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An Evaluation of Farmers Perception on the Effects of Variability in Rainfall and Temperature on Goat and Finger Millet Farming in Baringo County - Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Climate is subject to variations in many parts of world, exhibited by mainly rainfall and temperature fluctuations. The variability in Africa has resulted in the spread of desert conditions in the Sahel. Kenya experiences great variations of climate annually and considerable uncertainty when rains are expected, impacting negatively on farming activities. The objective of the study was to evaluate the farmer's perception of the effects of variability in rainfall and temperature on goat and finger millet farming in Baringo County. The study adopted a cross sectional survey which is a descriptive design. The sample size was 384 households derived from a target population of 555,507 using Webster (1995) formulae. Both stratified and simple random sampling techniques were used to

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select 384 households. Prospect theory guided the study. Primary Data collection tools included questionnaires, Key informants, focus Group discussions, Observation and photography. To ascertain reliability and validity of the research instruments, a pilot study was conducted where a reliability coefficient of 0.7 was deemed acceptable. Descriptive statistics such as frequencies, means, and standard deviation were used to analyze quantitative data. Qualitative data was analyzed by coding patterns and themes then evaluating it into useful information. Results indicated that climate variability has severe and adverse effects on finger millet and goat production. Pre-drought planning to cope up or overcome the effects of droughts were highly recommended and measures provided. The study findings are expected to help farmers, the government and economic planners to focus on effective mitigation areas, formulate alternative policies on mitigating the effect of rainfall and temperature variability on activities of farming in Baringo County.

Keywords: Variability; climate; drought; floods; climate change; desertification; sahel; arid and semi-arid lands; farmers.

1. INTRODUCTION

This study commences with the Background to the Problem, the Statement of the problem, Research objective, Literature review, Methodology and finally Results, Interpretation and Analysis. This study evaluates the farmers perception of the effects of variability in rainfall and temperature on goats and finger millet farming in Baringo County. The study findings are expected to help in formulating strategies to counter the problems of the effects of rainfall variability on farming activities.

1.1 Background to the Study

Rainfall and temperature are the most important elements determining climate and the world's climate is categorized based on rainfall and temperature. Rainfall variability is the degree to which rainfall amounts vary across an area or over a given period of time. When this variation of rainfall amounts is taken at various locations across a region for a specific time, it is referred to as areal variability. Where the variation of rainfall amounts is taken at one location over a specified period of time, it is known as temporal variability. Variability of rainfall and temperature is a global problem disrupting farming activities in most parts of the world and in particular, impacting negatively on crop and livestock production. This problem is more serious in marginal areas and the ASALs including Baringo County which is a semi arid area in Kenya's Rift valley.

Variability can cause either droughts or floods [1]. Rain fed agriculture in the affected areas suffers in terms of reduced yields, crop failure and to extremes livestock deaths. Subsistence crop production becomes uncertain [2].

Rainfall in many parts of the world is subject to variability and uncertainty as a result of fluctuations. According to Jose [3], climate change has made rainfall in the tropical regions of the world more irregular. It used to start raining in October and continue in July every year in the Brazilian Semi-Desert region that currently suffers from drought. Today rainfall in this Brazilian region is unpredictable, streams are disappearing and water available for agriculture has drastically reduced. A study conducted by Phillips et al., [4] stated that the effects of rainfall variability have continued to affect global food production throughout history. Rainfall variability in Australia has adversely affected the eastern part of the country with the effects of expanding the desert condition (Nicholls et al., 1977). The impact of the variability was seen in terms of environmental issues like desertification in northwestern India, river channel changes over the Gangetic plains and rising trend in surface temperature variation over the whole country (Nityanand, 2009).

In Africa, Rainfall variability has been common in many regions including the Sahel South of Sahara, West, East and Central Africa. African countries are the most vulnerable to rainfall variability as they mostly depend on rain fed agriculture for their livelihood [5]. In West Africa, a study by Gribin, [6], indicated that the area experienced prolonged droughts, which were responsible for decline in agricultural harvests. Inter annual rainfall variations in equatorial East Africa are tightly linked to the Elnino Southern Oscillations (ENSO) with more rain and flooding.

Variability has led to expansion of the Sahara desert and encroachment of savannah and steppes lands [7]. Many countries of the Sahelian region of Africa such as Burkina Faso, Mali and

Sudan are today affected by prolonged droughts adversely affecting crop yields [8]. A close study of documented rainfall datasets reveal that rainfall is changing over different periods and causing fluctuating subsistent crop production (Shongwe, et al., 2009).

Kenya's rainfall is characterized by variability in the annual total and considerable uncertainty in the time of the year the rains are expected [7]. This is mainly witnessed in marginal areas like Garisa, Mandera, Magadi, Kajiado, Samburu and Machakos which are semi arid (Ojany and Ogendo,1973). The drought periods elongate over the same period adversely impacting on agricultural production. A study by Sisanya et al. [9] on semi arid lands in Kenya, indicated that variability is persistent in the arid and semi arid lands of Kenya including Machakos and Baringo and that it continues to affect vegetation condition and consequently crop production.

In Baringo County, rainfall amounts vary from 1,000 mm - 1,500 mm experienced in highland areas to 600 mm and below annually experienced in the lowland areas (CIDP, 2018 – 2022). As a result of their varying altitudinal ranges, Baringo Sub-Counties receive varying amounts of rainfall and levels. Most parts of Baringo County receive unpredictable and erratic rain, less than 500 mm per annum. This is experienced mainly in the Sub Counties of Tyati and Baringo South (Marigat). The rainfall is characterized with fluctuations and erratic patterns in their distribution over different years [7]. The ranges of temperature vary between 10°c to 35°c in different areas throughout the county. There is need to compare climate variability for both highland and lowland areas of Baringo County.

These conditions impede on both livestock and crop farming in the county. Farming activities in Baringo include, crop, livestock and fish farming, horticulture, ranching, and general irrigation cultivation [10]. In Baringo County, the effects of variability in climate on farming activities range from reduction in crop yields, total crop failure and death of livestock in the event of prolonged droughts [11]. Rainfall and temperature variability affects farming activities by disrupting these activities, farming calendars and causing uncertainties in planning farming programs and activities, reduced crop yields and livestock productivity [12]. Studies conducted in Baringo on the effects of rainfall variability on farming activities have mainly focused on agricultural activities in general. The current study focusses on finger millet and goats. The justification for the choice of finger millet was that, it was the major subsistence crop in the county, particularly in the semi arid lowlands. Goats were equally the major livestock in the County.

1.2 Statement of the Problem

Baringo County receives erratic and unpredictable patterns of rainfall, below 500 mm annually. The rainfall is characterized and associated with uncertainty and acute fluctuating distributions spread from year to year causing prolonged droughts. Droughts disrupt planned farming calendars and activities; and therefore lead to reduced crop and livestock productivity. Droughts are responsible for low harvests, failure of crops, and livestock deaths especially in arid and semi arid areas like the Northern parts of Baringo County and many small holder farmers lack resources and the technical knowledge to counter these problems.

Consequently, droughts impede on the livelihoods of people in marginal areas. Drought oriented livestock trade; adopted to salvage the total loss of livestock has low returns because of low prices. At the same time bans imposed by government due to rainfall related disease outbreaks like the rift valley fever, mosquito borne virus epidemic malaria triggered diseases. These phenomena discourage agricultural activities resulting in increased poverty and human suffering. Thus the current study intended to evaluate the farmers perception on the effects of rainfall variability on farming activities, a focus on goats and finger millet farming and to identify effective mitigation strategies to counter these effects.

1.3 Purpose of the Study

The purpose of the study was to assess the effects of variability in rainfall and temperature on goat and finger millet farming in Baringo County.

1.3.1 The specific objective

The Specific Objective of the study was to; Evaluate the farmers' perception of the effects of variability in rainfall and temperature on goat and finger millet farming in Baringo County.

1.3.2 The study research question

The current study was guided using the Research Question below.

What are the farmers' perceptions on how variability in rainfall and temperature has affected finger millet and goat farming in Baringo County?

1.4 Justification of the Study

Farming activities rely on rainfall. Erratic, unreliable and unpredictable rainfall will inhibit the development of these activities. The activities include; crop farming and livestock farming. For crop farming, this study focuses on finger millet and for livestock the focus is on goats. Rain fed agriculture tends to be cheap and basically affordable, especially to small scale farmers. Irrigation farming supplements rainfall especially during periods of drought but tends to be expensive.

This study was motivated by the fact that there is a dire need to help farmers in arid and semi-arid areas to effectively counter the effects of climate variability in developing their farming activities.

This will help farmers to plan for effective strategies and to make decisions on the best type of coping strategies to apply in various instances so as to improve on their productivity. The findings also aim at helping the farmers, government, policy decision makers, and economic strategic planners to focus on effective mitigation areas, formulate alternative policies on ways of mitigating climate variability effects on farming practices in Baringo.

1.5 The Significance of the Study

The effect of rainfall variability on crop and livestock farming have had major economic implications leading to food insecurity and increased poverty rate. The results of the current study are expected to contribute to initiatives aimed at enhancing productivity of finger millet and goats. The initiatives will benefit both farmers, government and economic planners to focus on effective mitigation areas and formulate alternative policies on mitigating the effects of climate variability on farming activities in Baringo County.

2. LITERATURE REVIEW

2.1 Introduction

This section attempts to review the existing literature of the previous studies undertaken on the study topic. The literature content is organized on the basis of global, regional/ continental, national and local/study area. Focus is made on the farmers' perception of the Effects of variability in climate on farming activities,

2.2 The Effects of Climate Variability on Farming activities

2.2.1 The effects of climate variability on the global perspective

Climate variability affects both agricultural activities, yields and livestock keeping (Rao et. al., 2012). It affects ecosystems, water resources, and food resources [13]. The areas mostly affected globally, include countries in the Middle East, Southern Brazilian semi desert, California in the U.S.A and Eastern region of Australia which has expanded the Australian Desert [14]. The Brazilian semi desert that currently suffers from drought, previously experienced heavy equatorial rainfall. The changes have been brought about by extreme variability in climate experienced globally [3]. According to Ngaira (1999), [7] ASALs environments that constantly face malnutrition and threatened with deaths when the rains fail, accommodate 14 percent of the world's inhabitants. Crop failure is common and this leads to reduced crop yields and livestock deaths resulting into acute shortages in food supply (Hulme, 2009). The above global studies portray general results ranging from the effects of variability in climate on the environment to the effect on agricultural activities. There is need to narrow down the study to effects on crop and livestock farming practices.

2.2.2 The effects of climate variability on the African perspective

Both variability and change in climate in Africa have contributed to the expansion of the Sahara desert and the surrounding Sahelian regions through encroachment and spread of the desert conditions on the savannah lands [15]. The situation is made worse with increasing population in the affected areas [16]. Remarkable rainfall and temperature fluctuations have been experienced over the entire continent due to the 1950's droughts that affected much of Africa and especially the southern part. Severe droughts in Africa, since 1973 have caused massive losses in livestock.

Climate variability in the ASALs of Africa adversely affects the nomadic people of the Sahelian region in Niger, Burkina Faso, Chad

and Mali [17]. In the Sahelian lands including other regions bordering the Southern Sahara like chad, Central African Republic experienced a prolonged drought commencing in 1968 and extending to 1974 - 1975 [7]. Fluctuating rainfall and temperature patterns, mainly recorded in the southern parts of Africa adversely affected farming calendars and programs (Richard, 2002). In the early 1970s, persistent droughts in the Sahelian Africa led to declined agricultural production [6].

In Tanzania farmers heavily depend on seasonal rainfall which keeps on varying from one season to another [18]. A study by Mongul et al., [19] indicated that farmers in Tanzania have continuously experienced declining rainfall in the ASALs of the country. In this ASALs, low rainfall accompanied by dry spells contributed to reduction in yields and to extremes, total crop failure [20]. Namibia is an ASAL area, and where the economy heavily relies on extensive commercial and subsistence livestock production activities. Reid et al., (2007)'s study forecasted on the economic impact of changes in climate in the country. The study predicted that there was a grasslands shift to forests as rainfall decreased and an increased incident of diseases with increase in precipitation

2.2.3 The effects of climate variability on the Kenyan perspective

Climate variability and change tend to subject a significant impact on agricultural activities in Kenya. For example the greatest effects were witnessed in 1986, 1990 and 2008, in the tea sector [21]. Kenya with a national poverty rate estimated at 45.9 % and 49.1 % experienced in rural areas, faces severe impacts. The impacts are worth noting considering the fact that over 70% of the labor force in rural areas have their livelihood dependent on agricultural production (GoK, 2010a). The economic cost of climate change is projected at 2.6 % of the (GDP) per year by 2030 with coastal zones experiencing the largest economic burden due to rising sea level [22]. The periodic droughts and floods currently experienced in many parts of Kenya is evidently an indicator to significant economic costs. The fact that Kenya is not adequately prepared to deal with these challenges is a serious concern [23].

Rainfall variability, with expected higher temperatures and increased rates of evapotranspiration is expected bring about losses in agricultural production of the major staple foods, like maize, millet, sorghum and wheat [24]. Decreased production in maize by 4.2% in 2014, has been attributed to erratic and unpredictable patterns of rainfall, with some regions and parts of the country experiencing declining rainfall [25]. It is worth noting that, Kenya has been affected by prolonged droughts since the early 1990s.

2.2.4 The effects of climate variability on the perspective of the study area

In Baringo a number of effects of climate variability on farming activities have been documented. They include reduced yields of crops, acute crop failure and unexpected deaths of livestock in the event of prolonged droughts [11]. Climate variability causes uncertainty in planning farming activities, which affects farming activities by disrupting farming calendars, activities and reduced crop and livestock productivity [12]. The rainfall and temperature anomalies have led to widespread famine as a result of droughts which impact on livelihoods of the inhabitants of the affected areas [7]. The study sought to examine the effects of variability in climate on finger millet and goat farming in Baringo County. Studies identified in the review of the literature on the effect of variability in climate on farming activities in the former larger Baringo District and the current Baringo County have concentrated on production of crops and livestock in general. Maraga [26] for example focused on mitigation strategies of pastoralists to changes in climate effects in Baringo County. Olago [27] focused on the response of livestock to long-term variability in precipitation in Baringo County. The current study focusses on both large and small scale farming and specifically focusing on finger millet and goat production.

2.3 Conceptual Framework

The study assessed climate variability and its effect on farming activities. Climate variability is the independent variable and Farming activities were the dependent variables.

The conceptual framework demonstrates how independent variables interact with dependent to explain the effect of climate variability on farming activities. Climate variability has different components. The two main components adopted by the current study are, Rainfall and Temperature. Variability of these elements causes either droughts or Floods. Inadequate

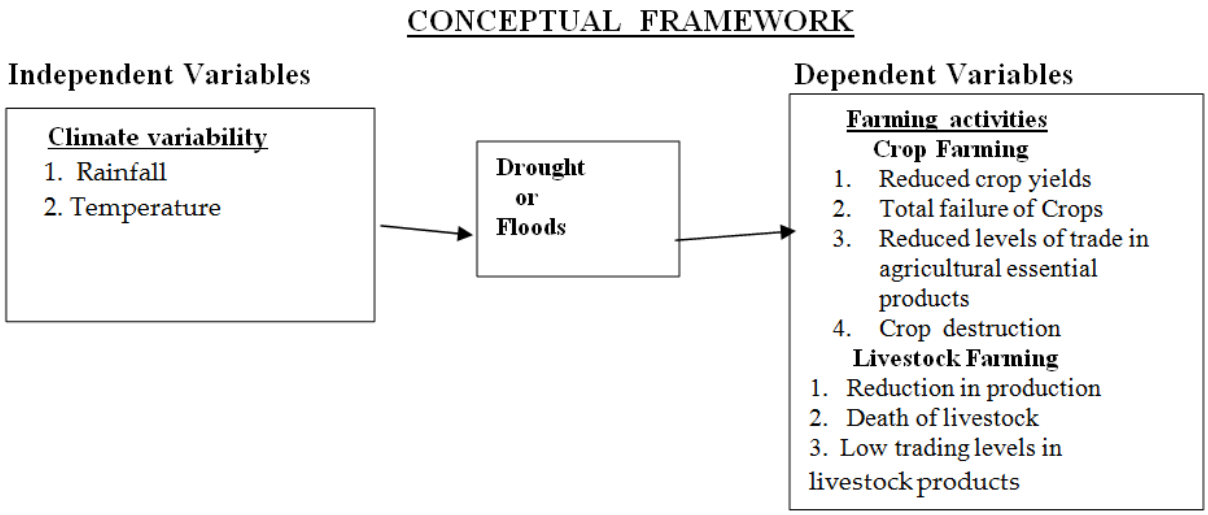

Fig. 1. Conceptual framework on evaluation of the effects of variability in climate on activities of farming in Baringo county

Source: Researcher, 2023

rainfall, high temperatures and elongated dry spells causes drought and excessive rainfall causes floods. Droughts have an effect on the farming of crops in form of reduction in crop yields or production, total failure of crops, destruction of farm crops and reduced levels of trade in agricultural produce. On livestock the effects, come in form of reduction in production and eventual death of livestock. Unavailability and shortage of livestock essential products, reduction in productivity and reduced levels of trading in livestock essential products. This is clearly demonstrated in the diagram, conceptual, framework above. Floods cause destruction of crops and death of livestock. This situation culminates in acute and rampant food shortages, hunger and consequently famine.

3. RESEARCH METHODOLOGY

3.1 Research Design

The targeted population comprised the rural communities engaged in crop farming and livestock keeping for their livelihoods. The unit of analysis are the households that grow finger millet and keep goats in the rural areas. A cross sectional descriptive study design was adopted for the study because, Firstly, the information to be provided was personal, in terms of opinions, views, perceptions and attitudes. Secondly, a wide range and variety of data could be collected at one point in time [28].

The study employed both quantitative and qualitative data collection and analysis methods. Qualitative analysis methods relied on question guides and interview schedules. The quantitative methods relied on documentary data analysis and household questionnaires of the data collected as articulated in the objective. The study is a descriptive survey of the effect of variability in climate on goats and finger millet in Baringo County.

3.2 Target Population and Sample Size

Based on 2019 population census report, Baringo County recorded a total population of 666,763. The target population is 169,250 people drawn from 55,507 households which comprises of the total household population of the three sampled sub counties namely Tiaty, Baringo South (Marigat), and Baringo North where the study was carried out. Table 1 shows sampled population and number of households in each of the Sub County in the study area. The unit of analysis is the household engaged in farming activities in the sampled sub counties totaling to 55,507 households.

3.3 Sample Size Determination

Data was collected in Tiaty, Marigat and North Baringo Sub Counties. The main sampling procedures were stratified and simple random sampling. The stratified random sampling technique was used in selecting respondents from the three sub counties to provide

information on finger millet farming and goat keeping. Key informants and the Sub Counties to be involved in the study were sampled purposively. Webster (1995) formula was used to determine the sample size of the study. Respondents targeted were mainly adults, male or female and who have resided in their Sub County for 20 years and above. The county rural population cannot be exactly determined. Based on this situation, Webster (1995) suggests that in a population which is more than 10,000 and not exactly known, the formulae below can be used to estimate the size of the sample.

$$n = \frac{Z^2\,\pi\,(1-\pi)}{(Error)}$$

Where π represents 50% proportion of the diversified rural population to the County's total population. Z represents the Critical value of the normal distribution at the required confidence level. At 95% desired Level of confidence and a margin error of 5%, the Sample size (n) is calculated as indicated below:

$$n = \frac{(1.96)^2\,(0.5)^2}{(0.05)^2} = 384.6 = households$$

The questionnaire was based on 384 respondents from the households in the three sub counties of Baringo County out of a population of 55,507 households. One respondent was picked from each household. The study population was stratified into three sub counties namely Tiaty, North Baringo and South Baringo. The unit of analysis is the household. Each sub county's number of households has been calculated as shown Table 2.

3.4 Sources of Data

Both primary and secondary sources were used to collect data.

3.4.1 Primary data

Household questionnaires, photographs, interview schedules, focus group discussions and participant observation were used to collect primary data. The unit of analysis was the households, whose head provided primary data on crop and livestock, acreage, production and yields. The research instruments were pretested and any correction on errors identified done before actual data collection took place. First hand and original data was obtained from Baringo County.

3.4.2 Secondary data

Secondary data entailed evaluating the available documented literature on the problem of the research study. The data was obtained or sourced from existing documented sources including unpublished and published reports. These documents were found in UNEP library in Nairobi and libraries in public universities.

3.5 Data Analysis and Interpretation

Descriptive statistics including frequency charts, tables, means, and standard deviation were used to analyze quantitative data. Qualitative data was edited and organized into themes and patterns and evaluated into useful information that could be easily interpreted, analyzed and conclusions made.

Table 1. The sampled sub counties

	Sub county	Population	No. of households
1	Tiaty Sub County	73,424	12,153
2	North Baringo	104,871	23,500
3	South Baringo (Marigat)	90,955	19,854
	Total	169,250	55,507

Table 2. The sample size calculation

	Sub County	n/N x 100	Percent	Households
1	Tiaty	12,153 / 55,507 x 100	21.9 %	84
2	North Baringo	23,500/ 55,507 x 100	42.3 %	163
3	South Baringo	19,854/ 55,507 x 100	35.8 %	137
	Total	55,507	100	384

Where n = No. of households in the Sub county
N = Total No. of households in the entire county

Respondents' perception was used to determine the effect of variability in rainfall and temperature on goat and finger millet farming in general. The respondents' perception was captured using the household questionnaire administered to the household head.

4. DATA ANALYSIS, FINDINGS AND DISCUSION

4.1 Introduction

This section sought to analyze the responses from the farmers on their farming experiences and in particular finger millet farming and goat keeping. Special attention was given on the respondents' perception on how their farming activities are affected by variations in rainfall and temperature.

4.1 Analysis Summary Report of the Responses from the Household Questionnaire

Rainfall variability in seasonal, monthly and annual rainfall adversely affected finger millet and goat farming particularly through delayed preparation of land, planting, stunted growth of plant sometimes leading to crop failure and decreased crop yields.

It was also observed that finger millet and goat production yields fluctuated relative to rainfall and temperature variations and distribution. This was indicated through three major evidences drawn from the analysis results as follows;

i. The respondents' perception on how variations in climate elements especially rainfall and temperature affected the productivity of their farming practices.
ii. Analysis of responses from the household questionnaire revealed various instances when farmers experienced rainfall and temperature variability such as delayed or unexpected onsets of rainfall, prolonged droughts, variations in seasonal yields, the problems encountered as a result of the effects.

4.2 The Respondents' Perception on the Effect of Climate Variability on Goat and Finger Millet Farming

Under this section, the study sought to investigate the respondents' perception on the effect of climate variability on goat and finger millet farming activities in the study area.

4.3 Finger Millet

Under this sub section, the study sought to establish the specific problems in the farming of finger millet in the event of fluctuating and unpredictable patterns of rainfall and temperature. The respondents were asked to indicate the specific problems encountered in finger millet farming in the event of fluctuating and unpredictable patterns of rainfall and temperature. Table 3 presents the results of the survey.

Results in the table indicate that reduced crop yields represented by 62.6% was the main specific problem, followed by crop failure 7.6 %, reduced trading levels 5.7% increased pests and diseases 5.2 % respectively. 19 % of the respondents failed to address this question.

The case processing summary, mean and standard deviation report provide the analysis of the report in the Table 4.

Specific problems encountered in the finger millet farming in the event of fluctuating and unpredictable pattern of rainfall and temperatures.

Table 3. Specific problems encountered in the finger millet farming in the event fluctuating and unpredictable patterns of rainfall and temperature

		Frequency	Percent	Valid percent	Cumulative percent
Valid	0	40	19.0	19.0	19.0
	Reduced crop yields	132	62.6	62.6	81.5
	Reduced trading levels	12	5.7	5.7	87.2
	Crop failure	16	7.6	7.6	94.8
	Increased pests and diseases	11	5.2	5.2	100.0
	Total	211	100.0	100.0	

Table 4. Mean and standard deviation report

Mean	N	Std. deviation
1.18	211	.996

The respondents were in consensus in responding to this item (Mean 1.18. SD 0.996). By consensus the respondents indicated that reduced crop yields represented by 62.6% was the main specific problem, followed by crop failure 7.6%, reduced trading levels 5.7% and increased pests and diseases 5.2%

1. Reduced crop yields 62.6%
2. Crop failure 7.6%,
3. Reduced trading levels 5.7%,
4. Increased pests and diseases 5.2%

The results of this study are in support of a study conducted in Tanzania by Alberto [5] which observed that, false onset of rains frequently lead to serious seed losses as a result uneven and poor germination, leading to acute reduced crop yields. Similar results were observed by Mdulu, (1996) who noted that climatic conditions in most parts of Tanzania are variable and unpredictable affecting crop production. In Bangladesh, Basak [20], posited that low rainfall events lead to drought events which culminates into decline or crop failure.

4.4 Goat Farming

Respondents were asked to rank the enlisted effects of climate variability on goat farming in order of their magnitude. Death of livestock, lack of water and pasture, low production and decreased trading levels. Table shows the outcome of the survey. The data developed in the table, shows the major effects of rainfall variability on goat farming ranked to include the following; The ranking is based on the magnitude of the effect and in accordance to the respondents perception and choice.

1. Lack water and of pasture 54.2%
2. Low production 20.9%
3. Death of livestock 10.9 %
4. Decreased trading levels 4%

These results are in support of a study conducted by Lenyayon [11] which observed that the main problem facing livestock farmers in Baringo is inadequate water and pasture. Makadho (2006) posit that lack of water and pasture in many ASALs of Africa is the major cause of social conflicts [29-33].

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the study content summary, key conclusions based on the study findings and objective, recommendations and areas or fields of further research.

5.2 Summary

Variability in climate, has become a global environmental problem and concern in the recent times. It entails the fluctuating mean in the elements of climate and its other observable typical characteristics on both temporal and spatial scales. The impacts and effects of variability in climate are mostly common and highly experienced in the ASALs that happen to be deficient in moisture. These arid and semi-arid lands with extreme inter annual rainfall and temperature variability inherently dominate many parts in the tropical regions of Africa, including Kenya and its neighbors. Characteristics of these climatic conditions include severe and prolonged droughts with devastating effects featuring very prominently.

Climatic elements and especially rainfall and temperature are subject to variations in many parts of the world, exhibited mainly by fluctuations in rainfall and temperature on both temporal and spatial scales. Africa happens to be one of the leading victims of the global variations in climate and eventually climate change. This situation has culminated in the spreading of desert conditions and characteristics in the Sahelian Africa and other areas in the neighborhood of the major continental deserts including Kalahari, Namib and Sahara. The most effective and efficient mitigation strategies should be brought on board to help cushion the residents of these areas from the adverse effects of these conditions.

Extremely high variations in both rainfall and temperature with considerable uncertainties when the rainfall onsets are expected is becoming a global concern. This situation continuously impacts negatively on planned farming activities and calendars particularly in the ASALs of Africa such as Kenya including Baringo the study areas.

The objective of the study was to; Evaluate the farmers perception on the effects of variability in

rainfall and temperature on finger millet and goat farming in Baringo County

The methods of data collection included;

a) Reviewing existing related literature from university and UNEP libraries, internet, journals and periodicals, newspapers and magazines.
b) Collection of secondary documented data from meteorological department, County government departments such as Agriculture, livestock and statistics.
c) House hold questionnaires administered to selected house hold heads as respondent groups within Baringo, the study area.

The data analysis methods included; The analysis and the resulting farmers' perceptions in Baringo County.

Frequent and prolonged droughts are responsible for high deaths of livestock resulting from lack of water and pasture, culminating into reduced production in livestock, such as milk and meat, reduced livestock population, widespread and increasing poverty among the county inhabitants and subsequent shortages. Frequent and prolonged droughts are also responsible for frequent reduction in crop yields and to extremes, increased crop failure leading to severe food shortages, food insecurity, prevalent malnutrition and hunger in the county.

5.3 Major Findings

The study sought to examine farmers' perception the effects of variability in rainfall and temperature on finger millet and goat farming in Baringo County. The following were the major findings of the study.

1. Rainfall variability in seasonal, monthly and annual rainfall adversely affected finger millet, and goat farming particularly through delayed preparation of land, planting, stunted growth of plant sometimes leading to crop failure and decreased crop yields. It was also observed that finger millet and goat production yields fluctuated relative to rainfall and temperature variations and distribution. This was indicated through three major evidences drawn from the analysis results as follows;

i) The respondents' perception on how variations in climate elements especially rainfall and temperature affected the productivity of their farming practices.
ii) Analysis of responses from the household questionnaire revealed various instances when farmers experienced rainfall and temperature variability such as delayed or unexpected onsets of rainfall, prolonged droughts, variations in seasonal yields, the problems encountered as a result of the effects.
ii) The comparison of production trends of finger millet and goats provided by the county agricultural and livestock officers with rainfall and temperature trends provided by Kenya meteorological Services (KMD). The trends from the two sets of dependent variables and independent variables revealed significant relationship.

5.4 Conclusion

The study assesses and analyzes the rainfall characteristics within Baringo County. The analysis reveal a high temporal variability in the County. A comparison of the two Sub Counties clearly shows Baringo South to have more variable rainfall than Baringo North. High variability of rainfall on monthly seasonal and annual basis adversely affects production of finger millet and goats in the County.

Variability in rainfall has had adverse effects on finger millet and goat farming in Baringo County. The variability leads to decreased crop yields and to extremes, it results into crop failure, leading to food shortages, food insecurity and cases of malnutrition.

Baringo residents need to demonstrate the right perceptions of variability in climate if any meaningful solutions to the problems farmers encounter on the effects of rainfall variability on farming activities have to be sought. Otherwise the continuity of the problems would subject subsistence farming to risks culminating into persistent food shortages, hunger and food insecurity.

5.5 Recommendations

The current management crisis in which the government only comes in to act in the event of a climate change disaster occurring as in the case

of floods or droughts by providing shelter, clothing and relief food to the affected victims particularly in flood prone arid and semi-arid areas is detrimental and inadequate. This activity only provides a temporary solution or measures and not a long term solution that could possibly or practically assist these affected communities. The measures do not prevent re occurrence of floods or droughts. It is more important to sensitize the public to make it understand the best ways and strategies to overcome such hazards. The inhabitants of Baringo County need sensitization to actually understand the fact that floods or droughts are a common environmental occurrence and therefore there is an important need for a pre-drought planning to cope up or overcome the problem. Some recommended approaches or strategies to preparedness include the following;

Investment in water supply by harvesting rain water and storing it in reservoir tanks or dams for use in small scale irrigation projects to supplement rainfall in the event of droughts. The occasional abnormal Elnino rains are always known to cause floods in most parts of the lowland dry areas of the county. If this excess water was harnessed and stored in reservoir dams or tanks, it would really be of benefit to irrigation projects and systems to supplement deficits of rainfall during droughts and sustain longer seasons of growing for subsistence crop farming. Constructing of large reservoir tanks to harness and store rainwater to be used in during the droughts period.

Planting short term drought resisting/ escaping crops including sorghum, millet, sweet potatoes and cassava at the earliest onset of the rains, will help to rehabilitate semi arid Baringo County which is adversely affected by climate change and variability. Vegetables and other horticultural crops should be encouraged and planted in plenty as they take a very short growing season. Their characteristics or nature of being perennial provides the possibility of constantly replacing them within the short rains period. In addition, the vegetables and beans can be intercropped with either maize or coffee in the wetter highland areas to intensively utilize the small farms and maximize on the available little rains.

Afforestation and agroforestry which are mitigation strategies applied to counter the effects of climate variability on farming activities, should be more intensified in the wetter highland areas. The government should step up its initiative of enhancing these programs through continuous funding and sensitization, establishment of tree nurseries, tree planting campaigns, as they were rated as being effective in the wetter highland areas.

Both central and county governments to heavily invest and finance the drilling of boreholes to supply water for irrigation during prolonged droughts. This important mitigation strategy has not been fully exploited. Borehole projects can be launched by the government to maximally utilize ground water for small scale irrigation farming.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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