa, p. 27.

⁷⁸ Abu, A and Eduarda, M. (2019). *Urbanization, livestock systems and food security in developing countries: A systematic review of the literature*, Volume 11, Issue 2, pp. 279-299.

⁷⁹ Ibid, (2019), p. 311.

2.2 Emerging Livestock Management Challenges in Eastern Africa

It is believed by survivalist that it is better to have livestock than crops during times of drought as they offer a better buffer to humans, but with increasing signs of climate change, it is uncertain whether the animals themselves will fare any better than crops during drought or famine.⁸⁰ And even if they do, extreme temperatures are known to stunt growth and reduce fertility in livestock.

2.2.1 Climate Change

Climate change will force all countries of the world to undergo severe restructuring of their environmental policies and inexorably this will lead to restructuring of their agricultural policies in order to deal with the stresses of food and livestock production that will inevitably be experienced on the planet. These challenges will also be exacerbated by rapid population growth, especially on the continent of Africa.⁸¹ This will require intensive agricultural practices, which if managed properly will lead to an increase in the increase of the natural resource base rather than its deterioration. base.

2.2.2 Temperature Vulnerability

Temperature affects livestock in different ways mainly based on age, genetic potential, species, life stage and nutritional status. At high altitudes increase in temperature affects livestock more adversely than in lower altitudes. Livestock is usually better adapted to lower altitudes mainly because of oxygen levels and heat retention factors. Ironically in East Africa and South Africa the most intense cattle production systems use exotic breeds like Frisian which are well adapted to higher altitudes but are not resistant to drought.⁸²

⁸⁰Fynn, R. (2015). *Functional resource heterogeneity increases livestock and rangeland productivity*. Rangeland Ecological Management, , pp. 319-329.

⁸¹Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁸²Katikati, A. and Fourie, S. (2019). *Improving Management Practices of Emerging Cattle Farmers in Selected Areas of the Easter Cape Province: The Role of Agricultural Extension*. Department of Agriculture, Central University, Free State, Republic of South Africa, pp. 4-11.

2.2.3 Policy Inconsistencies

Livestock keepers require options, the option to be able to find out what is ailing their livestock and the option to be able to do something about it.⁸³ These options are heavily influenced by legislation. Many a time heavy fines do not help the situation.⁸⁴ At a local level, farmers need secure land rights, strong and equitable local institutions and functioning legal systems.⁸⁵ But all these do not help if there are disincentives put in by government, like unreasonable fines or exorbitant license fees.⁸⁶

2.2.4 Increased Livestock Disease

Joelton states that fluctuations of water supply and temperature will modify the pattern with which livestock diseases occur.⁸⁷ Floods also bring about a myriad of health risks.⁸⁸ An example to this is the Rift Valley Fever, which is a zoonotic disease affecting both livestock and man. This disease is spread by mosquitoes and flooding provides a good environment for the proliferation of mosquito population.

2.2.5 Increased Insecurity

In many areas in East Africa where livestock is a major source of sustenance, insecurity is a major problem, this is especially so in pastoralist communities.⁸⁹ There are many reasons for this but the major one is resource competition and climate change may exacerbate the

⁸³Griggs, D. (2013). *Sustainable development goals for people and planet*, Nature, Vol. 395, pp. 305-307.

⁸⁴Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁸⁵MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

⁸⁶Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁸⁷Joelton, A. (2009). *A review of avian influenza in different bird species*. Vet. Microbiol, pp. 3-7.

⁸⁸MacMillan, S.(2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

⁸⁹Abu, A and Eduarda, M. (2019). *Urbanization, livestock systems and food security in developing countries: A systematic review of the literature*, Volume 11, Issue 2, pp. 279-299.

situation.⁹⁰ Resource scarcity may lead to more intense privatization of land especially riparian zones where crop producers will be most definitely interested in keeping for themselves.⁹¹ This will put more pressure on pasture zones.⁹² Also key areas like salt pans for animals will come under contestation.⁹³ These are circumstances that leave livestock farmers at a disadvantage and these conditions are ripe for creating conflict and increased insecurity in a given jurisdiction.

2.2.5 Land Use Policy

The definition of territorial land in Kenya is the “surface of the earth and the subsurface rock, anybody of water on or under the surface, marine waters in the territorial sea and exclusive economic zones, natural resources completely contained on or under the surface and the airspace above the surface.” It is a crucial resource for all the citizens of the republic. It needs to be used and managed properly for sustainability, maintaining and posterity. Conversion of grazing land to other competing uses like real estate as witnessed in counties like Kajiado County in Kenya will precipitate environmental degradation as available grazing areas continue to shrink.

⁹⁰Ibid, (2019), p. 331.

⁹¹Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁹²MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

⁹³Ibid, (2019), p. 34.

2.3 Livestock Economy in Eastern Africa

Okello states that, “livestock keeping helps alleviate the hardships of people living in vulnerable situations by providing a buffer when crops fail and it is also a major source of nutrients for many small holders around the world. Livestock products contribute 17 per cent to kilocalorie consumption and 33 per cent to protein consumption globally, but there are large differences between rich and poor countries.”⁹⁴

It should be worth stressing that Livestock contribute 17 per cent to the global food balance, in terms of calorific intake per person per day, and 33 per cent of the protein in human diets.⁹⁵ It is estimated that the livestock industry is responsible for about 18 per cent of greenhouse gas emissions. It is also believed that a reduction of meat consumption in developed countries could drastically improve people’s health. This would be observed by the reduced number of colorectal cancer cases, obesity and heart disease. But it has to be said that the livestock industry is not all bad, it has to be examined from a local to a regional perspective in order to determine its effects on a local community and on a region.

The dairy industry in East Africa has not been fully characterized; neither has the impact of climate change on the industry been well forecasted.⁹⁶ Milk is the primary output of most African rangelands, but little government subsidies and marketing make the whole industry grossly undervalued. It will further take a beating as input costs rise and shortages escalate.⁹⁷ In arid areas rearing of animals is positive in so many ways. For instance, it balances the ecosystem, minimizes the threat of global warming and meets human sustenance and even medical needs. In contrast in range areas and ranches the effects of livestock

⁹⁴Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁹⁵Braden, A. (2000). *Environmental Security*. Concept and implementation. Vol. No 1, p. 5.

⁹⁶MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

⁹⁷Griggs, D. (2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

farming has always the potential to seriously harm the environment.⁹⁸ It is acknowledged that these areas are prone to population surges and this produces competition of resources between humans, wildlife and livestock. This forces range farmers to encroach on already marginalized areas which in turn further degrades the environment and depletes resources for all while always posing the threat of cross-species infections. And in arid areas it is common to experience fluctuations of rain and the amount of moisture the area receives.⁹⁹ This is another factor that could make livestock farming for humans dangerous, because lack of adequate rain coupled with intense grazing depletes the biomass of a region.

The population in Kenya is projected to double in the near future.¹⁰⁰ By the same period, an estimated 50 per cent of the population will be living in the urban areas compared to 27 per cent as currently is the case. On the same breath, the GDP per capita is projected to increase by over 140 percent by 2050, a direct consequence of which will be a stiff rise in the demand for ASF.¹⁰¹ Over the same period, projections done for the growth in cattle and chicken population indicate an increase by 94 and 375 percent respectively, the same of which will be accompanied by significant gains in productivity. As a result of the foregoing, additional 7.8 million tonnes of milk, beef and chicken meat, an increase of approximately 150 percent, will be produced by the sector to feed the resultant human population.¹⁰²

It is worth stating that the recent developments in the global and regional arena may affect the aforementioned projections of food supply and demand. For instance in the years

⁹⁸Okello, M. (2014). *Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

⁹⁹MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

¹⁰⁰United Nation. FAO, (2019). *The Future of Livestock in Kenya*. Opportunities and challenges in the face of uncertainty. Rome, pp. 56-58.

¹⁰¹MacMillan, S.(2019).*Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

¹⁰²United Nation. FAO, (2019). *The Future of Livestock in Kenya*. Opportunities and challenges in the face of uncertainty. Rome, pp. 56-58.

(2019-2020) the invasion of desert locust which crossed into Kenya from Somalia and Ethiopia. Locusts are a threat to food security because swarms can consume two hundred tones of vegetation per day and the actual impact of the invasion on food security is yet to be established. In addition the outbreak of COVID-19 pandemic is another disruption which might impact on food security and derail the projections set.¹⁰³ The main effect might emanate from the disruption of the value chain distribution system affecting the input supplies, supply of produce to the markets, disruption of processing activities among others.

2.4 Innovative Livestock Production

Innovation is needed in livestock production to increase yield but it must be accepted that innovation can be a very complex. It has to meet the needs of multiple stakeholders before it can be feasible in the market. These stakeholders are in the health sector, environmentalists, farmers and so forth.

2.4.1 Exotic Breeds Innovation on

Fynn argues that innovation to increase output in local breeds may be helped along in studying innovation on exotic breed that exhibit the same stamina and health when exposed to similar environments as the local breeds.¹⁰⁴ An innovation is necessary as climate change is making managing of these animals a complicated affair. A lot has to be taken into account the fluctuation of herd sizes, ability to migrate and whether there is available technology locally to be used in the process of innovation, for instance devices on the ground that can receive satellite imagery.¹⁰⁵

¹⁰³MacMillan, S.(2019).*Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

¹⁰⁴Fynn, R. (2015).*Functional resource heterogeneity increases livestock and rangeland productivity*. Rangeland Ecological Management, pp. 319-329.

¹⁰⁵Ibid, (2015), pp. 319-329.

2.4.2 Mixed Farming

It is important to appreciate the fine line between mixed farming and agro-pastoralism. Mixed farming is when farmers rear both crops and livestock on fertile arable land while agro-pastoralism is when pastoralists rear their animals but plant a few resistant crops on the little fertile ground available.¹⁰⁶ Their distinction is usually made possible by time. Short term trends are for pastoralists and long-term trends are for mixed farmers.¹⁰⁷

2.4.3 Financing Regimes

Farming flourishes when it is close to urban centers due to accessibility to the market and small stock of livestock can be used as leverage in banking and lending institutions. These systems contribute 35 per cent of the total production of beef, 20 per cent of goat and sheep meat, 35 per cent of poultry, 40 per cent of pork, 15 per cent of milk and 10 per cent of eggs in East Africa. According to the World Bank, Africa lags behind other farming systems in terms of average output and yet the mixed farming contributes to 75 per cent of the meat and milk in the continent.¹⁰⁸ This implies that numerous numbers of range lands are not as productive as they should be.

2.4.4 Mobile Technology

Technology has permeated each and every sector and livestock management is not an exception.¹⁰⁹ It is becoming the norm for farmers to communicate and negotiate their prices with various buyers through the use of mobile technology.¹¹⁰ The same technology has also

¹⁰⁶MacMillan, S.(2019).*Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

¹⁰⁷Ibid, (2019), p. 11.

¹⁰⁸ Ibid, (2019), p. 13.

¹⁰⁹Okello, M.(2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

¹¹⁰MacMillan, S.(2019).*Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

been adopted and made it easy for farmers to order farm and other livestock inputs at a very fast, easy and cost effective price. Mobile phones are a great tool to pastoral farmers in the twenty-first century. With a myriad of Applications (APPs) now even the remotest of villages can receive messages about the weather pattern, can acquire accurate positions of water holes, can immediately know what's happening in the market and even can be a tool for warning systems and many more other functions that these gadgets can offer.¹¹¹

2.4.5 Information Systems

In Kenya, ILRI in conjunction with the Kenyan government has created an app that lets farmers know prices to their goods in real time. The main objective of the National Livestock Markets Information System (NLMIS) is to expand market access for livestock farmers and traders. The NLMIS brings down the cost of doing business by locking out brokers, now information is at the palm of their hands.¹¹²

It should also be noted that trade in livestock involves a copious amount of cash and this makes these farmers become targets for bandits and thugs but with today's mobile money transfer such transactions have been made more secure. Finances or the lack thereof is a real problem in livestock production throughout the whole continent of Africa. Governments have tried to initiate funding to livestock services but they are usually far in between and a little bit a little too late.¹¹³ Private lending has hardly penetrated into the marginal areas and this is where a great deal of livestock rearing and production.

¹¹¹Okello, M.(2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

¹¹²Ibid, (2014), p. 70.

¹¹³United Nation. FAO, (2019). *The Future of Livestock in Kenya*. Opportunities and challenges in the face of uncertainty. Rome, pp. 56-58.

2.5 Chapter Summary

This section found that a big part of raising livestock is there has to be the availability of pasture and water. From this fact it can be deduced that climate change will definitely affect how livestock will be reared in the coming years. Climate change will have a direct effect on the livestock by affecting development and fertility and also an indirect effect by affecting the environment around the animals. This will of course affect production and therefore affect incomes.

This section posits that best solutions will be found at the local level because it is at the local level where the pastoralists and farmers do the actual practice. Improving productivity per animal through such simple initiatives like record keeping, enhancement of breed development, proper management and utilization of forage resources are some of the best practices for the pastoralists and farmers.

CHAPTER THREE

THE LINKAGE BETWEEN LIVESTOCK MANAGEMENT AND ENVIRONMENTAL SECURITY IN KENYA

3.0 Introduction

It is worth pointing out that in reviewing the emerging livestock management challenges in Eastern Africa, the previous chapter found that one of the most major hindrances to increased animal production in the East African region is the increased occurrence of animal diseases especially what is considered as transboundary animal diseases, such as food and mouth disease. It is based on this that this chapter purposed to establish the linkage between livestock management and environmental security in Kenya.

3.1 Ecological Changes and Environmental Security

Worldwide ecological change through the perspective of human security interfaces such issues as softening ice tops and carbon outflows to value, conflict, and poverty.¹¹⁴ The security measurement of environmental change is clearer than any time in recent memory, the issue is still not being tended to by the global atmosphere administration; neither does it have any legitimate drive or support.¹¹⁵ Be that as it may, states, associations and different studies and reports keep highlighting the issue, and a few nations are enforcing improvements to their national strategies to oblige these worries and dangers.¹¹⁶

The United Nations Security Council has committed two sessions to the security danger posed by environmental change. Interestingly an evaluation report of the Intergovernmental Panel on Climate Change devoted a whole chapter to human security and

¹¹⁴Ibid, (1999).

¹¹⁵Spoooner, B. (2010). *Climate Change and Conflict in Africa: Implications for Pan-Africa Strategy, A Desk-Based Study Commissioned by the Department for International Development Africa Regional Department and Africa Conflict and Humanitarian Unit*. Global Impacts Limited, Kent.

¹¹⁶Ibid, (2006).

as of late distributed United States Department of Defense Adaptation Roadmap which states that climate change poses an immediate threat to the national security, approaching the military to fuse environmental change into broader strategic thinking about high-risk regions.¹¹⁷

Ecological security progressively got to be essential in security issues, because of the development of new contemporary dangers, for example, the expansion of total populace, water shortages, groundwater consumption, debasement of arable land, loss of tropical backwoods and substantial increases of GHG emissions.¹¹⁸ Environmental degradation, discriminatory access to the natural resources and across border transport of unsafe materials can prompt clash and represent a danger to the national security and human health.¹¹⁹ Yet the dangers that natural change stances to the human security are yet to be whisked out.¹²⁰ The size of utilization and contamination in advanced, high-vitality social orders have brought on vast abatements in essential woodland spread; biodiversity misfortunes; exhaustion of fish stocks; land debasement; water contamination and shortage; beach front and marine corruption; the tainting of individuals, plants, and creatures by chemical substances and environmental change and ocean level ascent.¹²¹

Environmental changes are “global” in light of the fact that they are pervasive and experienced everywhere regardless of the location.¹²² A number of states are encountering

¹¹⁷Ibid, (2006).

¹¹⁸United Nation. FAO, (2019). *The Future of Livestock in Kenya*. Opportunities and challenges in the face of uncertainty. Rome, p. 62.

¹¹⁹Spooner, B. (2010). *Climate Change and Conflict in Africa: Implications for Pan-Africa Strategy, A Desk-Based Study Commissioned by the Department for International Development Africa Regional Department and Africa Conflict and Humanitarian Unit*: Global Impacts Limited, Kent.

¹²⁰Griggs, D. (2013). *Sustainable development goals for people and planet, Nature*, Vol. 395pp. 305-307.

¹²¹Spooner, B. (2010). *Climate Change and Conflict in Africa: Implications for Pan-Africa Strategy, A Desk-Based Study Commissioned by the Department for International Development Africa Regional Department and Africa Conflict and Humanitarian Unit*: Global Impacts Limited, Kent.

¹²²Griggs, D. (2013). *Sustainable development goals for people and planet, Nature*, Vol. 395, pp. 305-307.

significant difficulties to their regional respectability, including little island states and different states very defenseless against rise in sea level.¹²³ Some transboundary effects of environmental change, for example, changes in ocean ice, shared water assets, and the relocation of fish stocks, can possibly build contention among states. The nearness of powerful organizations can oversee a significant number of these competitions with the end goal that human security is not extremely eroded.¹²⁴

Globally analysts have posited several pathways by which environmental factors could contribute to political conflicts. Expanded interest, driven by populace development or financial improvement, or declining supply, driven by overexploitation or ecological change, could make shortages of key natural resources, creating rivalry and competition between affected countries or communities.¹²⁵

According to Food and Agriculture Organization of the United Nations, the wealth in specific regions of exceptionally significant common assets, for example, oil fields or precious stone mines may render these zones an objective for battling powers, whether neighbouring countries or trying to misuse the assets for revenue.¹²⁶ It is vital to acknowledge that serious and constant ecological weights, for example, dry spell, or sudden intense catastrophes, for example, surges, may dislodge exile populaces from one district into another, straining nearby limits and conceivably beginning conflicts between the sending and receiving communities.¹²⁷

¹²³FAO (Food and Agriculture Organization), (2006). *The state of food insecurity in the world, 2006: Eradicating world hunger, taking stock 10 years after the World Food Summit*, Rome.

¹²⁴United Nations, *Population Distribution, Urbanization, Internal Migration and Development: An International Perspective*, (2011), p. 10.

¹²⁵FAO (Food and Agriculture Organization. (2006). *The state of food insecurity in the world, 2006: Eradicating world hunger, taking stock 10 years after the World Food Summit*. Rome.

¹²⁶Ibid, (2006).

¹²⁷Griggs, D. (2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

Allan Savory, in his “Holistic Management” concept, argues against the accusation that livestock shares part of the blame for environmental degradation and desertification witnessed over the years. He promotes systems thinking approach to managing resources and advocates clustering and moving livestock to what he claims mimics nature as a way of healing the environment. This concept is premised on timed grazing rotation and argues that overgrazing is often caused by leaving cattle too long in an area and returning to the same field too soon and that herd size does not really matter. The whole idea is to mimic nature at its virgin stages of regeneration, before man intervened and created his own cycles.¹²⁸

It is worth appreciating that livestock as a sector is also affected by climate change on the one hand and is also acknowledged to contribute to climate change through emission of greenhouse gases on the other. Livestock production is affected by climate change both directly and indirectly. The effects are seen in the area animal productivity, forage yields, animal health and biodiversity. In Kenya the impact of climate change on animals is seen both in the loss in productivity and in extreme cases, may threaten the survival of the very animals. It is a documented fact that elevated heat beyond the normal range of ambient temperature depresses feed intake in animals. This consequently will result in depressed productivity.

3.2 Livestock Production and the Environment in East Africa

In the East African context, in recent times there has been a great increase in food insecurity in pastoral areas of the region as a result of a combination of factors, ranging from environmental change, and increase in population, under investments, poor livestock management and the general neglect of pastoral areas.¹²⁹ In addition, there have been

¹²⁸ Allan Savory, *Holistic Resource Management*. Island Press. 2001.

¹²⁹ Muchemi, S. (2005). *Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, pp. 8-12.

increase settlements in pastoral areas, particularly around fixed water points.

It is crucial to appreciate that livestock rearing or farming can be damaging to the environment. It can be so in many different ways, for instance, biomass degradation, releasing of carbon-based gases into the atmosphere, contamination of water sources and so forth. But recent modern science is trying to change that by ensuring that livestock systems work in an eco-friendly way yet still be economically viable.¹³⁰ It is a challenge to have such systems that are both economically viable and eco-friendly as statistics show that Feed production processing contributes to about forty five percent and enteric fermentation (this describes a process in which the green forages are digested and broken down in to small molecules by micro-organisms in the stomach of ruminants, a by-product of which is the methane gas) of feed contributes to 39 percent of the total emissions from agriculture.¹³¹

The effects of environmental change and associated extreme weather events threaten sustainable development and impacts negatively on the livestock sector. In addition, flooding and droughts affect effective production of food, supply of water, effective rearing of farm animals and the livelihood of farmers.¹³² Such developments can prompt expanded pressures in getting zones if not tended to, especially when assets are as of now rare or strained in these regions. The occasional relocation of pastoralists has as of now been influenced by environmental change, bringing expanded rivalry between pastoralist bunches, additionally amongst pastoralists and stationary agriculturists (also generally referred to as sedentary agriculturalists, those who farm and live in the same place without periodically moving out to look for better environments like the nomadic pastoralists).¹³³

¹³⁰Ngaira, K. (2014). *Basic facts in contemporary climatology*, Lake Publishers and enterprises, Kisumu County, Kenya, p. 9.

¹³¹Ibid, (2014), p. 22.

¹³²Kinyua, T. (2004). achieving food security in Kenya. In assuring food security and nutrition security in Africa. Conference proceedings, IFRI, Kampala, Uganda.

¹³³Spooner, B. (2010). *Climate Change and Conflict in Africa: Implications for Pan-Africa Strategy, A Desk-*

Environmental security as a concept examines how the survival of individuals, communities or nations is threatened by environmental changes.¹³⁴ Through the study of environmental security over the last four decades it has been documented.¹³⁵ It is worth acknowledging that approximately twenty to sixty per cent of the herds in sub-Saharan Africa were lost during the serious drought events in the past two to three decades. Studies also found that dairy yields in a South African herd could decrease between 10 – 25 per cent under certain climate change scenarios.¹³⁶ On the side of animal health, some of the effects of climate change have been documented. For instance, one such impact which regularly affects Kenya are the outbreaks of Rift Valley Fever, and other blood sucking insects. This is a disease which affects cattle, sheep, goats, camels and buffaloes. Outbreak are associated with increased rainfall and flooding due to *El Nino*, associated with climate change.¹³⁷

3.3 Livestock Management and Environmental Security in Kenya

It is worth noting that over the last two decades productivity has increased in the livestock farming sector whether you consider in terms of per acreage of land used, labor or output of livestock itself.¹³⁸ Livestock can be viewed as a utility tool at the farm, providing it with renewable energy through bio fuels which are cheaper than other carbon based fuels and no energy is needed to manufacture.¹³⁹ A good example to describe the above mentioned

Based Study Commissioned by the Department for International Development Africa Regional Department and Africa Conflict and Humanitarian Unit. Global Impacts Limited, Kent.

¹³⁴United Nation. FAO, (2019). *The Future of Livestock in Kenya. Opportunities and challenges in the face of uncertainty.* Rome, pp. 56-58.

¹³⁵Ibid, (2019), p. 65.

¹³⁶United Nations. FAO, (2019). *The Future of Livestock in Kenya. Opportunities and challenges in the face of uncertainty.* Rome, pp. 68-71.

¹³⁷Ibid, (2019), p. 73.

¹³⁸Ibid, (2010).

¹³⁹Githeko, A.K. and Ndegwa, W. (2001). *Predicting malaria epidemics in the Kenyan Highlands using climate data: a tool for decision-makers.* Global Change and Human Health,): pp. 54-63.

situations is that it takes 6.3 times more energy using a tractor to prepare soy beans seed bed when sowing than using a farm animal.¹⁴⁰

Kenya has taken some steps to cushion farmers against the vagaries of climate change.¹⁴¹ It's the first non LDC countries to have formalized plans on how to deal with effects of climate change throughout all major sectors of the economy.¹⁴² For instance, half a decade ago, the Ministry of Environment and Mineral Resources, Ministry of Agriculture came up with a five-year Natural Resources Management Program (2010-2014) whose overall objective was poverty reduction and to safeguard the environment and enable sustainable growth and development as envisioned in the vision 2030 document.¹⁴³ The UN looks at ethics in this matter as a matter of concern for animals' welfare in their treatment, habitat and even slaughter but it also takes concern for the human outlook for safety, that is, is the food being served to a person fit for their consumption and so forth.¹⁴⁴ In these issues there are four main areas of concern.¹⁴⁵

3.3.1 Health and Safety of Animals and Humans

It is worth noting that the issues of health here deal with both animal and human as it relates to livestock production.¹⁴⁶ Many issues are involved in this topic such as resistance to antibiotics by both animals and humans; livestock transportation is also a matter of health,

¹⁴⁰Ibid, (2001), p. 66.

¹⁴¹Ayaga, K and Njenga, M.(2005).*Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series., pp. 4-8.

¹⁴²Ngaira, K.(2014).*Basic facts in contemporary climatology*, Lake Publishers and enterprises, Kisumu County, Kenya, p. 9.

¹⁴³ Ibid, (2014), p. 9.

¹⁴⁴Ayaga, K and Njenga, M.(2005).*Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

¹⁴⁵Griggs, D. (2013).*Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

¹⁴⁶ Ibid, (2005), p. 10.

especially as it pertains to the animal, eradication of infectious diseases and so forth.¹⁴⁷

3.3.2 The Integrity of the Livestock

The three things that are crucial to the quality of life of an animal are robustness, dignity and integrity.¹⁴⁸ This will of course involve considerations of the specific needs of specific animals. Free range rearing is best at ensuring an animal has adequate quality of life but in many production systems this is deemed as not feasible.¹⁴⁹

3.3.3 Environmental Concern

This section posits that there are two aspects to environmental concerns here. First, the animals must be handled in such a way that they don't leave contagion around its environment. These are things like noise, solid waste, dust or pathogens. The second aspect is that the production process does not physical harm or degrades the environs. This could be done through disseminating biodiversity or prevention of degradation.¹⁵⁰

3.3.4 High Livestock Performance

One of the modern family methods is the adoption of modern and high livestock performance breeds. The livestock production systems in developing states range from traditional stallholder livestock-keeping system to large highly productive commercial enterprises and it is important that farmer start adopting high performance livestock.¹⁵¹ The high livestock performance results in much higher yields that can make a higher, much needed and greater contribution to livestock products and services.

¹⁴⁷MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

¹⁴⁸Griggs, D. (2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

¹⁴⁹Ibid, (2013), p. 321.

¹⁵⁰MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 19.

¹⁵¹Ayaga, K and Njenga, M. (2005). *Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

3.4 Adaptation to Livestock Production and the Environment

It is worth stating that as has been mentioned in the previous chapters in this study, livestock farming has a lot of benefits both for humans and the environment.¹⁵² A few livestock systems are quite adapted to carbon sequestration and are therefore good for the environment.¹⁵³

Animals reared by humans undergo various challenges. One of the most fascinating is heat stress.¹⁵⁴ Adaptation is defined as the “morphological, anatomical, physiological and biochemical characteristics of the animal which promote welfare and favor survival in specific environment.” But when it comes to specifically temperature challenges, a higher rate of mortality is observed in the population.¹⁵⁵

3.4.1 Range Land Conservation

Rangeland management refers to a practice whose aim is to ensure a sustained yield of rangeland products while protecting and improving the basic range resources of soil. It is worth noting that range land animal rearing is a popular way of raising livestock. It works on a system of harvesting the sun energy and converting it into different sources of energy for different species. The primary harvester of the sun’s energy is the foliage which is consumed by the livestock and the livestock fertilizes the foliage with manure and humans consume the livestock and crops for sustenance.¹⁵⁶ This sort of energy harvesting requires very little carbon energy input, but the ecosystem has to be balanced and maintained.

¹⁵²Spooner, B. (2010). *Climate Change and Conflict in Africa: Implications for Pan-Africa Strategy, A Desk-Based Study Commissioned by the Department for International Development Africa Regional Department and Africa Conflict and Humanitarian Unit*: Global Impacts Limited, Kent.

¹⁵³MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 19.

¹⁵⁴Ibid, (2019), p. 23.

¹⁵⁵Griggs, D.(2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

¹⁵⁶Ibid, (2013), 311.

3.4.2 Climate-Smart Agriculture

In order to successfully deal with climate change challenges in the wake of livestock production, several climate-smart options are available for land-based systems (that is systems depending mainly on grazing).¹⁵⁷ Other interventions include use of biogas digesters which enables the trapped methane gas to be used for energy production; use of zero-tillage technologies establish pastures and fodders, among others.

Currently, there are two projects being implemented in the MoALF and were designed in compliance with the Kenya Climate Smart Agriculture Implementation Framework (KCSAIF). These programmes are Kenya Climate Smart Agriculture Programme (KCSAP) and National Agriculture and Rural Inclusive Growth Programme (NARIGP), both supported by the World Bank and cover most counties in Kenya.

3.4.3 Traditional Grazing Patterns.

Pastoralists in most of the eastern African countries had evolved coping mechanisms in terms of pasture management which saw them access pastures throughout the year before the climate change phenomenon disrupted the weather patterns. The concept of dry – season grazing areas and wet – season grazing areas ensured forage availability through all the seasons. In the ranches and agro-pastoral areas, rotational grazing is also practiced whereby paddocks are rotationally utilized and also given rest to rejuvenate. It has some advantages: it improves the quality of the foliage, improves productivity of the system and reduces carbon emissions per unit of live weight gain. This type of grazing is suited more for pasture systems, where the major expenses being fencing, digging watering holes, management and labor can be quickly recouped.¹⁵⁸

¹⁵⁷Ibid, (2013), p. 313.

¹⁵⁸MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 19.

3.4.4 Livestock Breed Manipulation

Crossbreeding programs can bring about simultaneous adaptation, food security and mitigation benefits. For example, composite cattle breeds in northern Australia have shown greater resistance and development than the already existing short cattle breeds. In short crossbreeding of indigenous breeds picked out for an advantageous trait will become more necessary in the future to combat the effects that climate change will bring. Another strategy to combat climate change is seen in form of switching of livestock species. The 2005-2006 drought caused the pastoralists' herds of cattle, goats and sheep to fall by 30% in just one year, leaving 80% of all Kenyan pastoralists dependent on international food aid.¹⁵⁹

3.5 Chapter Summary

This section of the study found that mismanaged livestock producing systems are a danger not only to human health but they can degrade the land and deplete foliage which is generally bad for the environment and may lead to desertification. On the other hand, these sorts of system may be good for the ecosystems depending on the variety of species being reared and the specific location of the world that one may be in.

This chapter posits that strategies employed to curb GHG emissions should be mitigated against the need to sustainably produce enough food for the ever increasing world population. Such strategies include rehabilitation of denuded pasture lands through reseeded programs, improving productivity per animal, investing in research for pursuit of high quality feeds, proper manure management include embracing of such technologies like biogas, improving efficiency of food processing plants, among others. It has also been established that swine lots and beef ranches exude the most amount of methane emissions, mainly due to the intensity of their systems being so high because of demand for these products.

¹⁵⁹Ibid, (2019), p. 25.

CHAPTER FOUR

THE KEY ACTORS AND STRATEGIES OF EFFECTIVELY ADDRESSING LIVESTOCK MANAGEMENT CHALLENGES IN EAST AFRICA

4.0 Introduction

In seeking to establish the livestock management and environmental security in Eastern Africa using a case study of Kenya, this chapter deliberately reviews the key actors and strategies of effectively addressing livestock management challenges in Kenya. The results of the study were presented in form of pie charts, bar graphs, frequency tables and narrative form. This study aims at contributing to effective policy making informed by provision of deeper understanding on key actors and strategies of effectively addressing livestock management challenges in Kenya.

4.1 Respondents Profile and Return Rate

The field data was collected, synthesized, sorted, and then analyzed using content analysis, thematic and document analysis techniques. It is worth noting in this section that the final texts, tables and graphics used complemented each other in providing a clear reporting of the research finding, in addition, the analyzed deductions were ultimately bounced against existing scholarly literature to accurately corroborate the research findings.

This section found that a total of 35 respondents successfully completed the interview guide, out of 50 initially administered for the study and thus this represented 70 percent return rate which this research considered adequate for the analysis, as the sample size remained as close to the original size as possible. The viable respondents captured were coded in numerical numbers ascending order from the 1st to 35th participant respectively.

Table 1: Participants response rate

Serial	Organization	Frequency
1.	Agricultural and Livestock Research Organization	3
2.	College of Agriculture and Veterinary Sciences	2
3.	County Commissioners	4
4.	Dairy Training Institute	2
5.	Directorate of Livestock Production	5
6.	International Livestock Research Institute	2
7.	Kenya Climate Smart Agriculture Program	2
8.	Kenya Institute for Public Policy Research and Analysis	1
9.	Kenya Livestock Marketing Council	2
10.	Kenya Wildlife Services	1
11.	National Agricultural and Rural Inclusive Growth Project	4
12.	National Intelligence Service	3
13.	Regional Pastoral Livelihood Support Program	1
14.	University of Nairobi	2
15.	World Agro-forestry Centre	1
	Grand total	35

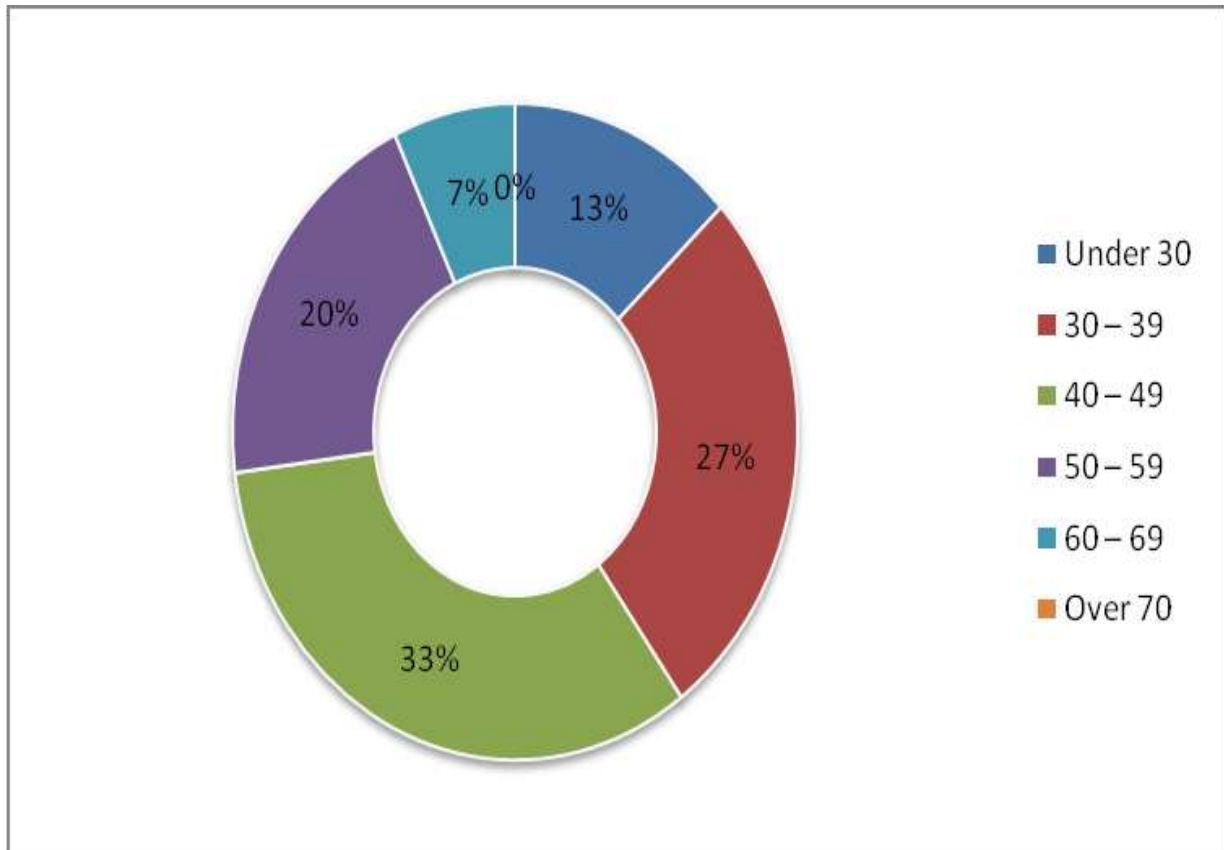
Source: Field data (2020)

The table shows the final outcome of the participants who took part in the study, and this is an indication that most targeted participants were subject matter experts, thus they were considered viable and fit for the research study with the majority coming from Directorate of Livestock Production in the Ministry of Agriculture.

4.1.1 Respondents by Age in Years

The respondents were asked to indicate their age distribution.

Figure 1: Respondents by age



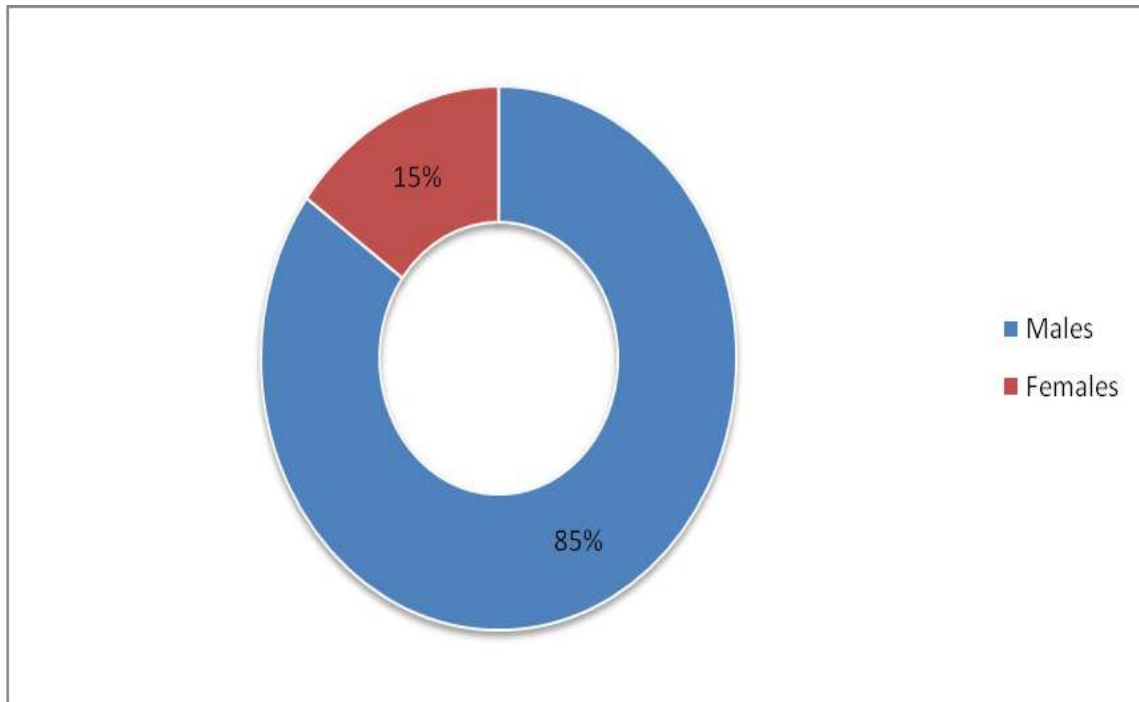
Source: Field data (2020)

The outcome showed in Figure 1 indicates that the age distribution found was higher among the respondents in age group 40-49 years at (33%), an indicating that most were mature, reliable informants and had a good grasp of the subject matter under research.

4.1.2 Respondents by Gender

The respondents were asked to indicate their gender distribution.

Figure 2: Respondents by gender



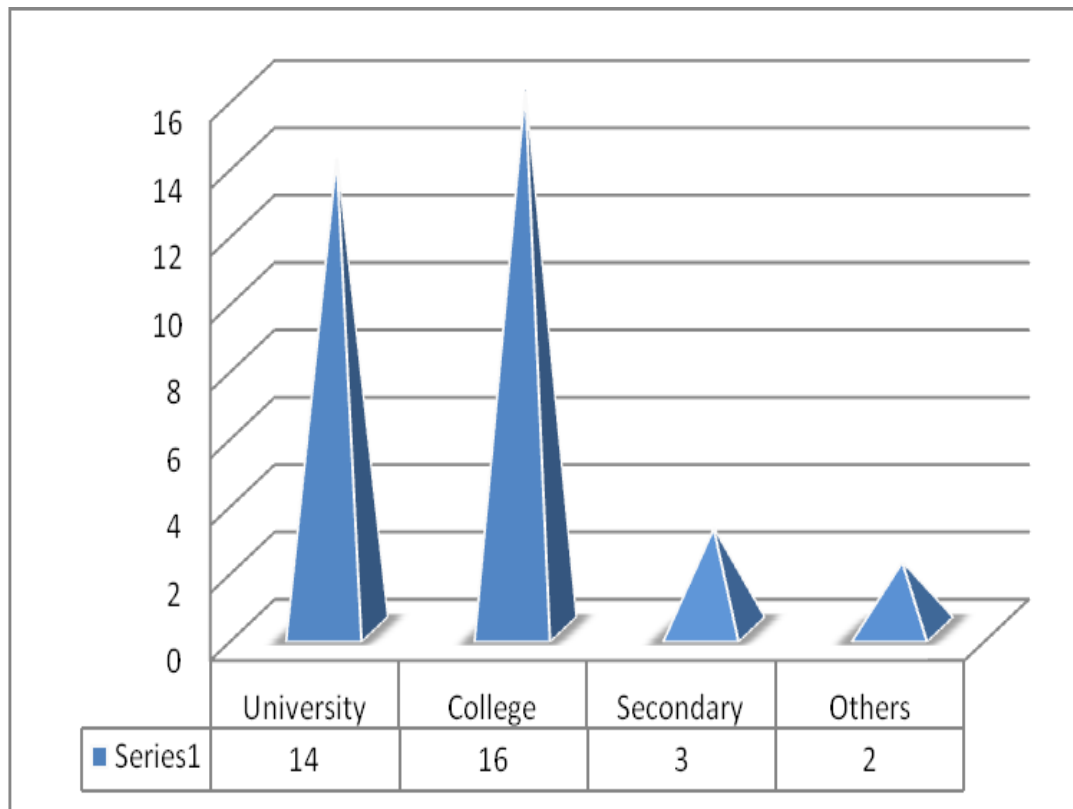
Source: Field data (2020)

The outcome showed in Figure 2 indicates that the gender distribution found was highest in males (85%) than females (15%), indicating that males more accessible at the time of study.

4.1.3 Respondents by Education

The education level of the targeted respondents was determined and the response shown in Figure 3.

Figure 3: Participant education level



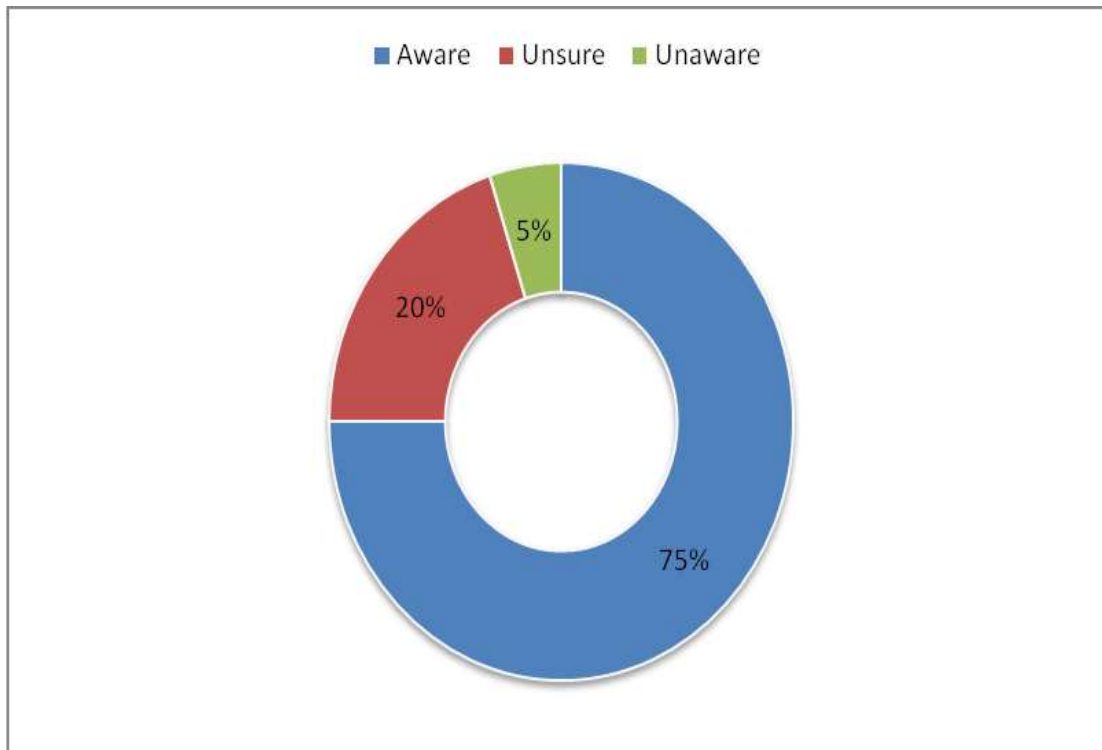
Source: Field data (2020)

This study demonstrated education level of respondents Figure 3 shows that majority of the participants education was college (16), university (14), secondary (3) and others (2) respectively, indicating that they were all fairly exposed to some degree to the topic of study.

4.1.4 Conceptualization of concept

The concepts considered in this research for the responded to articulate matters of livestock and environmental climate changes initiatives as a concept.

Figure 4: Respondents by awareness



Source: Field data (2020)

The respondents were probed on the concept of soft power and the results showed those aware comprised (75%), unsure (20%) and unaware (5%) as illustrated in Figure 4.

4.1.5 Linkage of Concepts under Study

The concepts considered in this study for the respondents to articulate included; climate change and human security, conservation measures adopted to tackle climate change and mountain forests. This study made a direct correlation between environmental protection and human security. Aspects of human security like protection of information and democratically letting this information be available to the public also has the effect of letting the public utilize their environmental resources more responsibly.¹⁶⁰

It is thus worth mentioning that the study found that (90%) of the respondents appreciated climate change concept. Most (99%) stated that climate change will lead to new challenges to nation-states and will increasingly shape both conditions of human security and national security policies. Physical aspects of climate change, such as melting of ice caps in Mount Kenya, extreme conditions like flooding, desertification, harsh climatic condition, and hydrologic cycle disruptions which pose major challenges to vital transport, water, and energy infrastructure¹⁶¹ The inter-connectedness of environmental change, water assets, desertification and biodiversity misfortune, for instance, makes secluded administration reactions insufficient and conceivably counterproductive.¹⁶²

Africa contains around 1/5 of every single known species of plants, warm blooded creatures, and birds, and additionally 1/6 of creatures of land and water and reptiles. These species make some out of the world's most various and naturally imperative biological communities, for example, savannahs, tropical timberlands, coral reef marine and freshwater living spaces, wetlands and different environments.¹⁶³ The universally imperative biological

¹⁶⁰ FAO (Food and Agriculture Organization), 2006. The state of food insecurity in the world, 2006: Eradicating world hunger, taking stock 10 years after the World Food Summit. Rome: FAO.

¹⁶¹ FAO (Food and Agriculture Organization), 2006. The state of food insecurity in the world, 2006: Eradicating world hunger, taking stock 10 years after the World Food Summit. Rome: FAO.

¹⁶²Ibid, (2013), p. 317.

¹⁶³Griggs, D. (2013). *Sustainable development goals for people and planet*, *Nature*, Vol. 395, pp. 305-307.

communities give the economic foundation that numerous Africa nations depend on by giving water, nourishment, and safe house. In any case, in view of environmental change, these biological communities and the employments that rely on upon them are debilitated. The point of this report is to highlight a portion of the significant effects of environmental change on preservation for East Africa nations including Kenya, Tanzania, Uganda and Rwanda.¹⁶⁴

The security ramifications of environmental change are of expanding pertinence to worldwide peace and security. Continents, like Africa, where adaptation instruments are feeble or uncoordinated, are particularly helpless against uncertainty identified with water, sustenance, vitality, and natural calamities.¹⁶⁵ This will be a noteworthy test for African nations as well as worldwide accomplices required in environmental change relief and adaptation endeavors.

In Africa, climate specialists caution particularly about changing patterns of rainfall and their prompt effect on grain yields, runoffs, water accessibility, and the survival of plant and creature species. Long haul changes in the examples of temperature and precipitations, that are a piece of environmental change, are relied upon to move creation seasons, adjust productivities, and alter the arrangement of practical harvests. Where these effects experience restricted versatile limit and unsustainable asset administration hones, the outcomes are more extensive and steadier nourishment (food) insecurity.¹⁶⁶

¹⁶⁴ Norman, M.(2004).*Consultant in Environment and Development, Special Advisor to The Hague Conference on Environment, Security and Sustainable Development*, p. 1.

¹⁶⁵ Ibid, (2004), p. 8.

¹⁶⁶ Norman, M.(2004).*Consultant in Environment and Development, Special Advisor to The Hague Conference on Environment, Security and Sustainable Development*, p. 3.

Environmental change will probably prompt generous changes in precipitation designs, including more occasional dry spells, floods, and storms. The sub-tropical zones have turned out to be more bone-dry, and desertification proceeds in the Sahara. The estimated higher surface temperatures will build vanishing rates, making water progressively rare and Water Security flimsy, thus firmly influencing human security and expanding the danger of water-related clashes. The population in Africa encountering water scarcity may increase by 75 million by 2020 and a few hundred million by 2050.¹⁶⁷

In the Kenyan perspective, one cannot assume that environmental change alone will prompt mass movement; it is normal that the larger part of natural relocation and removal will be inward or near circumscribing nations (universal movement).¹⁶⁸ In the early and middle of the road phases of ecological corruption, relocation is prone to be brief, round, or occasional in nature. In the meantime, when ecological corruption gets to be extreme or irreversible, for case, because of ocean level ascent, movement can get to be changeless and may require migration of influenced populaces, either inside or in another nation.¹⁶⁹

The findings of the study were in alignment with Adan and Naylor, who stated that in the East Africa context, resource based violent conflicts have been and continue to be experienced up to the present time. These violent resource based conflicts have had negative and severe impacts on the communities that are involved.¹⁷⁰ However, as competition increases for access to land, water and other natural resources, these conflicts have intensified, and new resource based conflicts, with governments, mining companies and national parks, have now emerged.

¹⁶⁷Muchemi, S.(2005).*Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, pp. 8-12.

¹⁶⁸Griggs, David.(2013).*Sustainable development goals for people and planet, Nature*, Vol. 395, pp. 305-307.

¹⁶⁹ Norman, M.(2004). *Consultant in Environment and Development, Special Advisor to The Hague Conference on Environment, Security and Sustainable Development*, p. 4.

¹⁷⁰ Adan, D. and Naylor, R, (2002). *Building sustainable peace; conflict, conciliation and civil society in Northern Ghana*, pp. 6-9.

4.2 Environmental Security and Livestock in Kenya

Okello is of the view that if farmers are aware of temperature trends they will be able to make informed choices about their rearing of livestock but his opinion is a little bit hollow considering the majority of livestock farmers are of small holdings and do not have resources to do much about climate change.¹⁷¹ Okello should know that adaptation by farmers to make their animals be able to handle change in climate will not only need know how but also infrastructure which many of these farmers cannot afford.¹⁷²

In many African nations livestock farming is a way of earning necessary money for sustenance and there is also a trend amongst African governments to use animal farms as a scheme for poverty alleviation. And this does not only apply to rural households but as seen in Kenya many urban households do supplement their income through the trade of livestock or their byproducts of either milk, honey or leather.¹⁷³

In the East African region, mixed farming is usually observed in areas with high population densities and the farm holdings have become small to support traditional type of farming. This usually involves intense crop growing with limited number of herds that supplement the income through dairy trade, sell of manure and crop residue.¹⁷⁴ This type of farming has proven to be more profitable in east Africa than even cash crop farming as its returns are consistent and not amended haphazardly by international market prices and crop residue which is used as fodder is just as profitable as the rest of the produce on the farm.

¹⁷¹ Okello, M.(2014).*Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya*. Journal of Sustainable Tourism, pp. 54-61.

¹⁷² Braden, A.(2000).*Environmental Security*. Concept and implementation. Vol. No 1, p. 5.

¹⁷³ Muchemi, S.(2005).*Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, pp. 8-12.

¹⁷⁴ Norman, M.(2004). *Consultant in Environment and Development, Special Advisor to The Hague Conference on Environment, Security and Sustainable Development*, p. 4.

It is argued by specialists that the contribution of livestock production to the Gross Domestic Product of east African economies is grossly underrated. It is clearly seen by the under reporting of milk revenues from the Kenyan market. It is estimated that about 5 per cent of milk produced in Kenya is never captured by official statistics which mostly come from small holdings.¹⁷⁵ According to IGAD livestock policy brief, Kenya's agriculture uses about 16% of available land, most of it done on a small scale proportion and the remaining 84% of land mass is not viable for any type of agriculture. About 60 per cent (over 10 million) of the country's livestock herd is found in the Arid and Semi Arid land (ASAL) which is a major source of beef in the country.¹⁷⁶ Some of the advantages of rearing livestock are milk, meat, leather and they are used many a time in cultural practices.¹⁷⁷

Climactic conditions in the arid and semi-arid areas force farmers to engage in extensive agro-activities which usually put more of a strain on other environmental aspects. In many of these areas pastoralism is the key agricultural activity.¹⁷⁸ Their animals have significance in all aspects of their lives, whether it be cultural, economic or social. They use their animals for trade, dowry payments, celebration of religious festivals and as a sign of a person's standing within the community.¹⁷⁹ Specific breeds of animals are usually found in these areas since they can stand or even thrive in these environments.

¹⁷⁵Muchemi, S.(2005).*Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, pp. 8-12.

¹⁷⁶Ayaga, K and Njenga, M.(2005).*Policy prospects for urban and peri-urban agriculture in Kenya*. Policy Dialogue Series, pp. 4-8.

¹⁷⁷ Ibid, (2005), p. 12.

¹⁷⁸Catherine, M. (2009).*Climate Change Science Compendium*, UNEP, p. 57.

¹⁷⁹MacMillan, S., (2019)*Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 9.

4.3 Key Actors of Addressing Livestock Management Challenges in Kenya

It is important that matters of livestock involve both state and non-state actors, but it is important to appreciate that in some livestock dominated areas of Eastern Africa, insecurity is already a major threat to sustainable livelihoods.¹⁸⁰ In seeking out key actors in livestock management.¹⁸¹

State actors are also largely involved in formulating policy in matters that are concerned with food production and livestock management.¹⁸² Sayer and Cassman are of the opinion that in many developing nations the demand for livestock products has peaked even though methods for processing these products have improved and in many cases have become sustainable.¹⁸³ In developing states, the livestock industry could be hit hard in the future by legislation and consumption curtailed by socio economic factors and health reasons.¹⁸⁴ This has created some anxiety in the world market in terms of future employment and the health of the largest stock markets in the world.

In north western Kenya, the Turkana usually plant low input sorghum along river banks and harvest according to the seasonal climactic conditions and some of this produce is used to feed their animals. All of this was been done at a subsistent level until intense commercialization of livestock began which forced the Turkana to be a little bit more conscious of their crop production methods. Disadvantages of livestock production in Africa are usually low market access and volatile prices.

¹⁸⁰Abu Hatab, Assem and Eduarda, Maria. *Urbanization, livestock systems and food security in developing countries: A systematic review of the literature*, (2019), Volume 11, Issue 2, pp. 279-299.

¹⁸¹MacMillan, Susan. *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, (2019), p. 9.

¹⁸²Dube, L., Pingali, P., and Webb, P., (2012). *Paths of convergence for agriculture, health and wealth*. Proc National Academy Science, p. 112.

¹⁸³Sayer, J. and Cassman, K. *Agricultural innovation to protect the environment*. Proc National Academy of Science, America, (2013), p. 824.

¹⁸⁴Ibid, (2012), p. 109.

4.4 The Key Strategies of Addressing Livestock Management Challenges in Kenya

It is worth noting that due to livestock management and environmental security in Eastern Africa issues, particularly in Kenya, it is best to have other strategies, like weather indexed livestock insurance schemes. Kenya has been piloting an index-based livestock insurance scheme in certain select ASAL counties namely Wajir, Garissa, Turkana, Mandera, Samburu, Marsabit, Tana River and Isiolo. This ‘index-based’ insurance scheme works by compensating livestock farmers when forage in a particular area diminishes and they end up losing some of their livestock due to drought. Satellite imaging helps in determining the annual amount of forage a particular area usually has and this influences the determination of premiums to be paid. Satellite imaging also determines if forage in an area has been substantially depleted. Payouts to insured farmers don’t have to necessarily be made when their livestock dies but in the event that forage in an area falls below what the farmers’ animals can be sustained by.¹⁸⁵

The demand for animal-based foods around the world will increase exponentially rise by 2050. It is estimated that it might increase by up to 70 per cent and this means advanced technologies will have to be used not only to produce product that will meet demand but also to mitigate the effects that such kind of intense farming will have on the climate. In the past decade genomic selection has been introduced in several major livestock species and has more than doubled genetic progress in some.¹⁸⁶

Grazing is done best when livestock farmers collaborate and therefore can come up with the right balance on how best to graze their animals in different seasons and how to rotate their animals in different sections of their land in order to avoid over grazing. This eventually leads to high yields in fodder production and the animals adapt to their

¹⁸⁵Ministry of Agriculture, Livestock and Fisheries. (2019). *Kenya Livestock Insurance Program - Project Document* (2019).

¹⁸⁶Ibid, (2019).

environment much better. Climate change is clearly a threat to all those involved in the livestock supply chain as explained several times in this study. This is especially true where stocks are kept at a minimum and there are no buffers in case of price hikes.¹⁸⁷ It could adversely affect landless systems due to its nature of relying on transportation and this is the stage the animals could be most vulnerable to diseases. Strategy to act on this is to either let the transport bear the crisis or figure out a way on how to recover quicker. A lot of study is still going into it but insurance companies, supply chains among other stakeholders are working to find a solution together. Also, improved buffer stocks could really help.

Other alternatives to livestock keeping in the ASALs can be found in the acacia trees which are common in dry areas of east Africa and are known to contain a resin called gum Arabic. It is of commercial value but Kenya exports negligible amounts of it so far. The chemicals in the resin have a variety of uses such as in pharmaceuticals, printing, ceramic making, textile and many more. There is no viable synthetic option for the resin and so needless to say its demand keeps going up. There aren't many places that acacia trees grow around the world and the demand for it being global; it is safe to say that most of the supply is consumed. Kenya is at the crossroads of two Arabic gum belts and 80 per cent of its land mass contains trees that produce this resin. The species of acacia we have available are *acacia Senegal* and *kerensis*.

¹⁸⁷Dube, L., Pingali, P., and Webb, P., (2012). *Paths of convergence for agriculture, health and wealth*. Proc National Academy Science, p. 107.

4.5 Chapter Summary

This section found that livestock development should be viewed as part and parcel of national security because of the strategic role it plays in the domain of human security. Livestock is a key component in the attainment of food security, the animal sourced food being described as “nutrient-dense, palatable sources of energy and high-quality protein, also providing a variety of essential micronutrients, some of which are difficult to obtain in adequate amounts from plant-based foods alone”. In other words, to win the fight against world hunger, which has been established that one in nine people suffer from hunger worldwide, majority of which live in developing countries, development of the livestock sector deserves the attention of decision makers world over.

In terms of environmental security, livestock production is seen as both a contributor to environmental degradation as well as a victim of the same. In the pastoral areas, the rising human population, coupled with rising livestock numbers and attempts to practice crop farming have been cited as contributing to land degradation, hence the need to march the livestock numbers with the land potential. Climate change, seen in form of altered weather patterns characterized by severe droughts alternating with flooding accompanied by landslides, affects livestock production through causing death, reduced productivity, resurgence of disease vectors among others. On the other hand, livestock, particularly ruminants, have also been accused of contributing to global warming through emission of GHG by their rumination processes and manure management, yet manure is also necessary for nutrient recycling in the soil.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter of the research acts as the last and final verdict of the study by giving a summary, conclusion and recommendations on the livestock management and environmental security in Eastern Africa using a case study of Kenya.

5.1 Summary

This section found that livestock keepers have to be empowered by having access to vital information that concerns their trade. Whether it be about resistant new breeds or availability of seed for fodder crops, markets available and outreach programs by nongovernmental organizations that concern the welfare of their trade.

In order to address the livestock management and environmental security in Eastern Africa using a case study of Kenya, this research found that it is critical to adopt modern technology in agro-business. This finding was supported by Griggs is of the opinion that an investment in technology is the way forward in promoting small holder livestock producers, especially agro-technology that will enable these pastoralists and farmers are able to harness more of the soil in producing fodder crops and digestible crop residues.¹⁸⁸

This section found that depending whether its mixed farming or pastoralist set up.¹⁸⁹ Kenya government has started an initiative to develop strategic feed reserves in the ASAL counties where large hay storage barns are constructed in strategic areas and pastoralists encouraged to harvest and conserve excess grass after the rains in such facilities.

¹⁸⁸Griggs, D.(2013).*Sustainable development goals for people andplanet, Nature*, Vol. 395, pp. 305-307.

¹⁸⁹Muchemi, S.(2005).*Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, p. 15.

5.2 Conclusion

Generally, it is assumed that animal health is directly related to the state of the environment and the current health of animals in east Africa bears a direct witness to the effects of climate change. Many factors have contributed to the change of livestock systems in the region, some of them include, *inter alia*, demographics, general economic development, environment and climate change, available technologies and knowledge.¹⁹⁰ It is based on this finding that the study concludes that farming of livestock directly affects the food security of the country. Sustainable models are constantly being researched in the region. This type of farming is essential to the nutrition of people in the region as it provides many a family with copious sources of protein which is essential to physical development in humans.

East Africa depends intensely on rain-nourished agribusiness making country occupations and sustenance security very powerless against atmosphere inconstancy, for example, moves in developing artificial weather.¹⁹¹ However on the grounds that temperature has expanded and precipitation in the district has diminished in a few ranges, numerous are as of now being influenced. For instance, from 1996 to 2003, there has been a decline in precipitation of 50-150 mm for every season (March to May) and comparing decrease in long-cycle yields, (for example, gradually developing assortments of sorghum and maize) crosswise over the vast majority of eastern Africa.¹⁹² This study thus concludes that long-cycle crops rely on rain amid this normally wet season and dynamic dampness deficiency brings about low harvest yields in the fall, along these lines affecting the accessible nourishment supply.

¹⁹⁰MacMillan, S. (2019). *Livestock for food security and nutrition*. Committee on World Food Security policy recommendations, p. 11.

¹⁹¹Ibid, (2019), p. 18.

¹⁹²Githeko, A.K. and Ndegwa, W. (2001). *Predicting malaria epidemics in the Kenyan Highlands using climate data: a tool for decision-makers*. Global Change and Human Health: pp. 54-63.

The significance of ecological maintainability to advancement is upon an arrangement of manageable improvement objectives of the Strategic Development Goals. In spite of some little advance towards meeting this objective, there is still considerable unfinished business and new worldwide and nearby difficulties jeopardize the improvement and ecological increases accomplished as such.¹⁹³ This research therefore concludes that regional natural change, for example, environmental change and the corruption of biological community administrations is uplifting danger and lessening open doors for defenseless populaces.

Expanding streams of merchandise and ventures, capital and innovation, data and work all fuel a developing worldwide populace with suggestions for examples of utilization and generation. The scale and diligence of worldwide natural issues require maintained aggregate endeavours to meet universally concurred objectives.¹⁹⁴ This study concludes that environmental change is required to expand atmosphere fluctuation and the frequency of extraordinary climate occasions (examples, dry seasons, surges). As of now in Kenya, with regards to natural manageability through environmental change, open exposure of implementation data is poor crosswise over different statutes and under different capable establishments. Despite the fact that means toward more open government are being taken, these have not yet flourished in the ecological implementation domain.

This research concludes that there are insufficiencies in accessible authorization data and the absence of proactive information revelation undermine native interest in ecological requirement. Kenyans merit an extensive and consistence database with the goal that they may discover what is, and happening in their groups, and this has motivated the analyst to get certainties on the worldwide natural economically through environmental change activities.

¹⁹³Muchemi, S. (2005). *Adaptation lessons learnt in Kenya on climate variability and change*. Kenya Meteorological Department, Nairobi, Kenya, pp. 8-12.

¹⁹⁴Githeko, A.K. and Ndegwa, W.(2001).*Predicting malaria epidemics in the Kenyan Highlands using climate data: a tool for decision-makers*. Global Change and Human Health: pp. 54-63.

5.3 Recommendations

This section therefore recommends that the land use can be effectively managed with proper laws and policy in place, especially in a country with a fast-growing population as East Africa particularly in Kenya. The laws and policies need to take into account that it is not only the citizens of the republic who will use it but other citizens of the world as well and the use of land will not only affect those in the country but across our borders too.

According to the Kenya's national development blue print, the Kenya Vision 2030, Kenya envisions being a middle-income country with citizens enjoying high quality of life and a sustained annual economic growth rate of at least 10 percent by year 2030.¹⁹⁵ The agricultural and livestock sector contributes significantly to the national economy.¹⁹⁶ This section recommends the government through the Ministry of Agriculture to step up efforts towards food security, reducing poverty and sustainable development is at risk due to adverse impacts of global warming. Records show that over the last half a decade Kenya has undergone drastic climatic changes and arbitrary weather patterns.

The climate disruption changes unless effectively mitigated, will likely result to massive economic losses and diminishing of strategic reserves and killing the resilience of rain-fed farming systems, especially in sub-Sahara Africa. Needless to say, in such conditions there can be no food security.¹⁹⁷ In response to this scenario, the Government has been exploring innovative and transformative measures to assist stakeholders across the agricultural value chains to manage the effects of climate change. The Kenya Climate Smart Agriculture Implementation Framework, 2018-2027 (KCSAIF) has been developed to

¹⁹⁵Kamweti, D., D. Osiro, and Mwiturubani.(2009).*Nature and Extent of Environmental Crime in Kenya*. Pretoria, South Africa: Institute for Security Studies, p. 10.

¹⁹⁶Griggs, D.(2013).*Sustainable development goals for people andplanet*, *Nature*, Vol. 395, pp. 305-307.

¹⁹⁷Kamweti, D., D. Osiro, and Mwiturubani.(2009).*Nature and Extent of Environmental Crime in Kenya*. Pretoria, South Africa: Institute for Security Studies, pp. 11-12.

provide guidance in mainstreaming Climate Smart Agriculture (CSA).¹⁹⁸ This study recommends the framework to be localized as the Framework envisions a climate resilient and low carbon growth sustainable agriculture that ensures food security and contributes to development goals in line with Kenya Vision 2030.

The index-based livestock insurance, which has been successfully piloted in eight ASAL counties, has been demonstrated to cushion the pastoralists against the severe dry spells whenever pay-outs are triggered. This scheme should be rolled out to cover other ASAL counties while at the same time promoting strategies to popularize voluntary uptake of insurance products by pastoralists on their own. Investment in research should be stepped up especially in the area of high yielding tropical forages to improve the carrying capacities of the land. Recent rolling out of the new cultivars of *Brachiarya spp*, which is a high yielding grass with a relatively higher crude protein content compared to other grasses, is revolutionizing livestock farming in areas where it has been taken up. The government should invest in technologies which enhance productivity per animal so that the increasing demand for animal protein is satisfied by fewer animals for the benefit of the environment. These include Assisted Reproductive Technologies (ART) like Multiple Ovulation Embryo Transfer (MOET), semen technology and use of genomic selection to shorten the evaluation of breeds.

5.4 Areas of Further Studies

Conversion of grazing land to other competing uses like real estate as witnessed in counties like Kajiado will precipitate environmental degradation as available grazing areas continue to shrink. Before it gets too late, there is urgent need for a deliberate policy intervention to safeguard the grazing and other food production lands from this rapid conversion witnessed in the last two decades..

¹⁹⁸Ibid, (2009), p. 14.

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APPENDICES


Appendix 1: NACOSTI Research Permit


REPUBLIC OF KENYA
National Commission for Science, Technology and Innovation


NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Ref No: **341215** Date of Issue: **03/May/2020**


RESEARCH LICENSE




This is to Certify that **Mr. HENRY KIPROTICH NGENOH** of **University of Nairobi**, has been licensed to conduct research in **Nairobi** on the topic: **Livestock Management and Environmental Security in Eastern Africa: A case Study of Kenya** for the period ending : **03 May 2021**.

License No: **NACOSTI/P/204861**

341215
Applicant Identification Number

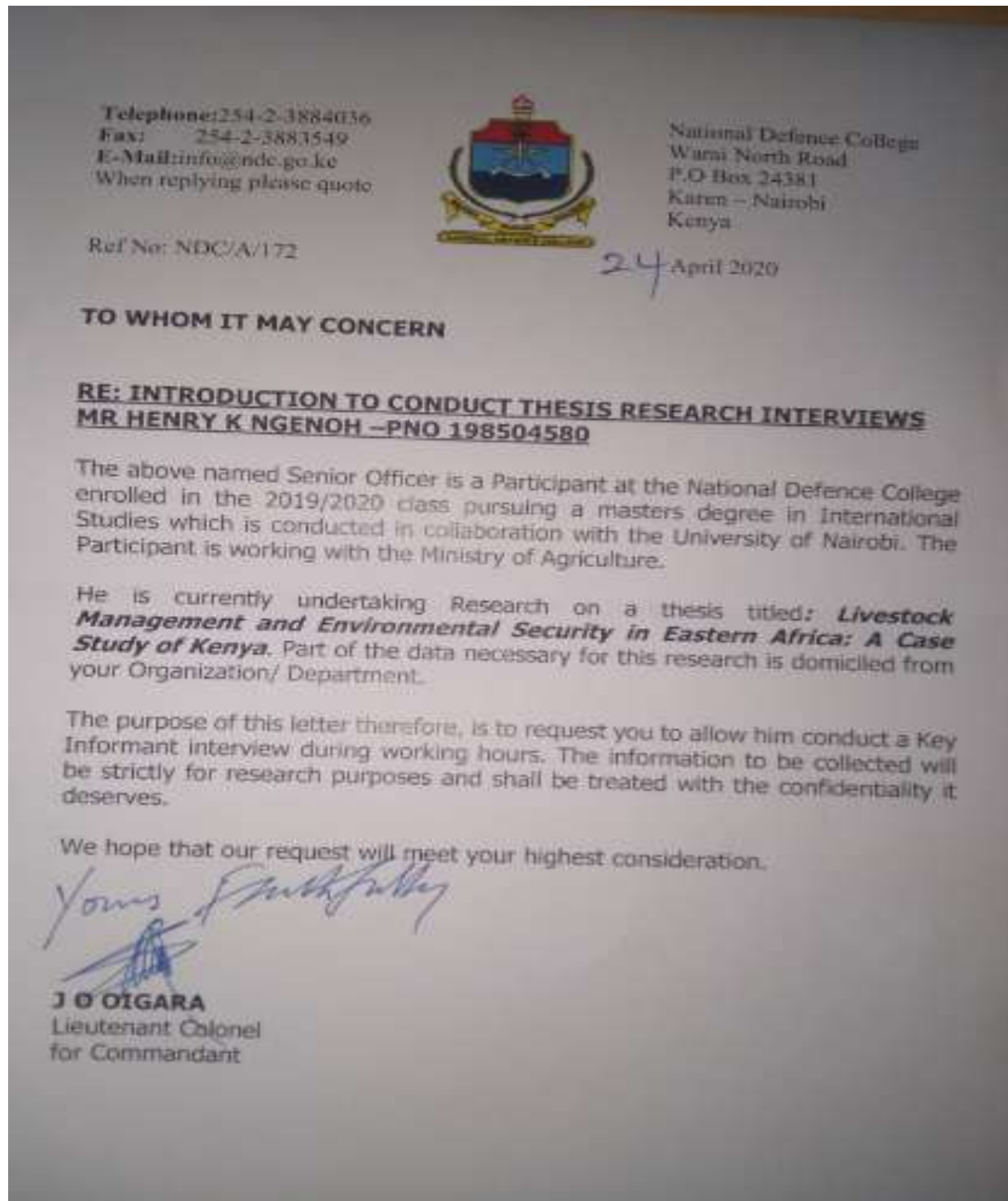

Director General
NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code



NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR-Code using QR scanner application.

Appendix 2: Letter of Data Collection Authority



Appendix 3: Permission of Data Collection from Ministry

REPUBLIC OF KENYA



**MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND
COOPERATIVES**

State Department for Livestock

Telegrams "MINAG"
Telephone: 020 2336755/6
Fax : 2721007
Ref: MDA/LP/SDL/DLP/DAIRY/46/VOL III (121)

Hill Plaza
Ngong Road
P. O. Box 34188
NAIROBI
26th April 2020

TO WHOM IT MAY CONCERN,

**RE: INTRODUCTION TO CONDUCT THESIS RESEARCH INTERVIEWS;
HENRY KIPROTICH NGENOH – P/NO 1985045580**

The above named is a senior officer working with the State Department for Livestock and is currently undertaking a one year course at the National Defence College (NDC). The course, which is administered in collaboration with the University of Nairobi, will culminate in the award of a Masters degree in International studies.

The officer is currently carrying out a research on a thesis topic "Livestock Management and Environmental Security in Eastern Africa: A Case Study of Kenya" and your organization has been identified as one among those which hold the needed data.

The purpose of this letter therefore is to request that you grant him access to your organization to contact key informant interviews and access to secondary data contained in the publications within your organization.

Looking forward to your cooperation on this matter.

A handwritten signature in blue ink, appearing to read 'Abraham Biwott'.

Abraham Biwott

For Director Livestock Production

Appendix 4: Structured Questionnaire

Serial:

Research Structured Questionnaire

This research aims to establish the livestock management and environmental security in Eastern Africa using a case study of Kenya. The purpose of this interview guide is to collect information from a wide range of informants, who have knowledge about livestock management and environmental security.

It is requested that you please give consent, before you respond. Clarification on each question can be made where necessarily to your satisfaction. The personal information is optional and kindly note that this work is purely for academic purposes only. Please fill in the questionnaire appropriately. This questionnaire will be submitted to you in hard copy.

Instructions

The statements articulate some issues of livestock management and environmental security in Eastern Africa.

How would you rate some of these statements and give explanations? That is where rating scale is

1 = Strongly agree, 2 = Agree, 3 = Un-decided, 4 = Disagree and 5 = Strongly disagree.

Section One: Personal Information

Gender? (tick) Male [] Female []

Age?

Occupation?

Office / Ministry / Organization?

Designation?

Duration in employment?

Section Two: Livestock management and environmental security

Please rate the following statements livestock management and environmental security in Eastern Africa using a case study of Kenya.

Rating scale:

- 1 = strongly agree
- 2 = agree
- 3 = un-decided
- 4 = disagree
- 5 = strongly disagree.

1. Are you familiar with livestock management? Yes No

If yes, which ones?

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2. Do you understand the concept of climate change? Yes No

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3. Globally, climate change manifest in various ways?

Scale:

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Explain:

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4. The East African region has faced increased livestock management challenges?

Scale:

.....

Explain:

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5. Do you understand the concept of environmental security? Yes No

Please explain your answer?

.....

.....

6. There is linkage between livestock management and environmental security in Kenya?

Scale:

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Explain:

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7. Kenya has applied policy approaches to deliberately tackle environmental security?

Scale:

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Explain:

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8. That there are various actors and strategies for effectively addressing livestock management challenges in Kenya?

Scale:

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Explain:

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9. That there are current strategies applied for addressing livestock impact on environmental security?

Scale:

.....

Explain: (List some of the strategies)

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10. What additional strategies would you propose to address livestock impact on environmental security?

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11. The multiagency approach is effective in fighting environmental security in Kenya?

(Name some of the agencies involved in environmental security)

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12. What is your view on the future demands or livestock and livestock products in Kenya?

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13. Additional relevant remarks?

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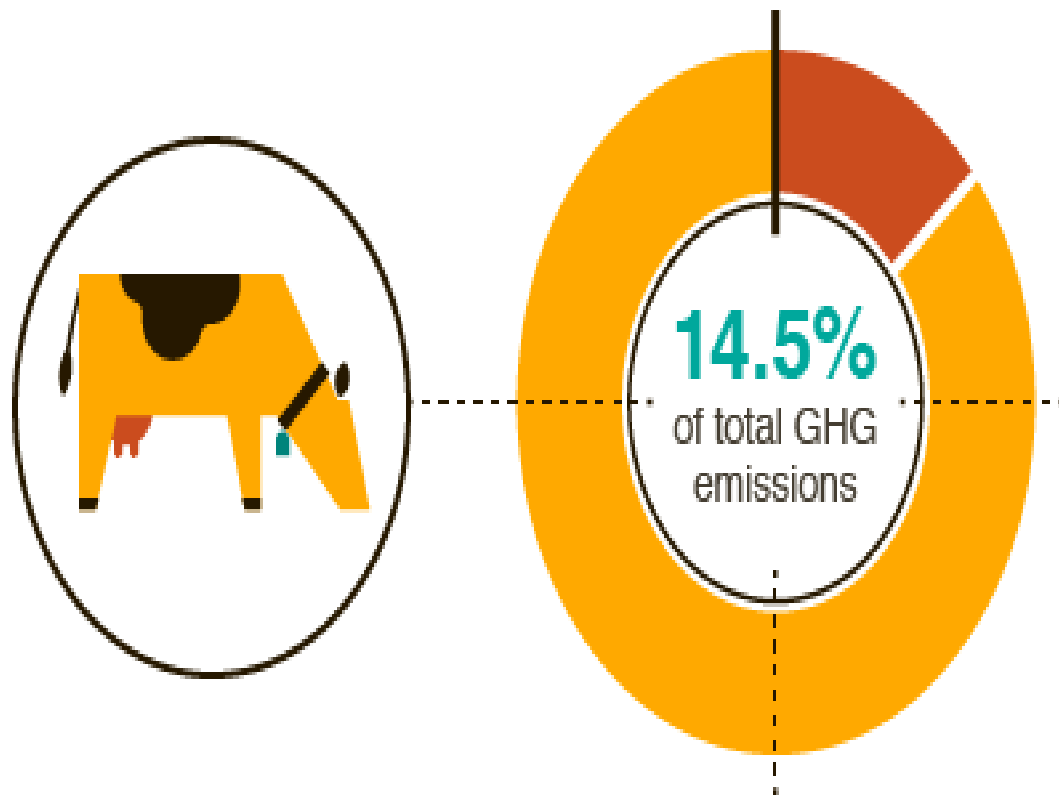
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Thank you for your participation.

Appendix 5: Press Release 1

Livestock contributes **7,100 MtCO₂e/year** or **14.5%** of total global GHG emissions.



Source: Gerber et al., 2013

Big Facts
ccaafs.cgiar.org/bigfacts

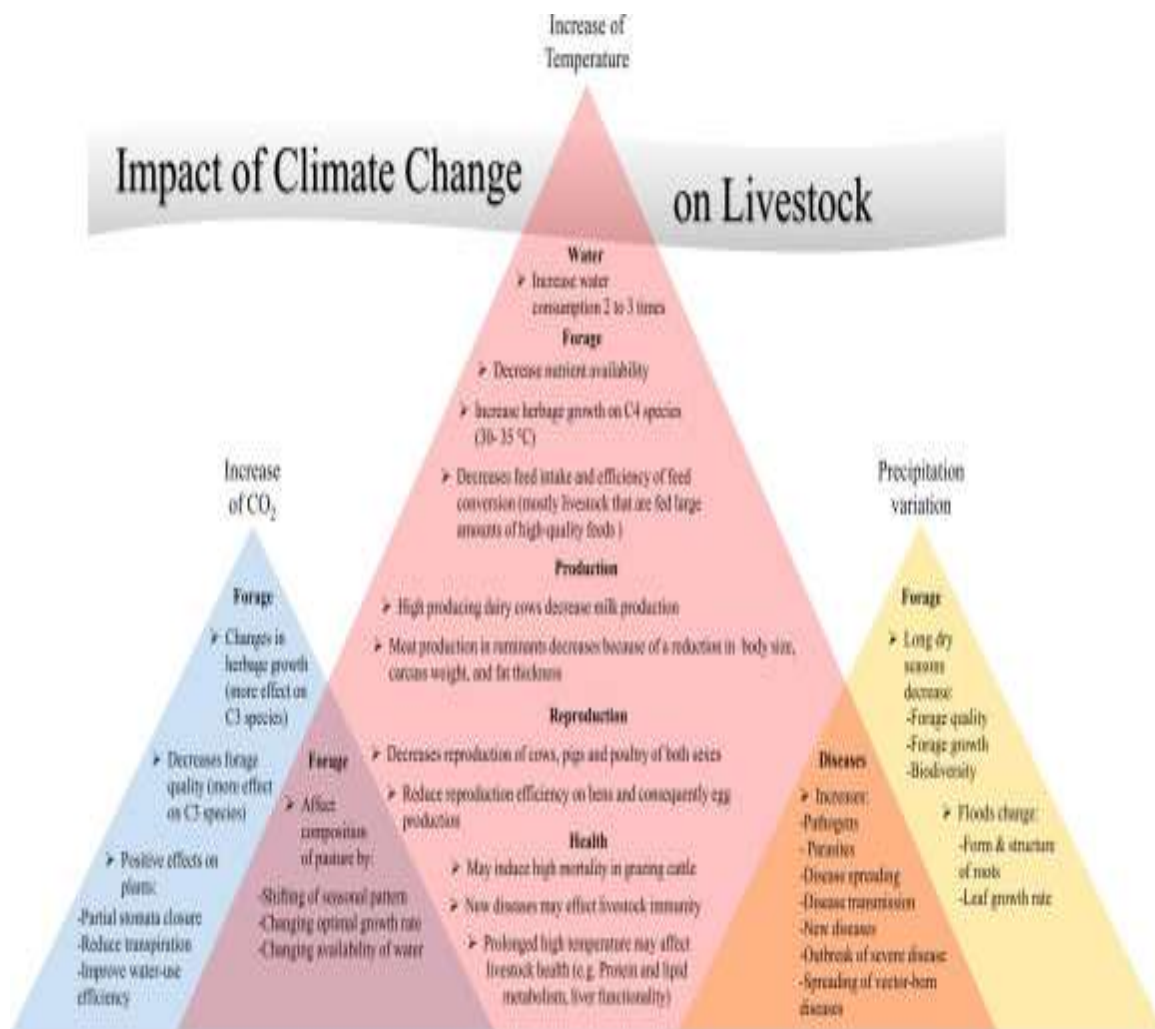


RESEARCH PROGRAM ON
Climate Change,
Agriculture and
Food Security

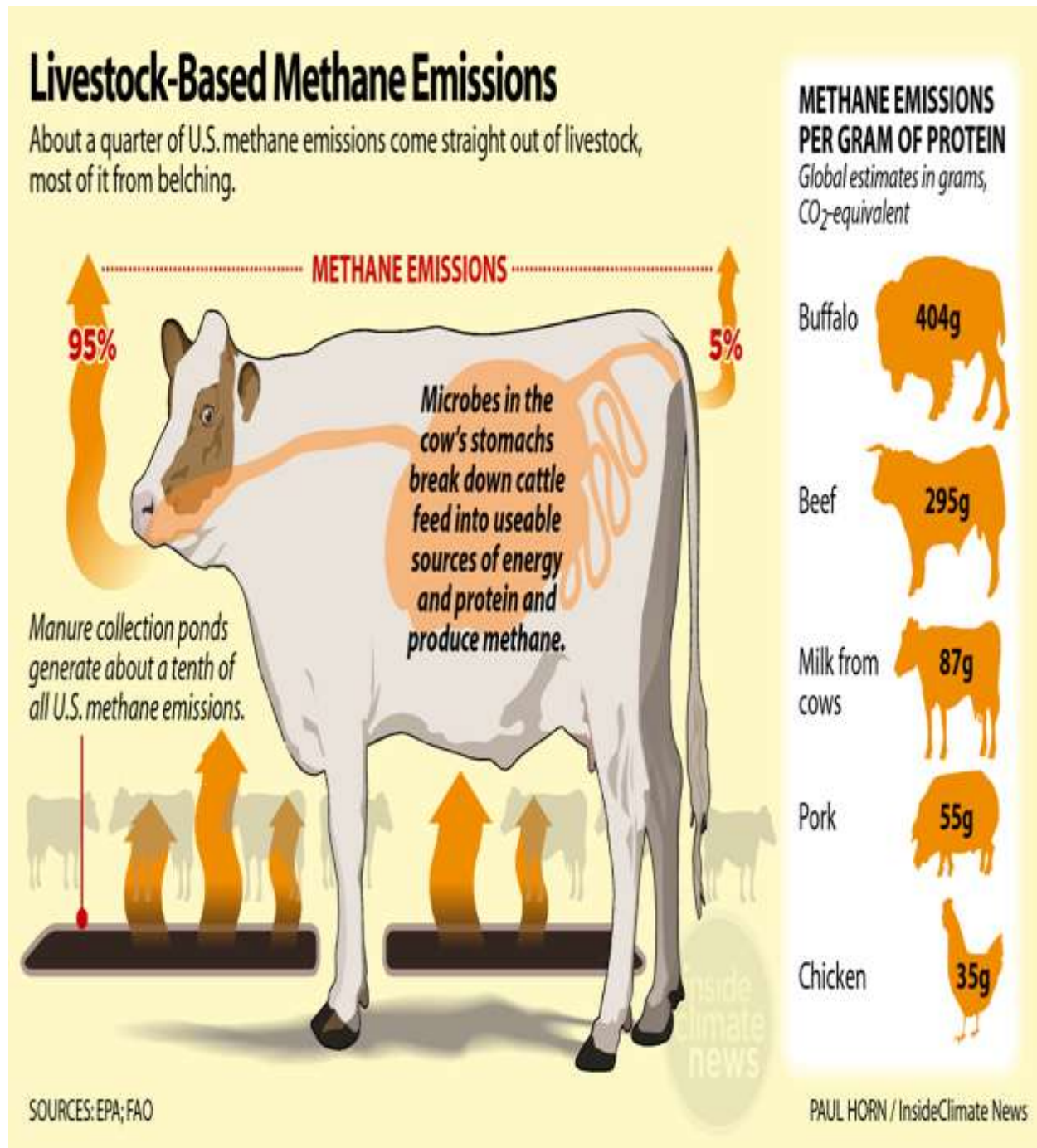


Source: United Nations. FAO. (2018). *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*. Rome.

Appendix 6: Press Release 2



Source: United Nations. FAO. (2018). *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*. Rome.



Source: United Nations. FAO. (2018). *World Livestock: Transforming the livestock sector through the Sustainable Development Goals*. Rome.

Appendix 8: Plagiarism Report

ORIGINALITY REPORT			
15%	13%	6%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	www.fao.org Internet Source		1%
2	www.gwiwater.org Internet Source		1%
3	cmsdata.iucn.org Internet Source		1%
4	Submitted to Kenyatta University Student Paper		<1%
5	canafrica.com Internet Source		<1%
6	www.kilimo.go.ke Internet Source		<1%
7	Submitted to St. Xavier High School Student Paper		<1%
8	erepository.uonbi.ac.ke Internet Source		<1%
9	wahis2-devt.oie.int Internet Source		<1%

END.