FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 10 No. 9, May, 2026, pp 72 – 78
DOI: https://doi.org/10.33003/fjs-2026-1009-4961

Effect of Climate Change on Livestock Production in Somalia

***Mumin Rage Ahmed, Hassan Omar Sabrie and Guuleed Abdullahi Rage**

Somali National University.

*Corresponding authors' email: muuraghe@gmail.com

ABSTRACT

This paper employs how climate change influences animal production in Somalia. using Time series data obtained from WDI and WB in 1990-2020. the study applied ARDL Model and the analysis was done in E-Views-12 Software. Distinct variables were used such as Annual temperature, Carbon dioxide, rural population. Carbon dioxide has positive significant effect in livestock production but Annual temperature and rural population have negative significant effect in the livestock production. All data variables were tested by the unit root livestock production, CO_2 and rural population were stationary at first difference but non- stationary at level. the study found that one-unit increase in annual temperature raised livestock production by 32.5% and it is significant level at 5%. Also, one-unit increase in CO_2 caused to increase livestock production by 0.006 a level that is not significant. Finally, one-unit increase of rural population will result to decrease livestock production by -1.37% and it is statistically not significant but in short run period all variables are significant. This paper concludes that in long term, annual temperature and CO_2 likely lead to increased livestock production and loss by Rural population. The study recommends to improve the service of veterinarians in order to prevent animal illness related to climate, which lowers productivity and increases mortality in animal production.

Received: 16 May 2026

Accepted: 01 June 2026

Published: 16 June 2026

Keywords: Climate Change, Livestock Production, Annual Temperature, CO_2 and Rural Population

INTRODUCTION

Globally production of livestock is currently under tremendous strain. Population development, urbanization, rising incomes and dietary changes have all contributed to the rising demand of livestock products, animal systems are subject to a variety of climatic circumstances, which means climate change is having growing impact on productivity. The livestock sector has experienced the least annual growth in meat output, approximately 25% of the global economic impact caused by climate related extremes with damage and loss of livestock bearing (Escarcha et al., 2018). The word "climate change'' is referred a permanent or long-term change in the climate of region, temperature variations, precipitation timing and quantity, co2 solar radiation and interaction of these variables may all effect. The breakdown of organic matter in the soil contributes to a portion of the increase in the atmosphere, and the breakdown of organic matter in wet soils like rice paddies is mostly responsible for the methane released into sky (Abebe, 2017). The developing countries systems of livestock are changing rapidly in response to a variety of factors; the world population is expected to expand approximately from 6.5 billion to 9.2 by 2050. an increase of more than one billion people will come from Africa and the growing urbanization is also expected to continue. Looking at developing countries, the demand of the world for livestock products will continue to grow significantly over the coming decades (Agbeja et al., 2021). In Africa Climate change has made food insecurity, poverty and worse violence, especially in sub- Saharan region. It altered weather pattern have resulted in longer droughts and lower agricultural production which has caused food shortages and famine. in addition, climate change has led to an increase in the frequency and intensity of hurricane and floods which can have catastrophe effects on agricultural systems and have long lasting effects on population (Hussein et al., 2024).

In Somali Livestock is based on nomadic livestock and meadows are natural food resource for animal and it is major exporter of animals to Arab countries. when these animals are transported to quarantine facilities, they are fed dried grass from different meadow species (Hassan et al., 2022).
According to Somalia climate conditions varies from semiarid in north and south to arid in the northeast and central parts. Somalia has climate with little seasonable change because of its closeness to the equator. All year long, there is a lot of heat, international monsoon winds, and unpredictable rainfall (Boitt et al., 2018).

Climate Change and Livestock Production

According to global climate change there is significant risk of social unrest, population dislocation, economic problems, and environmental damage, furthermore it is now well acknowledged that climate change and global warming have an impact on all ecosystems and will continue to do so if unchecked (Nayak et al., 2023). The majority of scientists and livestock producers understand and agree that the livestock industry has apart in contributing to climate change and will also have both direct and indirect impact on livestock productivity. Climate change effect on animal productivity has been divided into the following categories, availability of grain-based feed, quantity and quality of posture and forage crops, development, reproduction and health, diseases and their transmission (Rust, 2019). In developing nations livestock is produced using a wide variety of heterogeneous and varied production strategies. These can be included mixed crop livestock systems, which are typically found in areas suitable for both arable and production of livestock where the majority of the rural population resides, pastoral/grassland-based system. Urban regions are also frequently home to landless systems. Approximately 50% of the world's beef, 41% of its milk, 72% of its lamb, 59% of its pork, and 53 of its poultry came from these emerging country systems (Herrero et al., 2013).

The livestock population has been impacted by climate change in a number of ways, even minor and temporary changes in the climate could have a significant impact on food security because the primary sources of income are from agriculture and livestock. Droughts, heat waves, storms, dissertation are just few of the extreme weather events are predicted to occur more frequently due to climate change and it is anticipated to increase the shortage of livestock feed and encourage the establishment of unpleasant forage of rangelands (Steve Hatfield-Dodds, 2007).

Climate change is undeniable fact that is changing the distribution of water resource in space and time and having a major impact on the economy, society and ecology. As result governments worldwide and academic circles are paying more attention to this issue, it is anticipated that the greenhouse effect would cause global warming, altering the climate in many parts of the planet and potentially affecting crops, over the past few decades significant climate changes in particular, higher temperatures and precipitation have been seen throughout the planet (Kingra & Singh, 2016). Livestock is the main source of income for at least 20 million pastoralists and 200 million households who are stalk holding farmers in Asia, Africa and Latin America, a lot of people in sub-Saharan Africa still depend on livestock raising for their livelihood. However, during the past three decades, there has been little improvement and these areas remain characterized by high climatic sensitivity and low (Chauhan & Ghosh, 2014). Livestock Production is very essential for ensuring food security in communities. Additionally, rural communities view the production of livestock as diversification strategy it helps them deal with the issued by diminishing agricultural output, therefore this equation appears to be challenging to solve when discussing how climate change is negatively affecting animal production (Ateba Boyomo et al., 2024).

Livestock product like meat, eggs, and milk in sub-Saharan Africa is growing rapidly than local. And improving is a key strategy and clear information that livestock production makes better help to stakeholders (Erdaw, 2023) climate change effects intensive and extensive livestock systems differently, changing productivity and resource. (Bernabucci, 2019). The effects of climate change have real impact on livestock production in different ways. It is anticipated that climate change would lead to increase in extreme weather, including heat waves, storms, desertification, droughts. All animals if they live, houses or on farms. (Koirala & Bhandari, 2019). Livestock production will be impacted by climate change and number of other elements of the agricultural system. however human reactions to these biophysical consequences are complicated and unclear, similar to other production processes, the energy and fertilizer needed in livestock production result in the increase of carbon dioxide. Carbon emissions can also be released by animals, land use change and soil (Al Blooshi et al., 2020). Extreme temperature and periods of law rainfall mainly causing drought, crop production but they also effect on animal production, including milk yield, egg, reproductive performance and animal behavior and immune responses as well as raising the prevalence of diseases. Climate change poses the biggest problems to the production of animals in tropical and subtropical countries, where heat stress limits growth, production of milk and drastically changes the process physiologically. (Goma & Phillips, 2021). Temperature and precipitation variation are the main ways that climate change Changes effects natural grassland in addition to that higher could boast the growth of pests or natural disease which would increase the rates of animal health problems. in temperature, precipitation, frequency and intensity of extreme weather events like droughts, floods and snowstorms are all signs of climate change, the primary effects of climate change on herder households means of subsistence are on fodder, grasslands and livestock output, (Goma & Phillips, 2021).

MATERIALS AND METHODS

Methods

The study used annual time series data from 1990-2020 to analyze the effect of climate change and livestock production in Somalia. Livestock production is dependent variable while explanatory variables are annual temperature, CO_2 emissions and rural population. The Autoregressive Distributed Lag (ARDL) model is applied to measure both short run and long run relationship, with stationary tested using unit root test and cointegration focused on the ARDL bound test. An error correction model (ECM) is then used to capture short run dynamics; all analyses are conducted using E-Views Software.

Unit Root Test

Unit root test examines stationarity in time series, concerning non-stationarity assuming distribution don't change over time. They carry the Diskey Fuller Test and the Augmented Dickey Fuller (ADF) assessment for complex models. The (ADF) was utilized to measure the stationary of time series data, the null hypothesis is accepted if the ADF value is below critical t-value and the null hypothesis will be rejected while the ADF statistic test is upper critical t-value.

Co-integration and Bound Test

Co-integration is an econometric theory that incorporate short and long run time series data to form a stronger statistical basis for empirical error correction models and building persistent significant relationship and preventing the difference. The Co-integration test advanced by Granger (1981) and Engle and Granger (1987) specified co-integration but evaluating long term connections between variables of dynamic formulation and developing stability mechanisms to keep balance. While the Bound test decides if there is long run relationship or not, we accept null hypothesis if the F-Statistic is below 1(0) means there is no long run. If its greater than 1(1) we reject the null hypothesis and there is long run relationship and if it is among two bounds a long run is significant at all.

Model Specification

Econometric Step is analyzed in model specification and theoretical framework is changes into mathematical equation to explain the linkages among variables. This model provides dependent variables in livestock production (LP) Climatic independent variables are Average temperature (AT), CO_2 Emissions (CO_2 kt) and Rural Population (RP). The econometric model is then as follows:

$$LP = f(AT, CO2, RP) \quad (1)$$

The following PESERAN et al. (2001), the model specification of ARDL equation (1) is transported unrestricted error correction model (UECM) to check for cointegration among the variables belong the study.

$$\Delta LP(t) = \beta 0 + \sum_{i=1}^{p} \alpha 1 \Delta LP(t-i) + \sum_{i=0}^{p} \alpha 2 \Delta AT(t-i) + \sum_{i=0}^{p} \alpha 3 \Delta CO2(t-i) + \sum_{i=0}^{p} \alpha 4 \Delta RP(t-i) + \beta 1 LP(t-1) + \beta 2 AT(t-1) + \beta 3 CO2(t-1) + \beta 4 RP(t-1) + ut \quad (2)$$

When established in cointegration, the long run relationship is calculated given ARDL Model specified as:

$$LP = \beta 0 + \beta 1 ATt\text{-}1 + \beta 2 CO2t\text{-}1 + \beta 3 RPt\text{-}1 + ut \quad (3)$$

The short run measured dynamic relationship applied an error correction model as follows

$\Delta LPt = \beta 0 + \sum_{i=0}^{p} \alpha 1 \Delta LPt\text{-}i + \sum_{i=0}^{p} \alpha 2 \Delta ATt\text{-}i + \sum_{i=0}^{p} \alpha 3 \Delta CO2t\text{-}1 + \sum_{i=0}^{p} \alpha 4 RPt\text{-}1) + \delta ecmt\text{-}1 + ut$ (4)

RESULTS AND DISCUSSION

Findings

Unit Root Test

Unit root problem was tested by using Augmented Dickey fuller and the result was shown in below table 1. as we can see from the table all variables are none stationary at levels except Average temperature which is integrated I(0). All variables in first difference are stationary, knowing that average temperature has already been stationary at levels, and thus we have mixed order of integration indicating that appropriate model for this study is Autoregressive distribution lags ARDL.

Table 1: Augmented Dickey Fuller Test for Unit Root

Unit Root Test at Level				
Variable	**ADF-statistic**	**Critical value**	**P-value**	**Decision**
AT	-3.630516	-2.960411	0.0108	Stationary
CO2	-1.860292	-2.967767	0.3454	Non-stationary
LP	-1.818311	-2.960411	0.3650	Non-stationary
RP	1.321013	-2.960411	0.9982	Non-stationary
Unit Root Test at the 1st Differences				
Variable	**ADF- Statistic**	**Critical Value**	**P- Value**	**Decision**
AT	-4.210726	-2.986225	0.0032	Stationary
CO2	-3.261134	-2.967767	0.0264	Stationary
LP	-3.999130	-2.963972	0.0044	Stationary
RP	-3.973100	-2.963972	0.0047	Stationary

Multicollinearity Test

Table 2 indicates the multicollinearity and explored the correlation among the independent variables utilizing a correlation matrix. And represented that there is no evidence of severe multicollinearity among regressors.

Table 2: Correlation Test

Correlation				
Probability	**LP**	**AT**	**CO2**	**RP**
LP	1.000000			

AT	0.492086	1.000000		
	0.0049	-----		
CO2	0.124253	0.141806	1.000000	
	0.5054	0.4467	-----	
RP	0.614432	0.639527	0.211824	1.000000
	0.0002	0.0001	0.2526	-----

Cointegration Test

Table 3 explained the cointegration test and determines whether a long run relationship exist among the variables. The existence of cointegration justifies measuring and interpreting the long run model results.

Table 3: Cointegration Test

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.870345	87.15947	47.85613	0.0000
At most 1 *	0.456525	32.00176	29.79707	0.0274
At most 2 *	0.395749	15.53792	15.49471	0.0493
At most 3	0.069202	1.936244	3.841465	0.1641

Trace Test Indicates 3 Cointegrating eqn(s) at the 0.05 Level

Long Run Estimation

As presented in table 4, the long run findings shown that one unit increase in annual temperature (AT) is associated with a 32.5 unit increase in livestock production, the coefficient is statistically significant. Similarly, a one unit increase in CO2 emissions is related with 0.006 unit increase in livestock production, however this effect is not statistically significant, furthermore a one unit increase in rural population decreases animal production by 1.37 unit although the coefficient is statistically insignificant.

Table 4: Long Run Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AT	32.55579	12.93421	2.517029	0.0360
CO2	0.006557	0.033816	0.193906	0.8511
RP	-1.37E-06	2.33E-06	-0.591153	0.5707
C	-763.5747	343.3718	-2.223755	0.0568

Short Run Estimation

The below table 5 shows that Carbon Dioxide has positive significant in livestock production while Average temperature and rural population have negative significant in production of livestock, in Long Run Carbon dioxide and Rural population were in significant but in short run all variables are significant in short run period.

Table 5: Short Run Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AT	-10.51814	2.858351	-3.679793	0.0062
CO2	0.112690	0.031096	3.623992	0.0067
RP	-1.76E-05	5.77E-06	-3.055678	0.0157
ECT (-1)	-0.779967	0.075620	-10.31423	0.0000

Bound Test

Bound test indicates if there is long run relationship between variables, as shown in below table 6 Statistics test is 14.1 and it is greater than upper bounds and critical value of 3.67 at %5 level of significance. the result shows that there is long run relationship between variables.

Table 6: Bound Test

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	14.18445	10%	2.37	3.2
k	3	5%	2.79	3.67

Normality Test

Normality test is crucial to avoid implicating the results, normality testing was used including histogram and Jarque-Bera test which is good for to fit the test if kurtosis and skewness match normal distribution. As shown in figure 1 analysis of histogram declared that data were normally distributed. The Jarque Bera statistic was 1.401944 and its P. Value was 0.496 which is greater than the 0.05 level of significance, hence, we cannot reject the null hypothesis and the error terms are normally distributed.

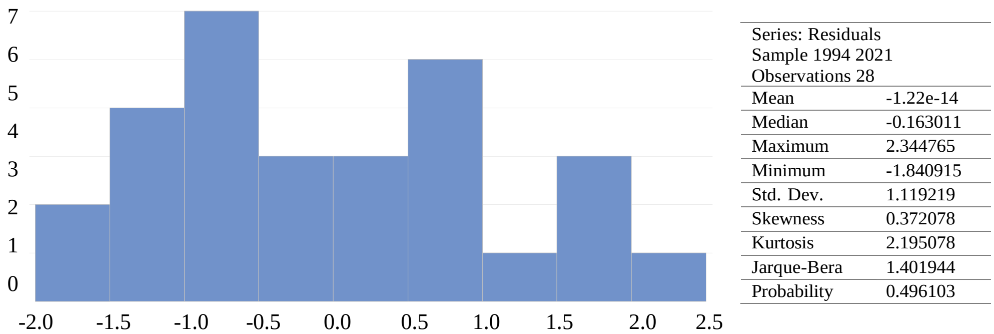

Figure 1: Normality Test

Serial Correlation LM Test

Table 7 shows the Breusch-Godfrey serial correlation LM Test results. Since the probability of F. statistic is (0.6230) and Obs*R-squared (0.1297) are greater than 5% significance level, the null hypothesis of no serial correlation cannot be rejected. Therefore, the model doeas not suffer from serial correlation.

Table 7: LM Test

F-statistic	**0.512561**	**Prob. F (2,6)**	**0.6230**
Obs*R-squared	4.085823	Prob. Chi-Square (2)	0.1297

Heteroscedasticity

The below table 8 presents to check the heteroscedasticity, the Obs R Squared (0.6222) and F- Statistics (0.606046) were higher than 5% level of significance indicates the acceptance of null hypothesis and error terms were heteroskedastic.

Table 8: Heteroskedasticity

F-statistic	**0.606046**	**Prob. F (19,8)**	**0.8239**
Obs*R-squared	16.52157	Prob. Chi-Square (19)	0.6222
Scaled explained SS	0.805901	Prob. Chi-Square (19)	1.0000

Stability Test

We evaluated the CUSUM test of the stability in ARDL model to know data stability. As shown in the figure our variable data is stable because of the CUSUM graph is within 5% significance level and cumulative sum of square of recursive CUSUMSQ is same as limits of 5% significance.

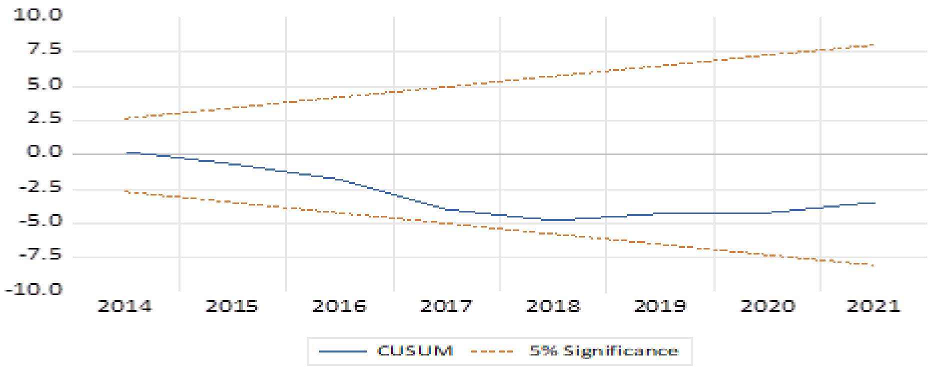

Figure 2: Cusum Test

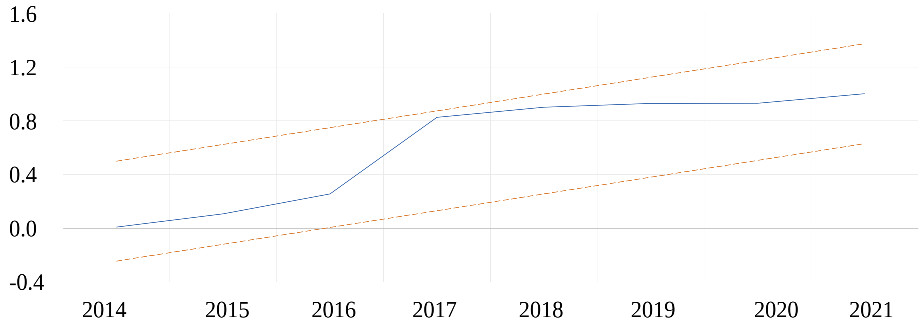

Figure 3: Cusum Square

Discussion

The study revealed effect of climate change on livestock production in Somalia. It found that climate change significantly effects livestock production. Rising temperature reduces animal production, it causes heat stress, reduce feed and water availability and lowers animal production. Similarly, the negative coefficient suggests that increase in rural population are linked with reduction of animal production. This may result from greater pressure on grazing land, water resource, also land fragmentation and competition for natural resource which reduce livestock productivity Additionally higher CO2 emission levels are related with increases livestock production due to fertilization which promotes pasture and forage thereby improving feed availability for livestock and results broad agricultural and economic development.

CONCLUSION

Climate change has significant challenges to animal production through water scarcity, heat stress, illness and environmental degradation. To promote resilience efforts should be concentrate on water management, improved veterinary service, climate smart animal practice and the adaptation of renewable energy sources. Government should support farmers through subsides research, climate information service, strengthening international cooperation, sharing knowledge and financial support for adaptation is also very Important for providing sustainable and climate resilient animal production.

REFERENCE

Abebe, K. (2017). Effect of Climate Change on Nutritional Supply to Livestock Production. Academic Research Journal of Agriculture Science and Research, 5(2), 98–106. Doi: https://doi.org/10.14662/ARJASR2016.056

Agbeja, A. O., Olaifa, K. A., Akindolu, D. R., Salau, H. O., & Akinlade. (2021). 9-13 Nigerian Society for animal Production Nigerian Journal of Animal Production © Climate change and livestock production: A review 1 1 1 2 1. Nig. J. Anim. Prod, 2021(4), 9–13.

Al Blooshi, L. S., Ksiksi, T. S., Aboelenein, M., & Gargoum, A. S. (2020). The impact of climate change on agricultural and livestock production and groundwater characteristics in Abu Dhabi, UAE. Nature Environment and Pollution Technology, 19(5), 1945–1956. Doi: https://doi.org/10.46488/NEPT.2020.v19i05.019

Ali, A. I., Kassem, Y., & Gökçekuş, H. (2023). Examining the impact of climate change on water resources in Somalia: The role of adaptation. Future Technology, 2(4), 45–58. Doi: https://doi.org/10.55670/fpll.futech.2.4.5

Ankrah Twumasi, M., & Jiang, Y. (2021). The impact of climate change coping and adaptation strategies on livestock farmers' technical efficiency: the case of rural Ghana. Environmental Science and Pollution Research, 28(12), 14386–14400. Doi: https://doi.org/10.1007/s11356-020-11525-1

Ateba Boyomo, H. A., Ongo Nkoa, B. E., & Awah Manga, L. A. (2024). Climate change and livestock production in Sub-Saharan Africa: Effects and transmission channels. Food and Energy Security, 13(1). Doi: https://doi.org/10.1002/fes3.521

Bernabucci, U. (2019). Climate change: impact on livestock and how can we adapt. Animal Frontiers, 9(1), 3–5. Doi: https://doi.org/10.1093/af/vfy039

Boitt, M. K., Langat, F. C., & Kapoi, J. K. (2018). Geospatial agro-climatic characterization for assessment of potential agricultural areas in Somalia, Africa. Journal of Agricultural Informatics, 9(3). Doi: https://doi.org/10.17700/jai.2018.9.3.479

BULUT, M., & ÖZDEN, C. (2023). Effects of Climate Change on Animal Husbandry. Black Sea Journal of Agriculture, 6(1), 87–94. Doi: https://doi.org/10.47115/bsagriculture.1216262

Chauhan, D. S., & Ghosh, N. (2014). Impact of Climate Change on Livestock Production: A Review. Journal of Animal Research, 4(2), 223. Doi: https://doi.org/10.5958/2277-940x.2014.00009.6

Chavez Michaelsen, A., Huamani Briceño, L., Vilchez Baldeon, H., Perz, S. G., Quaedvlieg, J., Rojas, R. O., Brown, I. F., & Pinedo Mora, R. (2020). The effects of climate change variability on rural livelihoods in Madre de Dios, Peru. Regional Environmental Change, 20(2). Doi: https://doi.org/10.1007/s10113-020-01649-y

Cheng, M., McCarl, B., & Fei, C. (2022). Climate Change and Livestock Production: A Literature Review. Atmosphere, 13(1). Doi: https://doi.org/10.3390/atmos13010140

Dey, S. (2023). Climate Change Effects on Livestock Production in Bangladesh and Its Economic Impacts. SAARC Journal of Agriculture, 21(2), 227–238. Doi: https://doi.org/10.3329/sja.v21i2.68030

Erdaw, M. M. (2023). Contribution, prospects and trends of livestock production in sub-Saharan Africa: a review. International Journal of Agricultural Sustainability, 21(1), 1–15. Doi: https://doi.org/10.1080/14735903.2023.2247776

Escarcha, J. F., Lassa, J. A., & Zander, K. K. (2018). Livestock under climate change: A systematic review of impacts and adaptation. Climate, 6(3), 1–17. Doi: https://doi.org/10.3390/cli6030054

Feng, X., Qiu, H., Pan, J., & Tang, J. (2021). The impact of climate change on livestock production in pastoral areas of China. Science of the Total Environment, 770, 144838. Doi: https://doi.org/10.1016/j.scitotenv.2020.144838

Goma, A. A., & Phillips, C. J. C. (2021). The impact of anthropogenic climate change on egyptian livestock production. Animals, 11(11), 1–14. Doi: https://doi.org/10.3390/ani11113127

Hanafiah, M. M., Ibraheem, A. J., & Razman, K. K. (2021). Emissions of carbon dioxide and methane from dairy cattle manure. IOP Conference Series: Earth and Environmental Science, 880(1). Doi: https://doi.org/10.1088/1755-1315/880/1/012037

Hassan, A., Mat, B., & Çevrimli, M. B. (2022). Antakya Veteriner Bilimleri Dergisi The Journal of Antakya Veterinary Science https://dergipark.org.tr/tr/pub/antakyavet

Economic development opportunities and general structure of livestock production in Somalia Economic development opportunities and general structure of livestock production in Somalia. 1, 23–32. https://dergipark.org.tr/tr/pub/antakyavet

Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S., & Rufino, M. C. (2013). The roles of livestock in developing countries. Animal, 7(SUPPL.1), 3–18. Doi: https://doi.org/10.1017/S1751731112001954

Hussein, J., Bilotto, F., Sircely, J., Mbui, D., Omondi, P., Ferreira, C. S. S., Fahad, S., Liu, K., & Harrison, M. T. (2024). From crisis to opportunity: climate change benefits livestock production in Somalia. Environmental Research: Food Systems, 1(2), 025004. Doi: https://doi.org/10.1088/2976-601x/ad6fa0

Kabubo-Mariara, J. (2009). Global warming and livestock husbandry in Kenya: Impacts and adaptations. Ecological Economics, 68(7), 1915–1924. Doi: https://doi.org/10.1016/j.ecolecon.2009.03.002

Kimaro, E. G., & Chibinga, O. C. (2013). Potential impact of climate change on livestock production and health in East Africa: A review. Livestock Research for Rural Development, 25(7), 1–11.

Kingra, P. K., & Singh, S. (2016). Climate Change and Sustainability of Agriculture-A Review. Indian Journal of Economics and Development, 12(4), 603. Doi: https://doi.org/10.5958/2322-0430.2016.00184.0

Koirala, A., & Bhandari, P. (2019). Impact of Climate Change on Livestock Production Building Resilience to Climate related Hazards Project, (Agriculture Management Information System), Ministry of Agricultural and Livestock Development. 178–183.

Lal, P., Alavalapati, J., & Mercer, D. E. (2009). Effects of Climate Change on Natural Resources and Communities: A Compendium of Briefing Papers Chapter 3: Socioeconomic Impacts of Climate Change on Rural Communities in the United States. 4, 73–118.

Lloyd, S. J., & Hales, S. (2019). Challenges and gaps in assessing impacts of climate change on health in rural areas. Expert Group Meeting on 'Eradicating Rural Poverty to …. https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2019/03/Lloyd_background_paper_final2.pdf

Nayak, G. D., Sardar, K. K., Das, B. C., & Das, D. P. (2023). Impact of climate change on livestock health and production. Impact of Climate Change on Livestock Health and Production, 16(5), 1–295. Doi: https://doi.org/10.4324/9781003364689

Okuduwor, A. A, Oretan, A, Amadi-Robert, C.C, & Johnson, N.C. (2023). Assessment of Climate Variability on Poultry

Production in Nigeria: 1990-2020. International Journal of Integrative Sciences, 2(7), 979–994. Doi: https://doi.org/10.55927/ijis.v2i7.4967

Osuji, E., Igberi, C., Enyia, C., Nwachukwu, E., Nwose, R., Adeolu, A., Tim-Ashama, A., Nkwocha, G., Eleazar, A., & Gabriel, A. D. (2023). Impact of Climate Change on Dairy Milk Production in Nigeria. Online Journal of Animal and Feed Research, 13(4), 246–252. Doi: https://doi.org/10.51227/ojafr.2023.37

Otim, J., Watundu, S., Mutenyo, J., Bagire, V., & Adaramola, M. S. (2023). Effects of carbon dioxide emissions on agricultural production indexes in East African community countries: Pooled mean group and fixed effect approaches. Energy Nexus, 12(October), 100247. Doi: https://doi.org/10.1016/j.nexus.2023.100247

Prasad, R. R., Dean, M. R. U., & Alungo, B. (2022). Climate Change Impacts on Livestock Production and Possible Adaptation and Mitigation Strategies in Developing Countries: A Review. Journal of Agricultural Science, 14(3), 240. Doi: https://doi.org/10.5539/jas.v14n3p240

Rust, J. M. (2019). The impact of climate change on extensive and intensive livestock production systems. Animal Frontiers, 9(1), 20–25. Doi: https://doi.org/10.1093/af/vfy028

Rust, J. M., & Rust, T. (2013). Climate Change and Livestock Un Africa. South African Journal of Animal Science, 43(3), 256–266.

Smith, M. R., Thornton, P. K., & Myers, S. S. (2018). The impact of rising carbon dioxide levels on crop nutrients and human health. Gender, Climate Change, and Nutrition Integration Initiative, July(July), 1–4. www.feedthefuture.gov

Society, N., Production, A., Journal, N., & Production, A. (2021). Climate change and livestock production: A review Agbeja, A. O., 1 Olaifa, K. A., 1 Akindolu, D. R., 2 Salau, H. O. and 1 Akinlade, M. S. 48(4), 9–13.

Sondakh, D. S. I., Tulungen, F. R., Kampilong, J. K., Rumondor, F. S. J., Kawuwung, Y. S., & Sanggelorang, E. P. (2024). Estimation of livestock greenhouse gas for impact mitigation. Global Journal of Environmental Science and Management, 10(2), 857–872. Doi: https://doi.org/10.22035/gjesm.2024.02.27