Nig. J. Anim. Prod. 2021, 48(4): 9 - 13
Nigerian Journal of Animal Production

Climate change and livestock production: A review

[1]Agbeja, A. O., [1]Olaifa, K. A., [1]Akindolu, D. R., [2]Salau, H. O. and [1]Akinlade, M. S.
Forestry Research Institute of Nigeria P. M. B 5054 Jericho, Ibadan[1]
Texas State Department of Agriculture, United State of America[2]
Corresponding author: bobbysoye@gmail.com; 08055287391

Abstract

The livestock system is one of the most important characteristics of agrarian economy; livestock sector provides sustainability and stability to the national economy by contributing to farm energy and food security. Climate change is seen as a major threat to the survival of many species, ecosystems and the sustainability of livestock production systems in many parts of the world. Green house gases (GHG) are released in the atmosphere both by natural sources and anthropogenic (human related) activities. The impact of climate change can heighten the vulnerability of livestock systems and exacerbate existing stresses upon them, such as drought. Parasites and diseases are among the most severe factors that impact livestock production and reproduction, impact on livestock health, impact on feed and fodder availability, reduction in livestock population and impact of climate change on livestock genetics resource. However, the climate change especially global warming may highly influence production performance of farm animals throughout the world, this results in decreased animal production and productivity.

Keywords: Climate change, livestock production, Food security and sustainability

Changement climatique et production animale: un bilan

Résumé

Le système de bétail est l'une des caractéristiques les plus importantes de l'économie agraire; Le secteur de l'élevage assure la durabilité et la stabilité de l'économie nationale en contribuant à l'énergie agricole et à la sécurité alimentaire. Le changement climatique est considéré comme une menace majeure pour la survie de nombreuses espèces, écosystèmes et la durabilité des systèmes de production animale dans de nombreuses régions du monde. Les gaz à effet de serre (GES) sont rejetés dans l'atmosphère à la fois par des sources naturelles et par des activités anthropiques (liées à l'homme). L'impact du changement climatique peut accroître la vulnérabilité des systèmes de bétail et exacerber les tensions existantes sur eux, telles que la sécheresse. Les parasites et les maladies sont parmi les facteurs les plus graves qui ont un impact sur la production et la reproduction du bétail, un impact sur la santé du bétail, un impact sur les aliments et la disponibilité du fourrage, la réduction du cheptel et l'impact du changement climatique sur les ressources génétiques du bétail. Cependant, le changement climatique, en particulier le réchauffement climatique, peut fortement influencer les performances de production des animaux d'élevage à travers le monde, ce qui entraîne une baisse de la production et de la productivité animales.

Mots clés: changement climatique, production animale, sécurité alimentaire et durabilité

Introduction

Livestock systems in developing countries are changing rapidly in response to a variety of drivers. Globally, human population is expected to increase from around 6.5 billion today to 9.2 billion by 2050. More than 1 billion of this increase will occur in Africa. Rapid urbanisation is expected to continue

in developing countries, and the global demand for livestock products will continue to increase significantly in the coming decades (Delgado *et al*., 1999). Livestock play a major role in the agricultural sector in developing nations, and the livestock sector contributes 40% to the agricultural GDP. Global demand for foods of animal origin is growing and it is apparent that the livestock sector will need to expand (FAO, 2009). Livestock are adversely affected by the detrimental effects of extreme weather. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to declines in production and reproduction efficiency (Sejian, 2013). Livestock system is one of the major sources of nutrition to the increasing population of the world. Human populations largely depend on animals and animal products like milk, meat, eggs, fibers, wool, and feather. Animals are also used for transport, draft and their manure. Livestock production is adversely affected by various events of extreme climatic conditions. Climate change is a major threat to the sustainability of livestock systems globally. Consequently, adaptation to, and mitigation of the detrimental effects of extreme climates has played a major role in combating the climatic impact on livestock (Sejian *et al*., 2015). There is little doubt that climate change will have an impact on livestock performance in many regions and as per most predictive models the impact will be detrimental. Climate change may manifest itself as rapid changes in climate in the short term (a couple of years) or more subtle changes over decades. Generally, climate change is associated with an increasing global temperature. Various climate model projections suggest that by the year 2100, mean global temperature may be 1.1–6.4 °C warmer than in 2010. The difficulty facing livestock is weather extremes, e.g. intense heat waves, floods and droughts. In addition to production losses, extreme events also result in livestock death (Gaughan and Cawsell-Smith, 2015). Animals can adapt to hot climates, however the response mechanisms that are helpful for survival may be detrimental to performance. This paper focuses in the effect of climate change on livestock production.

Climate change

Climate change is a phenomenon due to emissions of greenhouse gases from fuel combustion, deforestation, urbanization and industrialization (Upreti, 1999) resulting variations in solar energy, temperature and precipitation. It is a real threat to the lives in the world that largely affects water resources, agriculture, livestock, coastal regions, freshwater habitats, vegetation, forests, melting of snow-covered mountains and increase in climatic events such as landslide, desertification and flood. Around the world, the three major components of climate change already evident and escalating in magnitude and significance are; warming, altered patterns of precipitation and increased incidence of extreme climatic events.

Livestock owners' perception on the effects of climate change

Most of pastoralists and agro-pastoralists perceived that repeated frequencies of drought occurrences due to climatic change. They explained that prolonged drought was their major challenge that largely damaged the natural resources, and finally followed by lack of feed and water for people and animals (Berhe et al., 2016). Masih et al. (2014) also noted that drought severely harms the ecosystem and worsens considerably human crisis. Most of pastoralists and agro-pastoralists live in northern part of Nigeria confirmed that the effects of climate change, which widely destroyed crop farming twice or more times within a five years' period. During drought

period, almost all of the peoples reported lack of animal feed as their critical challenge. In this area, majority of the respondents sensitized the effects of climate change in terms of rainfall variability, temperature change, untimely raining and flooding, scarcity
of water, shortage of food for human and drying of streams and other water sources (Berhe *et al*., 2016).

Implication of climate change on livestock reproduction

Reproductive processes are affected by thermal stress. Conception rates of dairy cows may drop 20–27% in summer, and heat stressed cows often have poor expression of oestrus due to reduced oestradiol secretion from the dominant follicle developed in a low luteinizing hormone environment. Reproductive inefficiency due to heat stress involves changes in ovarian function and embryonic development by reducing the competence of oocyte to be fertilized and the resulting embryo (Naqvi *et al*., 2012). Heat stress compromises oocyte growth in cows by altering progesterone secretion, the secretion of luteinizing hormone, follicle-stimulating hormone and ovarian dynamics during the oestrus cycle. Heat stress has also been associated with impairment of embryo development and increase in embryonic mortality in cattle. Heat stress during pregnancy slows growth of the foetus and can increase foetal loss. Secretion of the hormones and enzymes regulating reproductive tract function may also be altered by heat stress. In males, heat stress adversely affects spermatogenesis perhaps by inhibiting the proliferation of spermatocytes.

Impact on feed and fodder availability

India has one of the largest livestock populations in the world, and one of its notable characteristics is that almost its entire feed requirement is met from crop residues and by-products; grasses, weeds and tree leaves; and grazing on common lands and harvested □elds (Dikshit and Birthal, 2010). Climate change affects livestock production by altering the quantity and quality of feed available for animals. Climate change is expected to change the species composition (and hence biodiversity and genetic resources) of grasslands as well as affect the digestibility and nutritional quality of forage (Thornton *et al*. 2009). Droughts and extreme rainfall variability can trigger periods of severe feed scarcity, especially in dry land areas, with devastating effects on livestock populations. Reductions in the quantity and quality of feed (leading to less feed intake and higher mortality) could make the impacts of climate change on livestock systems severe in certain places.

Impact on livestock health

The effects of climate change on the health of farm animals have not been studied in depth. However, it can be assumed that as in the case of humans, climate change, in particular global warming, is likely to greatly affect the health of farm animals. Global climate change alters ecological construction which causes both the geographical and phonological shifts (Slenning, 2010). These shifts affect the efficiency and transmission pattern of the pathogen and increase their spectrum in the hosts (Brooks and Hoberg, 2007). The increased spectrum of pathogens increases the disease susceptibility of the animal and thus, supports the pathogenicity of the causative agent. The livestock systems are susceptible to changes in severity and distribution of livestock diseases and parasites as potential consequences. Incidence of external parasite (43.3%) was first ranked as the problem in the warm temperate (Dhakal *et al*., 2013).

Reduction in livestock population

Global analyses have clearly shown that non-CO_2 greenhouse gas (GHG) emissions [(i.e. enteric methane (CH_4) and nitrous

oxide (N_2O)] are inversely related to animal productivity (Gerber *et al*., 2011). Increase in animal productivity can be achieved through improvements in animal genetics, feeding, reproduction, health, and overall management of the animal operation. In many parts of the world, reduction in animal numbers was the single most influential mitigation strategy that significantly reduced the C footprint (Capper *et al*., 2009). Similarly, In the Netherlands, with increase in milk production per cow from 6,270 kg in base year 1990 to 8.350 kg in 2008, with a decrease in CH_4 production from 17.6 to 15.4g/kg FPCM, respectively (Bannink *et al*., 2011). Chauhan and Ghosh Blümmel *et al*. (2009) estimated that increasing milk yield per animal in India from the national average of 3.6 liter per day to up to 9.0 liter per day was possible using currently available feed resources, and this would potentially reduce CH_4 production in the country from 2.29 to 1.38 Tg/yr. Sheep population has been reduced from 57.9 million in 1990 to 45.2 million in 2000, while dairy cattle and beef cattle population have increased slightly. The net outcome was a decline in ruminant CH_4 emission from 1.45 to 1.31 Tg/year from 1990 to 2000 (Sejian *et al*., 2011).

Impact of climate change on livestock genetics resource

Animal genetic diversity is critical for food security and rural development. It allows farmers to select stocks or develop new breeds in response to changing conditions, including climate change, new or resurgent disease threats, new knowledge of human nutritional requirements, and changing market conditions or changing societal needs all of which are largely unpredictable. What is predictable is increased future human demand for food. The effects will be most acute in developing countries, where the increase in demand is expected to be greatest, and occur at a rate faster than increases in production (FAO, 2003; 2006a), and where climate change is projected to have its greatest impact. Most flows of genetic material occur among developed countries, most of which are without zoo sanitary restrictions, and involve animals suited to high input production systems (Valle-Zarate *et al*., 2006; Hiemstra *et al*., 2007). More than 90% of exports originate from developed countries, and the share of trade in genetic material from developed to developing countries increased from 20% in 1995 to 30% in 2005 (Gollin *et al*., 2008). In many cases, the improved components of the high input management systems needed to express the genetic potential of the high output breeds have been transferred to developing countries. Industrial systems utilizing sophisticated technology and based on internationally sourced feed and animal genetics already produce 55% of pork, 68% of eggs and 74% of poultry meat globally (FAO, 2003; Steinfeld *et al*., 2006).

Conclusion

The study showed that livestock production system is sensitive to climate change and at the same time itself a contributor to the phenomenon, climate change has the potential to be an increasingly formidable challenge to the development of the livestock sector. The global demand of animal and animal products is increasing with the increasing human population. However, climate change is causing negative effects in the animal production and productivity. Climate extreme hazards are increasing causing huge loss of livestock assets and there is decrease in the feed, fodder and water availability for the animals, and increase in thermal and cold stress, diseases resulting in the decrease in animal production. Proper breeding strategies should be identified so that animal become tolerant to heat and cold and survive (Hoffmann, 2008). Identifying and strengthening local breeds adapted to local climatic stress and feed sources would be

one of the options to mitigate the negative effects of climate change in livestock. Likewise, early warning systems and forecasting system for livestock diseases should be developed.

References

Brooks, D. R. and Hoberg, E. P. 2007. How will global climate change affect parasite host assemblages. Trends in Parasitology 23: 571-574

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C. 1999. Livestock to2020: the next food revolution. Food, Agriculture and the EnvironmentDiscussion Paper 28. IFPRI/FAO/ILRI, Washington, DC, USA.

Dhakal C. K., Regmi P. P., Dhakal I. P, Khanal B. Bhatta U. K, Barsila S. R. and Acharya B. 2013. Perception, Impact and Adaptation to Climate Change: An Analysis of Livestock

System in Nepal. J. Anim. Sci. Adv., 3(9): 462-471

FAO 2009. The state of food and agriculture, Rome, Italy http://www.fao.org/docrep/012/i0680e/i0680e.pdf

Naqvi, S. M. K., Kumar, D., Paul, R. K. and Sejian, V. 2012. Environmental stresses and livestock reproduction. In: Environmental stress and amelioration in livestock production. Sejian, V., Naqvi, S. M. K., Ezeji, T., Lakritz, J and Lal, R. (Eds), Springer-VerlagGMbH Publisher, Germany, pp 97-128.

Sejian, V. (2013). Climate change: Impact on production and reproduction, Adaptation mechanisms and mitigation strategies in small ruminants: A review. The Indian Journal of Small Ruminants, 19(1):1-21.

Sejian, V., Bhatta, R., Soren, N. M., Malik, P. K., Ravindra, J. P., Prasad C. S., Lal, R. 2015. Introduction to concepts of climate change impact on livestock and its adaptation and mitigation. In: Climate change Impact on livestock: adaptation and mitigation. Sejian, V., Gaughan, J., Baumgard, L., Prasad, C. S. (Eds), Springer-Verlag GMbH Publisher, New Delhi, India, pp 1-26

Gaughan, J. B and Cawsell-Smith, A. J. 2015. Impact of climate change on livestock production and reproduction. In: Climate change Impact on livestock: adaptation and mitigation. Sejian, V., Gaughan, J., Baumgard, L., Prasad, C.S (Eds), Springer-Verlag GMbH Publisher, New Delhi, India, pp 51-60

Received: 10th November, 2020
Accepted: 4th January, 2021