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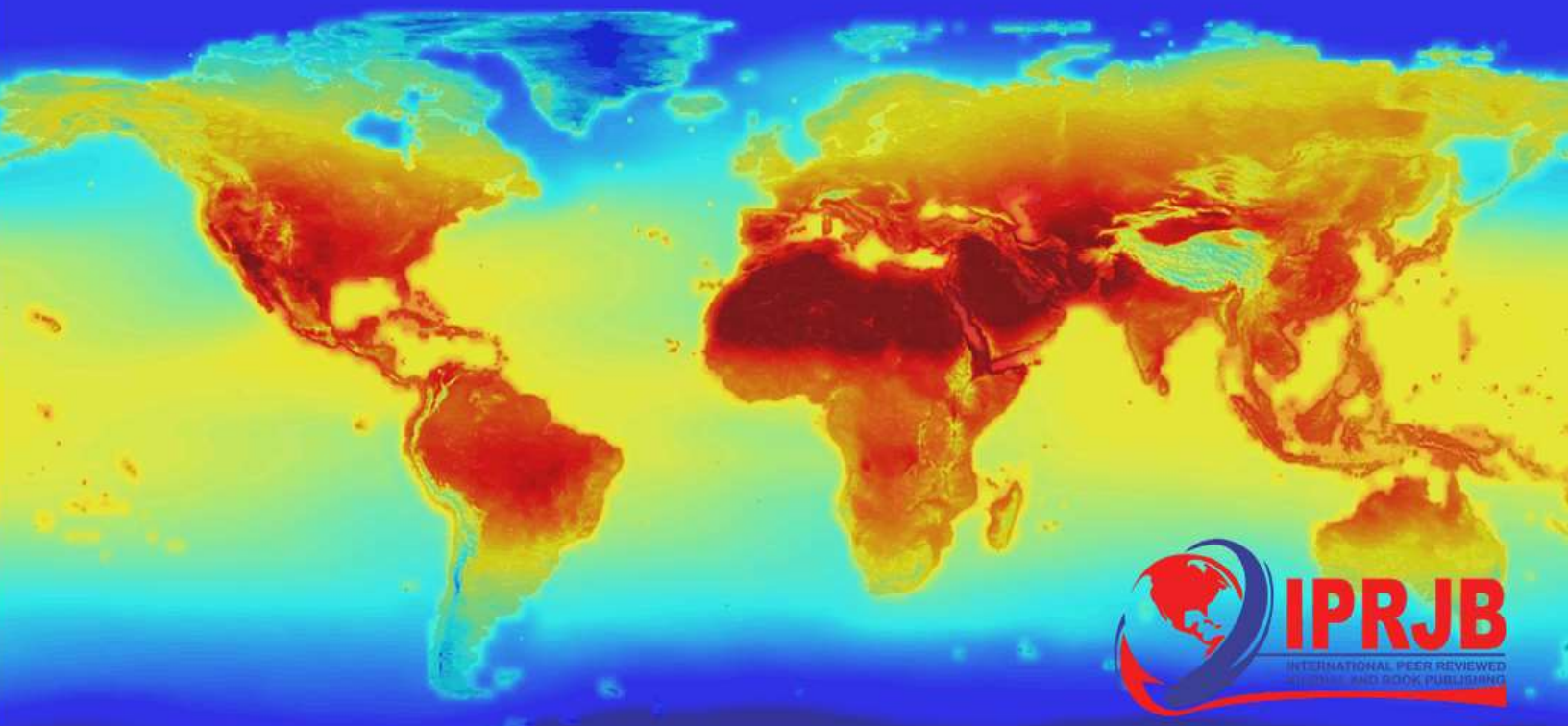

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Abstract

Purpose: The aim of this study is to assess the impact of climate changes on livestock and agriculture.

Methodology: The study adopted a desktop methodology. Desk research refers to secondary data or that which can be collected without fieldwork.

Findings: The study concluded that the impact of climate change in livestock include changes in water availability, animal growth and milk production, production and quality of feed crop and forage, diseases and reproduction and biodiversity. The agriculture sectors is highly affected by lack of rainfall, raising temperatures and greenhouse gases

Unique Contribution to Theory, Practice and Policy: The study recommends that proper education and training programs for agriculture workers, public officials and the personnel from the related agencies should be developed and put into practice so that they can properly cope with climate change. The study also recommends that policies should be put in place to regulate human activities such as deforestation and release of gases to the atmosphere that contribute to the changes in climate change.

Keywords: *Climate Change, Agriculture, Livestock, Rainfall, Temperatures*

INTRODUCTION

A significant change in the average condition of climate-relevant variables over time, typically over a period of more than 30 years, is referred to as climate change. These variables include temperature, precipitation, and wind (IPCC, 2013). Global climate change represents a significant threat to humanity. The Intergovernmental Panel on Climate Change (IPCC, 2013) asserts that climate change has increased global mean sea level and widespread melting of snow and ice. Many differences in ocean salinity, wind patterns and elements of extreme weather such as droughts, heavy precipitation, heat waves, and the strength of tropical cyclones, are among these changes. These changes put social groups, ecosystems and community livelihoods in danger (Silva and Leichenko, 2014). The production of food through agriculture and animals is one significant area that will feel the effects of these climate changes.

Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as variations in average values or/and changes in characteristics that endure for more than 30 years and are brought on by either a change in the natural environment or human activities (Nkondze, 2014). Climate change has an impact on almost every industry and aspect of contemporary life. It influences the frequency and length of extreme weather events such extended periods of above-average temperatures, floods, and timing, as well as the amount and spatial distribution of precipitation, sea level rise, management of tropical storms, and temperatures (Nkondze et al. 2014). Documentation done on how climate change affects farming crops and raising cattle, as well as how these factors influence people's ability to earn a living.

Several conferences and forums have also been organized, where representatives from numerous nations gather, converse, and share thoughts about changes in the environment and their repercussions (Clapp, 2018). Climate change will have an immediate impact on agriculture, the environment, human health, food security, and water supply, according to the IPCC (2007). Evaluations of temperature estimates since the first IPPC report was released in 1990 have revealed that the average global temperature is increasing by 0.15 to 0.3 degrees Celsius every decade. The average global temperature is predicted to have increased 3% by 2050 as a result of greenhouse gas emissions.

The UNDP also listed the following as major threats to the continent: population growth, land deterioration, desertification, and over use of natural resources like forests (UNDP, 2007). According to a 2013 FAO estimate, a severe water crisis would likely exist by 2020 for populations above 200 million owing to climate change. Millions of people's quality of life will be significantly impacted by the expected reduction of up to 50% in the yield from rain-fed agriculture in some African states. According to the UNFCCC (2007), agricultural yields, especially food availability, are heavily sold off in many African states. This might have a substantial impact on the continent's food security issue. Most subsistence crops, including maize, groundnuts, and millet, will experience a significant decline due to changes in the atmosphere in various parts of Africa (Vanhala, 2016).

The advocates of the human security approach to the study of environmental security who prefer to concentrate on how climate change may obstruct development concur that the effects of climate change can undermine livelihoods, cause a shortage of essential resources, increase poverty levels,

and result in a general decline in the quality of life. According to the 2007–2008 UN Human Development Report, climate change poses a serious threat to human development and is already impeding efforts by the international community to end extreme poverty in some regions. Overall, this will make people's socioeconomic vulnerability worse and make it harder for them to adapt to a more hostile environment.

After initially being portrayed as an environmental issue and subsequently an energy one, climate change is now being reframed as a security threat. The idea that environmental difficulties present a security risk has received a lot of attention in the literature on environmental security, and there are currently a number of strategies to resolve environmental conflict. The most prevalent of these emphasizes how environmental shortage contributes to conflict on its own. This idea's most notable development has been attributed to The Toronto Group, which was led by Thomas Homer-Dixon (Homer-Dixon, 2015). Thomas Homer-Dixon asserts that when finite renewable resources (such agriculture and river water) mix with unfavorable societal effects, conflict may develop (like population displacement or economic decline). 51 Kaplan popularized the idea that environmental restrictions may cause conflict directly or indirectly or may do it indirectly by causing environmental insecurity.

Global Perspective

According to Chen 2016, studies on how climate change is affecting Chinese agriculture have demonstrated how it is affecting the country's primary crops' yields. According to research, climate change's effects on agriculture production will be greater for spring wheat than for winter wheat. For one crop of rice, crop yields will steadily decline from the south to the north. Early rice yield will decline, with the central south of the Yangtze River experiencing the least amount of a decline. In the surrounding areas, notably in areas in the west, there will be a significant decline in production. The yield of late rice would all decrease greatly in the northwestern regions of the regions south of the Yangtze River, but less so in the south-eastern regions. There may be a decrease in the output of the three key crops, maize, rice, and wheat. Although China's ability to produce enough grains on its own, the nation would need improved agricultural production management techniques among other things to face the climatic challenge.

According to Kumar (2016), the issue is made worse by the perception of a slow but steady increase in environmental deterioration, the early effects of which are already being seen in regions of India that profited much from the Green Revolution's technological advancements. The degradation of irrigation water quality, for instance in north-western India, and the reduction in soil fertility, as well as the shift in the water’s level and the rise in salt, are all major causes for concern today. So, one of the main issues facing Indian agriculture in the twenty-first century will be to coordinate food production with both poverty reduction and environmental protection. The two additional significant worldwide drivers of change in agriculture in the ensuing decades globalization and climate change may also put into consideration by the 20-year roadmap for developing agriculture sustainably. India is being driven to make structural changes in the agriculture sector in order to increase its efficiency and competitiveness as a result of the continuous globalization process and multilateral trade liberalization linked to the World Trade Organization (WTO).

According to Kim (2015), Korea is well-known for its rice, and the cultivation period—which is determined by the environment and the type of rice—is the fundamental requirement for scheduling its production. Temperature is a crucial consideration when choosing the best time to plant rice among various agricultural environment conditions. In general, rice is a summer crop, and when the temperature rises, the area that may be used for rice cultivation expands to the north, and the variety and method of cultivation also alter to accommodate the change in temperature. The cultivation zones for rice's early and medium maturing varieties will switch places, and the cultivation zones for late maturing types will switch places with the early kinds. Certain early-maturing rice varieties may even be able to be produced in mountainous regions, where rice production has hitherto been difficult due to low temperatures, at an altitude of 600 meters or higher, according to reports.

Regional Perspective

Africa is one area of the world where the effects of climate change are being felt most keenly. African nations are projected to be the major victims of weather variability due to a lack of institutional, development, and economic capability (IPCC, 2013). As a result, the effects of climate change might potentially impair or even reverse the progress made in increasing the socioeconomic well-being of Africans, including East Africans (Adhikari, 2015). The negative effects of climate change are exacerbated by a number of other variables, such as widespread poverty, human diseases, and dense population. It is predicted that as population pressure rises, demand for food, water, and grazing land would all increase by a factor of two (Davidson, 2022).

Due to their limited adaptive capacity, Arid and Semi-Arid Lands (ASALs) and the disadvantaged in society are the most vulnerable to and likely to be struck hardest by climate change (IPCC, 2013). The risks pose a threat to rural residents who are living in abject poverty all over the world. Developing nations contribute little contribution to greenhouse gas, however they are nevertheless suffering its effects.

Hence, millions of people living in Africa's arid and semi-arid territories face a major danger to their livelihoods and food security as a result of climate change (WWF, 2006). This is due to the fact that the whole Sub-Saharan Africa (SSA) region's agricultural systems and food production depend heavily on rainfall, which is climate-sensitive (Wato, 2016). The semiarid tropics' coefficient of variation of rainfall can reach 50%, according to climate analysis from the area, whereas the majority of the annual rainfall frequently occurs in a small number of rainfall events during three to five months of the year. Several sections of Africa are predicted to have a more severe fall in food output, which would result in famine, malnutrition, insecurity, and migration (Wato, 2016).

Statement of the Problem

By advancing human objectives, food policy should benefit humanity and end hunger and poverty. Emerging influences, such as climate change, have recently put these objectives in jeopardy. Environmental and agricultural economists generally concur that a major threat is posed by climate change. to guaranteeing sustainable agriculture. According to the United Nations Development Programme (UNDP), Africa is one of the continents that is most affected by climate changes since

it experiences more severe consequences than other regions of the world. This is because the majority of the African economy's sectors are dependent on the environment, and the continent has very little capacity to survive in such environment (Wachira, 2021). It is obvious that a changing climate could halt the progress already made in the fight to end hunger in the world. This is based on the idea that due to short-term supply fluctuation brought on by climate change, the stability of the entire system of food production may be put at risk (Haile, 2017). The impact of climate change on agriculture and livestock productivity varies, though, across Kenya. Thus, this study looks into how climate change may affect farming and animal raising.

LITERATURE REVIEW

Theoretical Framework

Agro-Economic Model

The problem of underestimation arises from the agro-economic model's use of the crop production function to analyze the economic effects of climate change. This model does not take into account the indirect effects of climate change, such as crop conversion and the modification of input factors for adaptation to climate change. As indicated in the paper's introduction, the Ricardian model was created to address this issue (Seo, 2019). This model calculates the discounted value of future rent using the estimated current price of farmland as a component. It basically presupposes that, in a long-term balanced state where all production factors fluctuate along with climatic change, the price of farmland represents the quasi-rent, or the profit from using the farmland. While it can involve adaptation that cannot be precisely quantified or defined, it has a benefit in terms of assessing the impact of weather changes. It is frequently used to evaluate the financial effects of climate variability because it measures the change in farmland value or revenue by taking into account both direct impacts, such as changes in crop productivity. Collateral effects such as the replacement effect of input production factors and modifications in the use of farmland (Lee, 2016).

The Ricardian Approach Model

Literature does a good job of indicating how vulnerable the agricultural sector is to both variability and climate change. It is understandable that shifting temperatures and the consequent precipitation will alter water and land regimes, which will have an impact on agricultural output. Early crop production models used a production function method to account for the climate change's implications on agriculture (Bajelj, 2014). The approach, which employed just major grains and excluded animals and was dependent on intricate crop-yield models, rather failed to take into account all agricultural operations in farms. Also, farmers who changed their inputs to make substitutes or tweaks to lessen their susceptibility to climate change were already predisposed towards taking adaptation measures. One strategy for accounting for adaptation is the Ricardian method (Mendelsohn et al., 1994). By comparing the net profits of farmers in various climates throughout space, the Ricardian model estimates the effects of the climate. The Ricardian approach implicitly incorporates it because farmers everywhere have adapted to their particular environments. At the beginning, the Ricardian model was used in industrialized nations, namely in American agriculture (Huong, 2019).

Also, the approach has been used in a larger African context. According to Pourzand (2011), cross sectional methods combined with annual data analysis are used to estimate the majority of nonmarket valuation models, including the Ricardian model. Even though numerous years of data should make methods like that more robust, repeated cross sections indicate the findings are very steady. Repetition of cross sections does not adequately characterize the model, according to Kurukulasuriya and Mendelsohn's 2017 argument. Because it implicitly considers the adaptation strategies taken by the topic under study, the Ricardian model is hailed as the best model to assess the effects of climate change on agricultural and livestock output.

An investigation of how much agriculture has been impacted by climate change in Kenya was conducted by Kabubo-Mariara and Karanja (2018) using the Ricardian approach. The study demonstrates that Kenyan agriculture is significantly impacted by climate change. It also demonstrates that medium and low potential zones have a higher likelihood of being further impacted by the increased warmth brought on by global warming than by a decrease in precipitation. According to the study's findings, agricultural products are impacted by climate change. Precipitation increases have the effect of raising net crop revenues.

Empirical Review

Ali (2020) conducted research on Bangladesh's perspective of the implications of global climate change on cattle. Climate change poses both direct and indirect risks to cattle production and health. Because extreme weather events particularly greater temperatures are happening more frequently, their effects on livestock's health such as heat stress, metabolic dysfunction, oxidative stress, and immune suppression, are more pronounced. This raises the risk of sickness occurrence and fatality. The spread and proliferation of parasites, as well as the reproduction, pathogenicity, and transmission of infectious pathogens and/or their vectors, are examples of indirect health consequences. The management of Bangladesh's expanding crossbreeding cattle business is also directly impacted, with unknowable repercussions for the occurrence of new and reemerging illnesses.

Kim (2012) examined the implications of the agroindustry for low carbon, green growth strategy, and a roadmap for the East Asian region in relation to the impact of climate change on agriculture. The agricultural sector's responses to climate change focussed on reducing greenhouse gas emissions. Yet, given the inevitable effects of global warming and the peculiarities of agriculture depending on the environment, more attention and policy support should be given to adaptation strategies. It's crucial to comprehend that the agricultural sector's defenses against climate change focus on reducing the dangers and seizing the opportunities presented by it. For this, appropriate education and training programs should be designed and implemented for agricultural workers, public servants, and the staff from connected organizations so that they can effectively cope with climate change.

Okati S. K Juma (2010) conducted research on the effects of climate change and variability on livestock-based livelihoods. Cattle, sheep, and goats make up the bulk of the livestock species. The primary production methods in this area are nomadism and transhumance. This region is characterized by climate unpredictability and change, which manifest as periodic droughts and flash floods. The primary conclusions were that the number of cattle per person has decreased from

100 to 4 due to climate change. It was discovered that there were now ten sheep and goats for every person, up from five previously. Donkeys now average four per household, and camels have also been introduced to the neighborhood. There are more donkeys and camels being utilized to transport water, which suggests that there is more water stress. As a result, the populace is now more vulnerable in terms of their means of subsistence.

Rajesh (2022) conducted research on how climate change is affecting livestock in New Zealand. He stated that various changes in water availability, animal growth and milk production, the production and quality of feed crops and pasture, illness and reproduction rates, and biodiversity are only a few of the potential effects of climate change on livestock. The increase in air temperature, the concentration of carbon dioxide (CO2), variations in precipitation, and a combination of these elements are the main causes of the consequences mentioned above. Most of the important elements that affect the production of livestock, such as water availability, animal output, reproduction, and health, are also impacted by the rise in environmental temperature brought on by climate change. Variations in temperature, CO2, and precipitation all have an impact on the quantity and quality of forage. The primary effects of rising temperatures and changing precipitation on livestock illnesses. Even chickens, rabbits, and horses experience reduced fertility when the ambient temperature is high. Adult New Zealanders' exposure White rabbits exposed to extreme heat stress had significantly lower conceiving rates.

Gekemi 2022 conducted a research to determine how vulnerable the Southern Nyanza region's smallholder maize output is to adverse consequences of climate change. The study found that rainfall was generally declining while maximum and lowest temperatures were significantly increasing. The productivity of maize, the state of the infrastructure, and socioeconomic development all played a significant role in the study counties' vulnerability indices. Due to the high temperature increase, smallholder maize output in the Southern Nyanza region was usually vulnerable to climate change. Future predictions indicate that these tendencies will continue, increasing the vulnerability of Southern Nyanza region's smallholder maize output.

Sunguti (2021) conducted a research to evaluate the effects of climatic variability and change on maize productivity in Narok County. The analysis found that the majority of stations' rainfall onset dates showed an increasing tendency, suggesting that showers had been arriving later than usual lately. Most of the study sites had an early end to rainfall because the rainy season cessation dates showed a declining tendency. Growing season length showed a declining tendency, indicating a shorter or shorter growth season. For the majority of stations, the seasonal total rainfall during the main season fell. The length of dry spells lengthened during the research period. On the other hand, the intra-seasonal wet spell lengths showed a declining tendency, indicating shorter wet spells over the study area. The season's total number of wet days showed a trend toward decline, suggesting fewer rainy days overall. A rising trend was seen in the GDD, temperature range, maximum, and minimum temperatures.

Nasambaya (2018) determined how vulnerable the counties of Trans Nzoia, Uasin Gishu, Narok, and Nakuru are to the effects of climate change on maize production. The study used biophysical and socioeconomic data from the Kenya National Bureau of Statistics (KNBS), the Ministry of Agriculture, Livestock and Fisheries (MOALF), and the Tegemeo Institute of Agricultural Policy

and Development, as well as historical climate data from the Kenya Meteorological Department and simulated climate data from CORDEX for the CNRM model for the period between 2021 and 2050. (TIAPF). Temperatures climbed significantly, according to the trend study, whereas rainfall increased generally but not significantly during the baseline period. The outcomes demonstrated that all counties will experience a considerable increase in temperatures at both extremes during the study period. The correlation data demonstrated a connection between climate and maize yields. Across the maize growth stages, the association's intensity and direction varied.

METHODOLOGY

The study adopted a desktop methodology. Desk research refers to secondary data or that which can be collected without fieldwork. Desk research is basically involved in collecting data from existing resources. Thus, the study relied on already published studies, reports and statistics. This secondary data was easily accessed through the online journals and library.

RESULTS

The results were grouped into various research gap categories namely as conceptual, contextual, and geographical.

Conceptual and Contextual Gaps

Studies conducted by Ali (2020) present a conceptual gap as it only focuses on livestock production while the current study will focuss on both livestock and agriculture and the factors that lead to climate change. Kim (2012) also present a conceptual gap as this study focuses on agriculture sector and addressed greenhouse gas mitigation and this study will address all the other factors. Rajesh (2022) study present a contextual gap as it focused on the impact of climate change on livestock while the this study will also focuss on agriculture sector.

Gekemi 2022; Sunguti (2021); Nasambaya (2018) had a conceptual framework, All this studies did not discuss the impacts of climate change on livestock and agriculture in a clear manner. Therefore the current study seeks to address these conceptual gaps.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the results of the literature analysis, the study came to the conclusion that alterations in milk output, animal growth and water availability, productivity and standard of feed plants and forage, illnesses and reproduction and biodiversity are all affected by climate change in livestock. Lack of rain, rising temperatures and the influence of greenhouse gases is substantial on the agriculture sector. Hence, policy assistance for adaptation strategies should be focused on taking into account both the peculiarities of agriculture that is climate-dependent as well as the inevitable effects of global warming. It's crucial to comprehend that the agricultural sector's defenses against climate change focus on reducing the dangers and seizing the opportunities presented by it. The study also showed that in order for agricultural workers, public servants, and employees of relevant agencies to effectively deal with climate change, appropriate education and training programs needed to be designed and implemented.

The study came to the conclusion that because of extreme weather conditions, such as high temperatures, metabolic disorders, oxidative stress, and immunological suppression in livestock, there is a higher risk of disease incidence and mortality. contributes to the virulence, low reproduction, and transmission of infectious diseases, as well as the spread of parasites and their vectors.

Variations in atmospheric temperature, carbon dioxide (CO2) content, and precipitation patterns are the main drivers of weather changes. The main causes include global warming, human activities like deforestation, and gas emissions. By limiting human activity and using adaption techniques like raising cattle that can tolerate the environment's high temperatures and little rainfall, humans can deflect this.

Recommendations

The report suggests that appropriate education and training programs be created and implemented for agricultural workers, public servants, and employees from associated agencies so that they can effectively deal with climate change. The study also suggests that laws be passed to control human actions which is a core factor in climate change such as deforestation and gas emissions into the atmosphere.

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