

Review on Climatic Change Upshot on Livestock Husbandry in Ethiopia

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Abstract: Climate change and extreme weather events have an impact on crop and livestock husbandry in developing countries, particularly in Sub-Saharan Africa. The direct effects posed by anthropogenic to changes in environmental conditions have been thoroughly proven in recent years through empirical studies. As a result, since 1960, the global average temperature has risen by 1 degree Celsius. In Ethiopia, climate change has had an impact on livestock production and productivity. The majority of livestock owners in the country believe climate change will influence pasture shortages, water shortages, livestock genetic resource losses, loss of livestock life, and less meat on mature livestock or reduced growth rate to achieve the required weight. Consequently, regarding mature animals, that leads to reduced livestock physiological processes, low milk supply, and impaired procreant function. Drought oxen will become malnourished and will be unable to generate the required draught power or energy for farm activities such as ox-cart, ploughing, causing crop cultivation to be hampered. Moreover, conferring to patterns and occurrences of rainfall have a significant impact on the present quantity of water and pasture for livestock. As a result, the absence of quality pasture for livestock and enough water roots livestock productivity and reproduction to suffer in Ethiopia. Higher temperatures caused by climate change may hasten the growth of diseases and parasites that may proliferate in or outside of the host livestock for too long. However, climate variation and climate change are anticipated to far reach more detrimental effects on livestock well-being and productivity, particularly in disadvantaged areas. Therefore, in these food and human livelihood are of essence for survival. The purpose of this study is to highlight the potential effects of changes in climate contribution to livestock production and productivity in Ethiopia.

Keywords: Livestock, Climate, Temperature, Production, Milk, Pasture, Crop, Water, Rangeland

1. Introduction

Ethiopia has been experiencing a wide range of climatic variations and extremes over the years [1, 2]. Droughts and floods have become more common as a result of long-term climatic changes associated with variability in rainfall, temperature fluctuations among others [3]. Climate and location are certainly the most important factors that determine livestock husbandry output. Indeed, meteorological elements in particular amount of water vapour in the atmosphere, annual temperature and precipitation variations affect water and pasture availability for livestock throughout the year [4]. Most importantly, rainfall variations throughout the year have a positive contribution to the livestock

production system. The presence of a season that has variations in rainfall pattern accompanied with rainfall scarcity alludes to a feature of tropical and Mediterranean climates [4-6].

Even though there is a linkage between livestock and changes in climate that is far more multifaceted and sometimes disregarded [7]. Livestock husbandry plays an important role in poverty eradication as well as rural development in Africa [8]. In African rural communities, livestock production is heavily reliant on natural resources, particularly pasture and water [8, 7]. According to Taruvinga and Mushunje [9] as a result, climate variations and changes in climate influence animal output indirectly and directly. Additionally, the effects on livestock performance are also indirect through the environmental conditions. Therein, in the

tropics is also known as the dry season, while in the Mediterranean climes, it is also known as summer. Therefore, Vulkani [10] alluded that throughout the rainy season, pastures are more plentiful and of greater nutritional value, during the dry period. Adding to that the pasture are of lower nutritional value, with high fibre and low protein content, resulting in decreased animal productivity.

Livestock serves a variety of economic, social, and risk management purposes mostly in integrated agricultural-pastoral and pastoral practices [8]. Climate change has exacerbated the helplessness in livestock husbandry systems and reinforced prevailing aspects that are majorly affecting other systems at the same time. Among other aspects increase human population, economic shocks, food shortages mount pressure on nature including livestock. In addition, social factors like conflicts have also influenced the increase in demand for natural resources (i.e. land, forestry products, water, biofuels etc.). In households that solely depend on livestock as a mainstay losing it might lead to chronic poverty and shortage of protein in rural communities. Hence, resulting in long and short-term consequences for the well-being of people [11].

Lastly, Ethiopia boasts of Africa's largest cattle population and the world's ninth largest according to CSA (2017) report. According to latest animal population estimates, the country has 60.04 million poultry, 60.39 million cattle herds, 32.74 million goats, 31.30 million sheep, 8.44 million donkeys, 2.16 million steeds, and 1.21 million camels [9, 11, 12]. Therefore, Robinson *et al.* [13] and Thorton [14] compounded that despite its size, livestock husbandry has been projected to be negatively impacted by climate variations and change in climatic conditions (i.e. through water competition and food security at a time when it is most needed). Livestock especially cattle and donkeys contribute crucially to the agriculture sector through the provision of draught power, hides, farmyard manure, milk and protein in form of meat [14]. Hence, the diversity of agro-ecological zones, Ethiopia can support a variety of animals.

2. Literature Review

2.1. Perception of Livestock Producers on Climate Change Effects

Studies by Thornton [14] and Funk *et al.* [15] highlighted that majority of agricultural-pastoralists and mere pastoralists in the Afar region North-Eastern based in Aba'ala district, believe that climatic change is causing droughts to occur more frequently. Livestock producers also indicated that a long drought was their biggest problem, causing significant harm to natural resources and eventually leading to a deficiency of food and water for human beings, and livestock. The majority of animal herders in Aba'ala stated that climatic upshot has wreaked havoc on crop cultivation twice or more in the last five years. Nearly all smallholder farmers talked about the absence or insufficient natural occurring pastures for their animals as the most pressing problem due to drought.

Additionally, in the Southern and Central Tigray Zones smallholder farmers on other hand believe that climate change is occurring. To ascertain this allusion temperature and rainfall were used as parameters in the examination of climate change over time.

2.2. Climate Change Versus Livestock Husbandry

An approximation of 600 million farming households across the globe depends on livestock and livestock systems for their mainstay, especially in Sub-Saharan Africa and South Asia. Livestock husbandry importantly contributes positively to farming households' livelihoods and/or welfare [16, 17]. It is a rapidly expanding agricultural subsector, with a 33 percentage (%) share of agricultural gross domestic product (GDP) and rising, pioneered by the increase in population, good prices on global market and urbanization. By 2050, demand for all animal products in Sub-Saharan Africa countries (SSA) and South Asia is predicted to roughly treble [17, 18]. However, climate change, on the other hand, has already reduced world agricultural productivity by 1-5 percentage every decade over the last 30 years. Unlike cropping systems, evidence of recent impacts on livestock systems is still scarce [17, 19]. Future consequences are expected to have extensive detrimental effects on pasture quality and consequently cattle productivity in both high and low latitudes, according to predictions. This will have a cascade effect on incomes and food security in most of Sub-Sahara Africa countries, where millions of smallholder farmers rely on livestock-based systems for subsistence [20].

Increased temperature has been proven to have negative effects on feeding habits, reproduction (i.e. mating time, heat time and semen synthesis) and overall general performance in a variety of livestock species [21]. The totaled implications of climatic upshot on livestock husbandry systems with and without adaptation are far less certain to imagine. Livestock is a critical risk management resource; livestock may be one of the few assets available to around 170 million impoverished households in rural parts of Sub-Saharan Africa [22]. Wherefore, Bertram [21] for example, predicted that the most severe effects of climate variations and climatic upshot could be evident in livestock husbandry practices and other systems especially in the least developed countries, where most people are already vulnerable. Climate change, according to Niang *et al.* [23], can and will become a more difficult barrier to the development of the livestock sector, because the livestock production system is both susceptible to and a supporter of the natural phenomena. To respond to the problem of climate change, the industry must develop appropriate adaptation and mitigation solutions.

Climate change is anticipated to exacerbate the exposure of livestock husbandry systems and underline prevailing issues that are affecting livestock production systems. Therefore, loss of livestock could lead to chronic poverty in rural communities, with long-term consequences for their welfare [24]. According to Apata [25] and Nyasimi *et al.* [26], Africa is one of the continents that is most vulnerable to changes in climatic conditions. That is owing to the irregular and unstable

weather, which necessitates farmers' awareness of the effects of this weather pattern on farming in the short and long-term production periods. It also recommends that adaptation strategies be implemented to mitigate the detrimental consequences of climate change, particularly on cattle output. Climate change, according to Thornton [14] and Easterling [27] will result in a water deficit, which will affect cattle feed and pasture productivity.

2.3. Climate Change Effects on Livestock Production and Productivity

There are four principle effects of climate change on livestock husbandry practices, as emphasized by pastoralists and agricultural pastoralists (i.e. feed shortages, water shortages, reduced productivity, decreased mature weight and/or longer time to achieve mature weight, in that order).

Unfortunately, precipitation patterns and their availability significantly affect pasture growth. Precipitation (rainfall) also influences the availability of water for livestock as well as humans [28]. Changes in rainfall patterns and temperature ranges have an impact on pasture availability, grazing lands nourishments, pasture quality. Furthermore, brings about the occurrence of new pests, and diseases [28, 29]. On the other hand, the frequency and intensity of extreme occurrences like droughts, and floods all have a direct impact on livestock production.

Nonetheless, climate change is projected to devour the greatest impact on vulnerable pastoral communities that rely on huge livestock production systems in arid environments [29, 30]. In Ethiopia, according to Amasalu and Kassa [30], the majority of livestock owners in the country believe climate change will have influence feed shortages, water shortages, livestock genetic resource losses, reduced productivity, and decreased mature weight or a longer time to achieve mature weight. Haan [31], concluded that climate change poses special dangers to poor farmers and pastoralists who rely on climate-sensitive livelihoods and natural resources daily. Aside from the physiological consequences of rising temperatures on individual animals, livestock loss as a result of droughts and floods, as well as disease epidemics linked to climate change, may increase.

Similarly, according to Alamineh [32] assessment, all pastoral zones and/or rangelands in Ethiopia are very vulnerable to negative effects of climate change, with the problem being especially widespread in the country's North Eastern lowlands. Wherefore, households that solely depend on livestock husbandry for there are at risk of climatic upshot related disasters. According to a study by Belay *et al.* [28], climatic change-related disasters have a significant impact on livestock output in Ethiopia's already fragile ecological systems. Correspondingly, ILRI [33] reported that the invasion of foreign species of plants, burning of bushes and climate change are significantly contributing to the loss of viable grazing land or severely reducing grazing land. Climate change-related trends, for instance, frequent droughts, floods, non-uniform rainfall distribution, and increase in daily temperature, are dramatically exacerbating these pressures

about pasture availability [33, 34]. The range terrain is frequently transformed into a naked termite mound. That entails how climate change is far-reaching implications for dairy and meat production, particularly in vulnerable areas of the world wherever these products are critical for nutrition in addition to livelihoods. According to the research, done in Yabelo, Borana Zone, southern Ethiopia, families devoured seen a significant decrease in their livestock with an average fall of 80% from the peak holdings during the preceding ten years. However, owing to primarily climate change to have contributed to the losses. According to the study, pastoralists in the Moyale and Dillo areas incurred a dramatic reduction in the number of livestock species goats, cattle, ducks, chickens, sheep and donkeys, with the majority of the animals dying during severe droughts between 2005 and 2008.

2.3.1. Effects on Pasture and Range Land

Carbon dioxide levels and temperature in the atmosphere have a considerable impact on the quantity and quality of pasture [30, 35]. Climate change's impact on feed quantity and quality varies by region, livestock system, and species [36]. The quality and amount of fodder that may be produced in a particular region are directly influenced by the climate. Therein, climatic upshot and climatic variations, in semi-arid regions are expected to receive less rainfall in general. In many parts of the tropics regions, mostly the growing season is longer than is expected. This is the result of greater season variability in rainfall patterns and more frequent droughts [16]. This is anticipated to increase the likelihood of livestock animals experiencing prolonged nutritional stress. Furthermore, livestock animals are forced to roam long distances in search of greener pastures and sometimes subjected to less regular water intake. As livestock animals cluster together or move into foreign places diseases are spread from animal to animal populations. In drought-affected areas, overgrazing occurs as well as in nearby areas. In the long run, livestock may contact new diseases and parasites of economic importance. Another potential danger is conflict over grazing pasture and water. High temperatures, escalate the lignification processes of plant tissues, lowering forage digestibility [36].

The changes in climatic conditions negatively astoundingly affect rangelands [25]. The range terrain is frequently transformed into a naked termite mound area. When some plants are visible, it is usually a sign that unpalatable bushes are encroaching on the area. Additionally, the area comprises invasive and other harmful plant species according to pastoralists. *Acacia drepanolobium* is the most common invasive woody plant [31]. Besides the increase in temperature, prolonged dry spells, prevalence of diseases, alien invasion species on rangelands for livestock. The alteration in a natural pasture due to the aforementioned factors imperils livestock production output. In addition, according to Food and Agriculture Organization (FAO) [37], drought and a delay at the beginning of rain results in poor grass regeneration, water shortages, and heat stress in livestock. It goes on to say that the drought and delayed

rainfall result in increased cattle mortality, disease vulnerability, and physical degeneration as a result of far distances of travel to look for water and fresh pastures for animals.

According to Food and Agriculture Organization [37], severe drought has had a direct influence on the growth and maturation of palatable grass species for animals to graze on. Therein, the regeneration of herbaceous species in pastureland is diminishing because of reduced rainfall. Reduced rainfall results in a lack of assortment and quality of pastures for animals. Whereby results in a drop in animal population, which has affected milk production, milk products, and meat output. The absence of rainfall also affects livestock like cattle, as dried up wetlands, pastureland, water resources, and streams reduce the amount of drinking water available for animals. Temperature, rainfall, and CO₂ levels will all have an impact on pasture growth, pasture regrowth, species richness and composition. The latter triggers changes in animal diets and worsening reduced nutrition availability [38, 39].

Finally, climate variations and climate change have a direct effect on livestock husbandry by influencing the availability of food for animals. Indirectly, it consequently affects rangeland's holding capacity, ecosystem buffering ability, sustainable pasture management, feed trade, feeding options, and grazing management [13]. However, the influence of climate change on crop, forage and rangeland healthiness is mostly visible through animal food resources scarcity. It is so evident in grassland where cattle and other livestock range on, simply been a key predictor or indicator [39].

2.3.2. Effects on Water Availability

In recent years, decreased river water levels and poor water buildup in community ponds have been noticed in Ethiopia. Thereby, water scarcity is more prevalent and severe in low-lying rural areas or communities. However, during the dry season, ponds dry up quickly once the rains finish due to increased evaporation caused by rising temperatures and less water vapour in the atmosphere [40]. Pastoralists in the Borana region have stated that climate change has resulted in a critical water shortage for domestic purposes and agricultural activity. Smallholder farmers further explained the severity of lack of rainfall, as it results in drying up of water points, streams and rivers because they do not fill too full capacity during the summertime. Not only do natural bodies that dry up also sunken boreholes dry out this is common in most parts of Northern and Western parts of Ethiopia [41].

2.3.3. Impacts on Milk Production

Livestock and climate change are inextricably linked although the latter affects more the other [38]. Consequently, variations in climatic elements like daily temperature, precipitation (rainfall distribution) and the prevalence of droughts over time pose great danger to milking animals. For that reason, frequency and extreme occurrences of the above-mentioned events affect majorly cattle as well as other ruminants' output [42]. The science is that; neuroendocrine response to climatic variables, climatic factors or seasonal fluctuations have a significant impact on animal behaviour,

influencing animal production and health [4, 43]. Additionally, fluctuating temperatures affect badly the metabolic reactions of animals particularly livestock. Nevertheless, increased air temperature and relative humidity are linked to high-production animals that are more subjected to climatic factors, particularly those that are reared in tropical circumstances [44-46]. High temperatures, according to Martello *et al.* [45], can reduce feed intake, limit milk output, and cause energy deficits, all of which can affect livestock like a cow's fertility, fitness, and longevity. High temperatures, therefore, do not only affect cattle but also other livestock like donkeys, sheep to mention a few. The empirical studies conducted have concluded that the upkeep of energy needs for instance a dairy cow weighing 635kg supplying 36kg of milk daily might be raised to 22% at 32° Celsius compared to what is required at 16° Celsius using the Cornell Net Carbohydrate and Protein System model [11, 47]. Therefore, anticipation that an 18% decrease in dry matter intake and a 32% decrease in milk intake for the same temperature increase. The above is as true as many cattle breeders and pastoralists have attested to it in Ethiopia [12].

2.3.4. Impacts on Livestock Reproduction

The empirical studies carried out in Ethiopia attest that rainfall variability has a significant impact on the dynamics of the herds that are under community and ranch management. It results in increased herd mortalities, reduced birthrates and milk production reduction [23]. In addition to that, households in livestock production face challenges in animal products consumption [23]. The droughts that hit Ethiopia in the 1980s accounted for 49%t herd losses under communal land usage, whilst droughts in the 1990s were responsible for 57% of cow mortality under ranch management [47, 48]. In the 1980s and 1990s droughts did not only harm cattle but also other livestock animals. Livestock animals are quite sensitive to temperature variations as it harms the reproductive capabilities, of females and males. This is expressed by heat stress that has a deleterious impact on reproductive function as well [49]. Heat stress in male animals' affects libido or sexual drive that hinders mating despite the female being on heat [50]. Of which it adds to the unproductivity of animals during mating season sessions. Furthermore, increased temperatures affect semen production and/or the quality and quantity of semen production. Meaning that as climate variation and change keep on going the more genetic degradation among exotic breeds [50, 51].

2.3.5. Effects on Livestock Adaptation

Heat stressed animals begin to compensate and adaptive body processes to establish a homoeothermic and homeostasis to balance the body for survival. In so doing animals lose their reproductive and productive potential. The relative variations in several animal physiological responses, such as respiration rate, pulse rate, and rectal temperature, indicate whether cattle are under stress [51]. The hypothalamic-pituitary-adrenal axis is affected by temperature stress. Somatostatin is stimulated by corticotropin-releasing hormone, which could be one of the reasons why heat-stressed animals have lower

amounts of growth hormone and thyroxin [52, 53].

2.3.6. Impacts on Livestock Health

Most diseases are adversely affected by drought and desiccation [53]. Host immunity can be lowered by climate change (i.e. heat, lack of food and water) [54, 55]. Climate change could cause significant modifications in disease distribution, leading to outbreaks in some regions. Disease outbreaks can also occur in previously unaffected animal groups perhaps due to the breakdown of endemic stability [46]. Increased disease incidence throughout the drawn-out dry season, when livestock animals are more susceptible due to insufficient feed supply [56]. Increased temperatures pioneer the severity of disease outbreaks [50, 56]. On the other hand, high temperature and humidity are favourable conditions for bacterial and fungal proliferation. High-temperature favour diseases such as foot and mouth disease, bovine disease, Newcastle, blackleg to mention a few identified by [56, 57].

3. Conclusion

Livestock owners have different perspectives on climatic upshot and climatic variations express their effects in various ways. They put first interconnected effects of environmental changes to livestock husbandry towards water scarcity, pasture scarcity, increased livestock mortality rates, reduced mature weight, to mention a few. Climate changes influence livestock husbandry in Ethiopia in two ways: the quality and quantity of pasture from grasslands/grazing lands may be reduced for animals. Despite the importance of livestock to impoverished households in Ethiopia, the scale of the changes are required in terms of investments and planning. The efforts and capacity of individual farmers' to adapt and adopt new technology that contributes to both mitigation and the long-term viability of farming. In addition, the livestock sectors must anticipate these changes, be ready for unforeseen events, and adopt adaptation plans to survive. The government, individuals and civil society organizations need to be more proactive in addressing climate change issues. Not forgetting the vulnerable rural groups in rural communities that need to be made aware of changes in climate and variations. In regards to livestock, owning households needs to be equipped practically on adaptation measures. As climate changes put livestock husbandry output in jeopardy. Due to the natural pastures on which livestock thrive on it gets degraded in terms of quality and quantity. Furthermore, the accessible water sources are unreliable dry up due to increased temperature and shortage of rainfall. Excessive heat, a lack of water, nutrition, and unknown diseases have all contributed to the loss of livestock. Climate change has an impact on cattle output throughout the world, but especially in developing countries including Ethiopia. Climate change has been proven to influence livestock output in Ethiopia over the years. Therefore, it has hugely contributed to food insecurity regarding meat protein and it is still threatened. Concurrently pasture and feed quality are essential components of

livestock products such as calories, proteins and energy. Globally livestock resources are of importance to the human body and critical macronutrients provider. As in the case of Ethiopia and other SSA countries, mitigation measures to combat the impacts of climate change need to be installed as soon as possible.

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