



Examining the Comprehensive Impact of Climate Change on Agro-Pastoral System: A Critical Review

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Abstract: The study investigates the “Impact of climate change on agro-pastoral.” Agro-pastoral communities face a lot of difficulties due to climate change. The study aims to identify the influence of ‘climate change’ on the income of ‘agro-pastoral communities’ and to assess the impact of climate change on the food of livestock. The study uses descriptive analysis to gather data. The study is done using secondary data. The study shows that climate change badly affects the agro-pastoral communities and their livestock. Agro-pastoral communities play a crucial role in primary industries, and any impact of climate change on these communities directly affects the primary industries. The study drives climate change's effect on the movement of agro-pastoral communities and reduces the income of these communities. All national governments must be serious about fast-changing climate conditions and minimize the effects of climate change. Agro-pastoral community's problem must be solved for the future expansion of the economy and earth.

Keywords: *Agro-pastoral, Climate change, livestock*

1. Introduction

The urgency to address climate change has become increasingly apparent as the world experiences increasing tangible impacts. A lot of abundant evidence of a rapidly changing climate is demonstrated by deadly wildfires, increasingly frequent extreme weather events, and rising sea levels that pose a threat to coastal communities. The rising global temperatures emphasize the immediate need for concerted actions to reduce greenhouse gas emissions and adapt to the changing climate. Every passing day reduces the opportunity to mitigate the catastrophic effects of climate change, highlighting the urgent requirement for decisive and determined action in all areas of society and governance (Rahman, et. al., 2013). Climate change is now disrupting societal and environmental systems, and substantial disturbances are anticipated in the future, even with the



most optimistic emission reduction scenarios. Climate change poses a threat to several aspects that are important to humans, such as ecological services, species, economic sectors, landscapes, dwellings, and human health. Many climate and related investigators assume that society only considers climate change important when climate change affects tangible aspects of well-being, especially those that can be measured in economic terms. The study of the "Impact of climate change on Agro-Pastoralism" is essential as these communities provide key resources that influence food prices in the global market. The issues faced by these communities, including land degradation and water scarcity, need to be identified and addressed. While they engage in both animal husbandry and agriculture, the primary source of income of households comes from pastoral activities.

A) Climate change

Climate change is a shift in the Earth's climate caused by human activities, which affects the makeup of the atmosphere on a global scale and goes beyond natural variations in temperature. Climate change refers to any alteration in climatic patterns over a period of time, which can be caused by natural fluctuations or human actions (Dietz, et. al., 2020). Climate change is the extended modification of Earth's climate patterns, such as changes in temperature, precipitation, wind patterns, and other climatic elements, mostly caused by human activity, particularly the release of greenhouse gases into the atmosphere (Romm, (2022)). Activities like deforestation, burning fossil fuels, industrial processes, and agriculture have caused a significant rise in greenhouse gas concentrations such as methane, nitrous oxide, and carbon dioxide resulting in trapping heat in the Earth's atmosphere and causing a rise in the planet's normal temperature (Pielke Jr, 2004). Climate change directly impacts human rights such as the right to life, cultural participation, property use, adequate living standards, food, and physical and mental health (Yusoff, et. al., 2011). The 'High Representative' and the 'European Commission' to the 'European Council' released a statement on Climate Change and International Security, stating that climate change amplifies current trends, tensions, and instability, making it a danger multiplier. The argument states that climate change will lead to insecurities such as disputes over scarce resources, land loss, border conflicts, energy source disputes, migration-induced conflicts, and tensions between polluters and those affected by climate change (Caney, 2015).



B) Agro-pastoralism

Agro-pastoralism is a land use and livelihood approach that involves combining agricultural production with animal husbandry in the same farming system. Agro pastoralism is the practice of cultivating crops and rearing cattle in a mutually beneficial partnership. Agro-pastoral systems depend on the mutual advantages of crop leftovers as animal feed and animal waste for enhancing soil fertility and establishing a sustainable and efficient agricultural environment (Høgestøl, et. al., 2006). Agro-pastoralism, which enables farmers and herders to maximize output and optimize land usage, is widely practiced in locations where arable land and grazing grounds coexist. The conventional farming method is known for its capacity to withstand environmental fluctuations and adjust to evolving circumstances, playing a crucial role in rural economies and food security worldwide (Karmebäck, et. al., 2015). Agro-pastoralism is a diverse type of pastoralism that combines farming, and the degree of integration of agriculture ultimately influences the specific agropastoral community (Lane, 2006). Agro-pastoralists engage in both agricultural production and animal husbandry on the same piece of land. Livestock is essential in agro-pastoral systems as it provides manure for fertilizing crops, while agricultural leftovers and by-products are used as animal feed. Agro-pastoralism enables people to broaden their livelihood options by participating in both farming and herding activities. Diversifying can disperse risks and provide protection against uncertainties like droughts or crop failures (Namgay, et. al., 2013). Agro-pastoral systems frequently function in marginal or semi-arid areas where the conditions may not be ideal for growing crops. Small ruminants such as sheep and goats may graze on vegetation that is not ideal for growing crops, allowing for the utilization of areas for food production (Cheng, et. al., 2022). Agro-pastoralism encourages sustainable land management through practices including crop rotation, agroforestry, and rotational grazing. These measures aid in preserving soil fertility, reducing erosion, and enhancing overall land production. Agro-pastoralism frequently has strong cultural and traditional foundations, with knowledge and practices transmitted over generations. Conventional agro-pastoral systems are tailored to specific local environmental factors and integrate native wisdom on land utilization, crop variety, and livestock care (Wang, et. al., 2021). Agro-pastoral systems gain resistance to climate unpredictability by integrating crops and animals. During droughts, farmers may depend more on animal products for sustenance and revenue, while livestock may feed on agricultural waste and fallow fields (Deng, et. al., 2016).



This literary work examines the effects of Climate Change on Agro-Pastoral communities, including reduced snow cover and sea ice, and changes in precipitation patterns. The Arctic is undergoing the most rapid warming, with sea ice melting adding to the increase in sea levels. The study examines the issue and consequences of Climate Change on Agro-Pastoral communities. The present review paper is organized into six sections. The first section presents an introduction to the impact of emerging technologies on organizational structure, its definitions, and its significance. The second section presents a literature review. The third section presents the objectives of the present review paper. The fourth section is applied to the research methodology that describes the study's overall approach, and data collection methods. This is followed by the fifth section which presents the discussion by previous authors on the objectives of the present review paper. The sixth section presents the conclusion which summarizes the main findings and significant aspects of the study.

2. Literature review

Godde, Mason-D’Croz, et. al.(2021) studied the impact of climate change on the cattle feeding supply chain. The study was difficult to precisely quantify the full extent of climate change's influence on the cattle business. The study provided compelling data indicating that there will be consequences across the whole supply chain, including agricultural production, processing, storage, transportation, retail, and consumption. Climate-related hazards were expected to rise in regions that are already warm and lack sufficient socio-economic and institutional resources for adaptation. Therefore, assessments of adaptability need to consider many potential future situations, including those with a low likelihood but significant impact

Menghistu, et. al. (2020) investigated the determinants of smallholder farmers' and agropastoral communities' adaptability to climate change in sub-Saharan Africa. The study set out to evaluate the elements that contribute to “climate change adaptation”(CCA), in “sub-Saharan Africa” (SSA). The main determining factors in the case of agro-pastoralists were found to be age, knowledge availability, household income, and ownership of land and cattle. The study identified the primary influencing elements based on production systems and emphasized the significance of addressing particular aspects while building CCA strategies.



Kaczan&Orgill-Meyer (2020) investigated how people in areas vulnerable to drought, floods, and temperature swings will respond to climate change as a result of a study into the human effects of climate change. The study showed that climate change led to substantial increases in human migration as families struggled to adjust to the impacts of changing climatic conditions. The study demonstrated that migration patterns changed based on the severity of climatic disasters and the household's capacity to travel, among other things. Together, characteristics account for four main trends observed in the study. (1) Poorer households did not necessarily experience higher rates of climate-induced migration; (2) Long-distance domestic relocations were more common in climate-induced migration compared to local or international moves; (3) Migration was more likely to increase due to gradual climate changes like droughts rather than sudden changes like floods; and (4) The intensity of climate shocks affected migration in a nonlinear manner, with the dominant influence being either capability or vulnerability.

Kgosikoma, Lekota, et. al.(2018) examined the elements that impact the adaptation of agro-pastoralists to climate shift. The study aimed to investigate the perceptions of smallholder farmers on climate change and its associated pressures. Information was gathered through in-person interviews using a standardized questionnaire. The study recommended that climate change policy should prioritize enhancing agricultural diversification at the family level and provide information on weathervariation and adaptation policies. The study recommendations can be proposed Government initiatives for climate change should prioritize diversifying agriculture at the family level. The study provided insights on factors affecting adaption processes and highlighted areas for improvement to strengthen resilience in the agriculture industry.

Rojas-Downing, Nejadhashemi, et. al.(2017) investigated the impacts of climate change on cattle and strategies for adjusting to mitigating effects. Global demand for animal products was expected to double by 2050, mostly due to improvements in global living standards. Climate change threatens livestock productivity through its impact on feed crop and forage quality, water availability, animal and milk production, livestock health, animal reproduction, and biodiversity. The transition to sustainable livestock production necessitated assessments of tailored adaptation and mitigation strategies based on the specific location and livestock production system in use, as well as the implementation of regulations that provision and simplify the adoption of strategies to address weather change.



Berhe, Hoag, et. al.(2016)examined the climate hazards and effects on the environment and people in arid regions, where pastoralists and agro-pastoralists mostly live, which had been the main policy concern in Africa. The study aimed to investigate the effects of various adaptation strategies on the income of pastoralists and agro-pastoralists in northern Ethiopia. The study discovered that repeated droughts, linked to climate change, led to a substantial reduction in livestock numbers for pastoral and agro-pastoral populations because of inadequate animal feed. Cattle owners generated income from cattle, crops, fuelwood sales, agricultural wages, remittances, and disaster assistance. Sustained revenue creation through various adaptation measures was essential to help pastoral and agro-pastoral communities deal with the bad impacts of weather change.

Thornton, van de Steeg, et. al. (2009)studied the effects of weathershifts on cattle and cattle systems in underdeveloped nations. The study on the effects of weathervariation on livestock systems in poor countries was insufficient, despite the crucial role livestock plays in the livelihoods of impoverished persons and the possibility of considerable alterations in agro-pastoral systems. Livestock systems in various tropical and subtropical climates were rapidly changing, leading to great regional variability in how families respond to climate changes. Enhanced rangeland and agricultural conditions might be advantageous for certain households but were likely to pose substantial difficulties for others. The study suggested that organizations could be forced to modify aims to address the needs of vulnerable livestock caregivers more effectively in the future.

3. Objective of the study

The following objectives have been considered:

1. To identify the ‘impact of climate change on the income of Agro-Pastoral communities.’
2. To assess the ‘impact of climate change on the food of livestock’
3. To identify the ‘impact of climate change on migration’

4. Methodology

The review article "Impact of climate change on agro-pastoral" is a descriptive study that tries to determine the effects of climate change on the lifestyles and standard of living of the Agro-Pastoral community. The study is done using secondary data. The author consistently focused on the study's objectives and meticulously chose the necessary data to achieve them. Secondary data sources



include newspapers, books, journals, research papers, and academic working papers. The study explores how climate change affects the primary industries and strategies to overcome climate change. Climate change endangers agro-pastoral systems by disrupting ecosystems, changing precipitation patterns, and intensifying extreme weather events. This results in decreased agricultural productivity and difficulties in managing livestock. To address these challenges and safeguard food security for agro-pastoral communities, it's crucial to implement adaptation measures like sustainable land management and diversified livelihoods.

5. Discussion

I. To identify the ‘impact of climate change on the income of Agro-Pastoral communities’

Climate change affects the income of agro-pastoral communities in diverse ways, influenced by geographical location, local socio-economic factors, and adaptation abilities. Climate change can cause shifts in temperature and rainfall patterns, resulting in changes in growing seasons and more frequent occurrences of floods, droughts, and various other extreme weather events (Thornton, et. al., 2015). These alterations can greatly diminish crop production and grazing areas, thus affecting the revenue earned from agricultural operations. Increasing temperatures and alterations in precipitation patterns impact the accessibility and standard of pasture and water supplies for cattle, this can result in greater expenses for additional food and water supply, reduced animal production, and increased death rates, thus lowering the revenue generated by livestock-related endeavours (Tadesse, et. al., 2016). Agro-pastoral communities in marginal areas are very susceptible to climate change effects because they depend on rain-fed crops and intensive livestock farming (FAO, 2019). Climate-related shocks worsen current vulnerabilities, resulting in financial losses due to failed crops, dead animals, and higher healthcare costs. Agro-pastoral communities utilize many adaptation measures to mitigate the effects of climate change and protect their incomes. Strategies may involve diversifying livelihoods, using climate-resilient agricultural types, implementing water-collecting techniques, practicing soil conservation, and accessing weather information and insurance programs (Ngigi, et. al., 2018).

Understanding the effect of climate change on the income of agro-pastoral communities necessitates a comprehensive assessment from several perspectives. Climate variability impacts crop yields, grazing patterns, and water availability, directly affecting the economic productivity of



these communities (Tubiello et. al., 2007; Thornton et. al., 2009). Droughts occur more often, and unpredictable rainfall can result in crop failures and reduced feed availability, affecting agricultural and animal productivity(Seo and Mendelsohn, 2008; Vermeulen et. al., 2012). Decreased revenue from farming and herding worsens poverty and food insecurity for agro-pastoralists, particularly in emerging areas(Morton, 2007). Implementing strategies including diversifying livelihoods, boosting water management, and providing access to climate-resilient technology is essential for improving the resilience and economic stability of agro-pastoral communities in response to climate change(Bryan et. al., 2013).

II. To assess the ‘impact of climate change on the food of livestock’

Evaluating how climate change affects the food sources of cattle is essential for comprehending the wider consequences for agricultural production and food security. Changes in temperature and precipitation caused by climate change can impact the quantity and quality of food available for cattle, which can influence the nutritional intake and overall health. Alterations in plant species and timing of growth, together with more frequent severe weather events like droughts or floods, can reduce the quality and quantity of pasture, resulting in a shortage of feed supplies. Rising temperatures might worsen pest and disease issues for crops and pastures, which could further reduce the supply of animal feed. The influence of climate change-induced changes in rainfall patterns on the distribution of fodder plants and its effects on cattle grazing patterns and production(Thornton et. al., 2018). Implementing adaptation options including enhanced pasture management, water collecting methods, and growing drought-resistant forage crops can reduce the negative impacts of climate change on cattle feed supply(FAO, 2020). Furthermore, enhancing resilience in livestock production systems may be achieved by boosting variety in feed sources and incorporating agroforestry activities(Thornton et. al., 2018). Thus, a thorough evaluation that considers ecological, agronomic, and climatic elements is essential to reduce the negative impacts of climate change on livestock food supply and to enhance the resilience of agro-pastoral systems.

III. To identify the ‘impact of climate change on migration of agro-pastoral communities’

Climate change significantly influences the migration patterns of agro-pastoral groups, leading to extensive consequences. Climate unpredictability and extreme weather events are increasing, posing considerable challenges to the conventional livelihoods of agro-pastoralists and prompting them to



find alternate sources of subsistence. Studies such as those by Henry et. al. (2004) and Black et. al. (2011) have documented how changing climatic conditions, including prolonged droughts, erratic rainfall, and declining pastureland, have led to increased migration among agro-pastoral communities in regions like Sub-Saharan Africa and Central Asia. The migrations are typically marked by relocation, loss of cultural identity, and increased susceptibility to poverty and food insecurity (Mortreux & Barnett, 2009). Additionally, the arrival of migrants in metropolitan areas that are already under pressure can worsen social conflicts and burden local resources (McLeman & Smit, 2006). Migration can serve as a coping mechanism for agro-pastoralists, enabling them to broaden their sources of income and tap into improved chances in non-agricultural fields (Hunter et. al., 2015).

Climate change has a detrimental impact on agriculture and horticulture, leading to a shortage of resources and food. To address the issues faced by migration among agro-pastoral communities caused by climate change, effective adaptation and mitigation strategies are essential. Strategies involve creating sustainable land management techniques, allocating resources to agriculture that can withstand climatic challenges, and establishing social support systems for communities that are in danger. (FAO, 2016). Policies that support inclusive governance, fair resource distribution, and community-driven adaptation initiatives can enhance resilience and decrease the necessity for involuntary migration (Warner et al., 2010). Climate change's effect on the movement of agro-pastoral communities highlights the immediate requirement for holistic, multidisciplinary strategies that focus on the welfare and rights of at-risk people while promoting sustainable development in response to environmental shifts.

From the above discussion, it is clear that agro-pastoral communities badly suffer from climate change. Climate change is one of the main causes of migration of agro-pastoral communities and it also affects their income and livestock. Floods, droughts, and heat waves are becoming more often and more intense as a result of climate change. These occurrences can severely damage crops and pastures, resulting in food insecurity and financial setbacks for agro-pastoral communities.



6. Conclusion

“Impact of climate change on agro-pastoral systems” has revealed significance that underscores the vulnerability of these systems to changing environmental conditions. The study demonstrated that Climate change is causing shifts in temperature and precipitation patterns, altering the suitability of certain areas for agriculture and pastoralism. Regions once conducive to certain crops or livestock may become unsuitable, leading to changes in land use and agricultural practices. Altered precipitation patterns and heightened evaporation rates are causing water scarcity in several agro-pastoral areas. This stress impacts agricultural output and water availability for livestock, resulting in decreased yields and livestock productivity. Climate change is causing an increase in the frequency and severity of flooding, extreme temperatures, and droughts. These occurrences can severely damage crops and pastures, resulting in food insecurity and financial setbacks for agro-pastoral communities. Climate change endangers biodiversity in agro-pastoral systems by disturbing ecosystems and habitats. The decline in biodiversity can lead to a series of consequences on ecosystem services including pollination, soil fertility, and insect control, ultimately reducing agricultural output. Agro-pastoral communities, especially those in peripheral regions, are extremely susceptible to the effects of climate change since they rely on natural resources for their sustenance. Climate-related disturbances can worsen poverty, food insecurity, and social unrest in these areas. Hence climate change's worsening effect on agro-pastoral communities and also livestock of these communities.

Future studies will target addressing and reducing the impact of climate change, such as severe deficiencies, water shortage, strong fires, increasing sea levels, waves, vaporizing ice, intense storms, and declining biodiversity. Further study will investigate the impacts on pastoralism and agriculture due to shifts in temperature, patterns of precipitation, and the frequency and severity of extreme weather events.

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