FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 9 No. 3, September 2023: Pp. 157-163

https://doi.org/10.33003/jaat.2023.0903.22

# EFFECT OF GLOBAL WARMING ON SUSTAINABLE LIVESTOCK PRODUCTION IN THE SUB-SAHARAN AFRICA

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## ABSTRACT

The greenhouse gas emissions from Animal production related activities has turn out to be an important cause of global warming. This can be attributed to the continent-wide massive burdens arising from the switch in food consumption pattern. Anthropogenic activitiesrelated to livestock production contribute 37% of methane ($CH_4$) emission, 9% of carbon dioxide ($CO_2$) output and utilize 8% of the world water. An estimated aggregate of 7.1 billion tonnes of $CO_2$ are generated by the feed and livestock industries. The effect of global warming is presently being experienced such as unstable rainfall pattern, drought, extended walk in search of pasture and water, coupled with significant impact on livestock productivity (rate of weight gainand milk production potentials).The potential of Sub-Saharan Africa to achieve sustainable animal production is being threatened by global warming, it is. therefore necessary to leverage on the use of livestock breed that combine the heat tolerance of the local stock with the high milk yield of the exotic breed (crossbreeding) to produce an improved breed of livestock. Ameliorative strategies such as strategic supplementation of diets, matching genetics to specific systems and management of manure with potential to improve productivity of livestock should be included into livestock production systems in the Sub-Sahara Africa. The use of Geographic Information System (GIS) techniques will also assist to acquire ideal results on susceptibility of smallholder farmers. Finally, there is the need for shift in policy to promote the livelihood of indigenous livestock farmers under favourable environmental conditions.

Key words: Global warming, Green House emission, livestock, Sub-Saharan Africa

## INTRODUCTION

The livestock sector supports over 1 billion people and accounts for 40% of global agricultural gross domestic product (GDP). It also account for over 33% of the world's protein intake. It is projected that the global meat production would more than double within 60 years to 465 million tonnes by 2050. According to Erdaw (2023),the demand for poultry meat and pork in selected countries of SSA will increase by 214% and 161%, respectively. The consumption rate of animal-based food is expected to rise by 80% worldwide.The current world-wide enormous pressures on livestock production to catch up with the need for animal protein that are of high value hasoccasioned a major revolutionin the the livestock sector, from a resource-driven (based on surplus products and available waste) to one that searches hostilely for new resources to cope with the ever growing demand for animal protein by humans.However, the growth of the livestock production systems has significant effect on global warming and climate change as it contributes 14.5% of overall greenhouse emissions, 5% of anthropogenic CO2 emissions; 44% of anthropogenic methane emissions; and 53% of anthropogenic nitrous oxide emissions. This paper is a review of the literatures on the role of conventional livestock production in greenhouse gas emissions and global warming,impact of global warming in sub-Saharan Africa and the strategies for ameliorating the effects of global warming in this highly vulnerable region.

## THE ROLES OF CONVENTIONAL LIVESTOCK PRODUCTION IN GREEN-HOUSE GAS EMISSIONS AND GLOBAL WARMING

The worldwide livestock sector is developing faster than any other agricultural sector. It is presently the single principal anthropogenic user of land, and the cause of several problems encountered within the environment such as global warming (Keith, 2008). The change in dietary pattern from the usual root crop and cereals to processed foods that are wheat based and animal products of high protein value has heightened the demand for livestock. According to FAO (2020), there are 25 billion poultry in existence today, 2.2 billion goats and sheep and about 1.7 billion cattle (FAO 2020). Globally, the livestock sector utilizes an average of 3.4 billion hectares of pasture land and 470 million hectares or 33 per cent of all arable land are being devoted to feed production (Thepoultrysite, 2008). The dairy and beef cattle has been reported to contribute 24.7% and 72% of the overall $CH_4$ arising from enteric fermentation; while manure management from swine and beef accounts for 32.4% 55.9% of the total $CH_4$ respectively (EPA 2020).

Methane is emitted through belching by animals like cattle,while nitrous oxide is obtained from their manures. Methane and nitrous oxide has two times and 310 times, respectively greater potentials of causing global warming than the carbon-dioxide from automobile exhaust pipe(IPCC, 2021). Within

the last few decades, conventional livestock production systems have emerged as one of the major contributors to thegrave environmental problems, generating more greenhouse gas emissions than the entire transport system of the world. According to the UN Food and Agriculture Organization, livestock production currentlyaccounts for 18% of the totalgreenhouse gas emissions that are humanly induced (Steinfeld, 2006). For instance, 36.4 kilograms of Green House Gases (GHG) emissions is released during the production of 1 kilogram of beef, 340 grams and 59 grams of sulphur dioxide and phosphate are generatedrespectively while 169 megajoules of energy are consumed. It will also involve using hundreds of litres of water and a source of thepollution of almost 200 square metres of land (Fanelli, 2007). According to Gerber *et al*. (2013) the worldwide animal agriculture contributes approximately $7.1 \times 10^3$ MMT $CO_{2\text{-eq}}$ GHG emissions each year, and about 44% of this total amount is accounted for by livestock methane emission.

Greenhouse gas emissions not only come through the livestock themselves, but also through production of feed and use of chemical fertilizers for growing feedstuffs. A total of 7.1 billion tonnes of carbon dioxide ($CO_2$) are generated by the feed and livestock industries, with 36% of the emissions arising from land use change, feed production 7 per cent, manuremanagement produces 31% whileanimals themselves produce 25%. Transport in livestock production produces only 1% of the GHG emissions (Thepoultrysite, 2008).

The Third Assessment Report of the UNEP/WMO Intergovernmental Panel on Climate Change (IPCC) recorded a warming of approximately 0.7°C over majority of the African continent during the 20th century (UNEP/GRIDA, 2008). This translates to an average rate of about 0.05°C per decade. Green house contribution from Sub-Saharan Africa is negligible at present. It is however clear that continued high rates of human population growth and the promotion of intensive animal production would lead to considerable increases in the Sub-Continent's GHG emissions in the next few decades, even if per capita emissions are kept at a low level.

## THE IMPACT OF GLOBAL WARMINGON LIVESTOCKPRODUCTION IN SUB-SAHARA AFRICA

The effect of regional warming is currently been noticed and this includes increased susceptibility of the forest to fires, disappearing glaciers in places like Mt. Kenya and Mt. Kilimanjaro, Ruwenzori (in Uganda). Anticipated climate change will likely lead to changes in tree productivity, resulting in further pressure on forest ecosystems and species range shifts. Changes in ultraviolet radiation, temperature,moisture levels and $CO_2$ levels arising from climate change can have damaging effects on water balances of forage crop. Beyond the deleterious effect that global warming has onforage crop, it also has a huge impact on appetite, frequency of weight gain by growing animals, rate of conception and milk production potentials of livestock in Sub-Saharan Africa. Heat stress can result in hormonal imbalance in animal and ultimately affects milk production (Singh *et.al*., 2013, Prathap*et.al*., 2017). It has also been reported to affect semen quality, sexual behavior and ultimately the reproductive performance of males (Balic*et al*., 2012).

*Fig. 1. Climate change highly vunerabie horns of Africa- a NASA picture*

A World Bank study shows that the striking change that climate function may produce lies in the types of livestock species being raised. As climate gets hotter, small ruminant animals will take priority over chickens and cattle, because of their susceptibility to heat stress. Studies have shown that feed intake is reduced in poultry by 5% for every 1$^{o}$C upsurge in temperature within 32-38$^{o}$C (Sohail*et al*., 2012), likewise the growth performance (Imik*et al*., 2012). The rearing of dairy cows and chickens will then be limited to highland area such as plateau state of Nigeria. However, chicken and goats may become more attractive options if rainfall increases in these areas. In 2007, it was recommended by UNEP that the number of small ruminants in Africa should be increased. This may be the reason for an already increased goat production in Ghana (SPORE, 2008).


*Fig. 2.Mt Kilimanjaro. The ice covered top is declining*

In many parts of Sub-Saharan Africa (SSA),global warming, exacerbated by series of human-induced activities and deforestation has resulted into reduction in average annual rainfall. Climate change has occasioneddrought and also made it difficult to forecastthe start and length of the rainy season. The extended period of drought inthe region has led into longer walk by animals in search of pasture and water. This is also experienced in Burkina Faso where daily trek by grazing animals has increased by 20km within the last 10 years (SPORE, 2008). Galissowangonza, a livestock keeper in Noro Tahona, 600km from Niamey made the following submission:*"Some of my brothers are skeptical about climate change. But I've been to school and I know a bit about it…. Our livestock have to walk distances to get water…. The fields no longer produce much due to lack of rain. It is very hot and grass is getting scarce. In a few years' time, many livestock keepers like me won't know what to do any more. That warns me because our livestock are a part of us"* (SPORE, 2008).

*Fig. 3. Animals travelling lomg distances in search of pasture and water*

The cattle area, which extends from Central and Western Uganda to mid-northern and semi-arid to arid regionscontaining 980,000 households, is currently experiencing some impact on its livestock productivity. Attempt by farmers to move their animals to wetland for grazing now poses new challenge of conflicts with crop farmers in many parts of Northern and Central Nigeria and attacks

by predators, especially snakes and crocodiles. Herders in Burkina Faso shift their animals to the east or settle in the coastal countries of Ghana, Benin and Togoand consideredas one of the most vulnerable countries to climate change in Africa (Busby *et al*., 2014)

Climate change also has a distinct impact on animal diseases. It has been predicted that global distribution of diseases will be altered (Guis*et al*., 2011). According to an FAO Interdepartmental Working Group (cited by AFP, 2005), Climate change is expected to impact the expansion and escalation of animal diseases and plant pests, apart from impacting food security negatively. The report further warned that farmers, government, health and agricultural experts will have to acclimatize to an increasing stream of fresh pests and diseases triggered by a change in ecological conditions. One of the concerns that researchers are presentlyprobing is the possibility of viruses responsible for animal diseases to change vectors and migrate into areas withfavourableclimate even when their traditional vectors do not exist in the new area. Such a possibility will result in proliferation and high level of losses in many SSA countries and regions where there are no adequatepreparation for the disease organisms. In less semi-arid regions of SSA, the smaller numberof watering holes in pastoral lands could upsurge the interaction between domestic livestock and wild animals. Interaction between gnus and cattle for example, could prompt the outbreaks of chronic catarrhal fever which is fatal to livestock but for which gnus are mere carriers.

*Fig.4. Animals sharing water points with wild animals could breed interspecie infection*

The change in temperature, as well as increase in air pollution, can heighten the spread of trans-boundary zoonotic diseases. According to a FAO Interdepartmental Working Group on Climate Change (cited by AFP, 2005), Sub-Saharan African countries are mostly at risk, because of their limited ability to acclimatize to global warming and to alleviate its impact via an increase in food importation.

**STRATEGIES FOR AMELIORATING THE EFFECTS OF GLOBAL WARMING ON LIVESTOCK PRODUCTION IN SUB-SAHARAN AFRICA**

The present impact of climate change on livestock production in SSA requires urgent remedial action so as to save the countries in sub-continent from increasing dependence on western countries for animal products.There is acriticaldemand for local breeds with better adaption to the sub-region rather than introducingforeign/exotic breeds as breeding stocks from the temperate region. The reports obtained as an aftermath of a drought in Uganda revealed that herders that kept the local Ankole cows successfully drove them to far away watering points, while those who had substituted local breeds with imported ones, lost all their animals (SPORE, 2008).

The prospect for sustainable dairy industry in the Sub-Saharan Africa lies in the adoption of new production system such as stall feeding of animals, especially in areas with poor grazing. In Uganda, for instance farmers have adjusted to the demoralizing effect of climate change by paddocking and planting of planting of pastures that are resistant to drought such as *Panicum maximum*(SPORE, 2008).This system however requires that fodder crops should be highly digestible to reduce flatulence. Effort will also be needed to improve the management of slurry and manure from the animals to reduce methane emission by converting them to such materials as biogas.Smallholder livestock farmers in challenging region can also combine the high milk yield of the exotic breedwith the heat tolerance of the local stock through crossbreeding.

There is an increase in the need for meat and animal products globally, therefore substantialreduction in global warming arising from animal production cannot be achieved solely through reducing consumption in developed countries. Jones (cited in PoultrySite, 2009) therefore opined that most importantly, modifications must be made to achieve a reduction in GHG emissions *per unit of product* via environmentally friendly management practices.

One of the most promising and cost effective strategies that could help to reduce methane emission from livestock is to improve the capacityof livestock production system to produce more efficiently (Leng, 1991). A more efficient animal will generate lower emission of methane comparatively to the amount of meat and or milk they produce. The huge cost incurred in procuring and air-lifting the high yielding but less adaptive exotic animals can be diverted to the selection and breeding of indigenous stock for meat and milk traits.

Strategic supplementations of diets to enhance weight gain, milk production and reproductive performance is another attractive proposition to reducing methane emissions per unit of products. Strategic feed manipulation to improve GHG emissions have been the subject of recent research in the Nigerian University system. There are a number of natural products that have been utilized to improve milk and meat production, thereby reducing the amount of methane produced. An artificially produced hormone called Bovine somatotrophin (bST) can be introduced into dairy cows to increase milk production approximately by 3.2kg per day and thereby reducing the quantity of GHG per litre of milk (Gómez,*et al*., 2022)The use of medicaments to promote greater efficiency of production must be selectively done to promote healthy and safe animal products.

Breeding is an important tool which can be exploited for reducing emissions from livestock production. There were however no change for beef and sheep. Using records from the UK team, it was also predicted that an annual enhancement of 0.3 per cent., or 4.4 per cent in 2022 is possible for cattle,while the corresponding figures for sheep was an annual rate of 0.54 percent or 8.1 per cent in 2022 compared to 2007. According to PoultrySite(2009), breeding strategies which has potential to reduce GHG emissions include:

- use of novel tools to hasten the level of improvement
- selection that is focusedon new traits like disease resistance
- optimizing systems that matchesspecific production systems to genetics
- developing models that are comprehensive and allows merits of diverse options to be measured.
- advance research to examineany genetic discrepancy in the effectiveness of nutrients digestion and absorption and
- emissionsof GHG should be consideredamong the indices for selection.

**Table1. Percentage variations through genetic improvement (1988-2007)**

| | Methane $CH_4$ | Ammonia $NH_3$ | GWP 100 | Nitrous Oxide, $N_2O$ |
|---|---|---|---|---|
| **Layers** | -30 | -36 | -25 | -29 |
| **Broilers** | -20 | 10 | -23 | -23 |
| **Pigs** | -17 | -18 | -15 | -14 |
| **Dairy** | -25 | -17 | -16 | -30 |
| **Beef** | 0 | 0 | 0 | 0 |
| **Sheep** | -1 | 0 | -1 | 0 |

Source: Poultrysite (2009)

The need to monitor the evolution of traditional vector's habitat to preclude the rate at which diseases for which they are carriers are being spreadcannot be over-emphasized. The recent resurgence of the Rift Valley fever in Kenya in late 2006 has been blamed by the World Organization for Animal Health on the increased rainfall in East Africa. The outbreak of this debilitating zoonotic viral infection soon spread to some neighbouring countries. Proper monitoring of the vector is needed to prevent future occurrence.

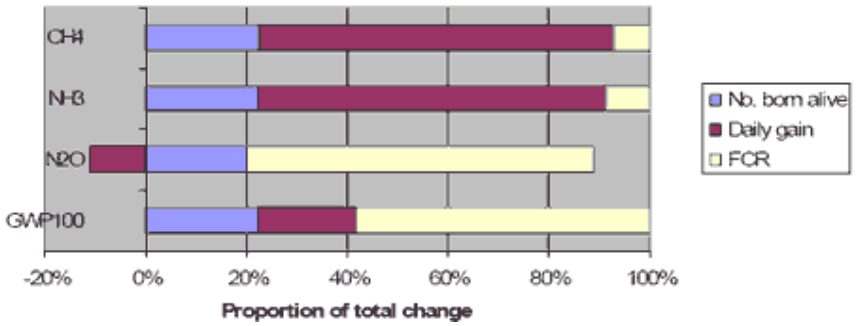


Fig. 6: Genetic gains related to GHG reductions in pigs (1988-2007)

Source: Poultrysite (2009)

Technical information is needed on which disease has disappeared in the region due to unfavourable environment for the causal organism, and which new diseases are to be fought. Science must come out with sustainable solutions that will inform policy decision makers and the herders on necessary measures. Existing

climatic forecast models are too harsh for the development of a credible and dependable regional climatic scenarios. While it is clear that the global temperatures will increase but we do not know what will happen at the regional level. It is likewise necessary to develop the use of Geographic Information System (GIS) techniques that can generate results on the vulnerability of smallholders andresponse strategies to climate impacts that are found to be effective.

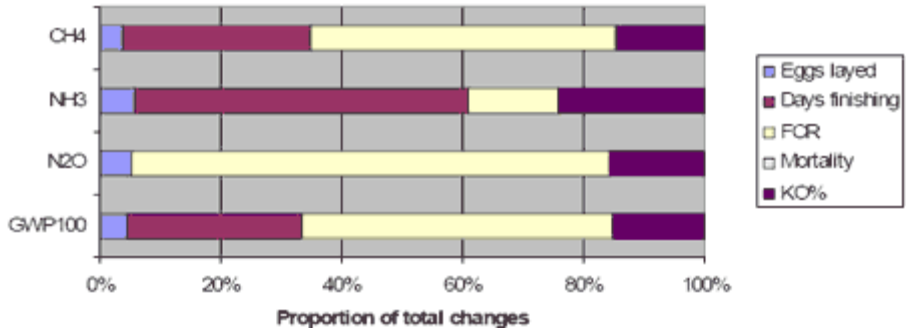


Fig. 7: Genetic improvements related to GHG reductions in broilers (1988-2007)
Source: Poultrysite (2009)

Beyond the institutional framework that are currently been put in place in many Sub-Saharan Countries, we need technical information on the regional causes and consequences of global warming such as its effect on geographical shift in disease distribution. It is this technical information that can trigger both policy makers and livestock owners to undertake appropriate measures that will enhance the sustainability of livestock production in Sub-Saharan Africa.

Finally, thestate organs and the NGOs should cooperate to encourage livestock herders and other stakeholdersto adopt good practices for sustainable livestock production. The present scenario calls for new policies, programs and new technologies to make livestock production in the Sub-Saharan Africa more environmentally benign. Unlike the USA and European Union, where the lobbies for livestock belong to the most influential political action groups, livestock herders in sub-Saharan Africa are politically marginalized. NGOs can form a formidable coalition to lobby for a shift in policy that will improve the livelihood of native livestock farmers under favourableenvironmentally conditions in the Sub-Saharan Africa.

**CONCLUSION**

The effect of regional warming is currently been noticed in sub-Saharan Africa and this include increased susceptibility of the forest to fires and disappearing glaciers in places like Mt. Kenya and Mt. Kilimanjaro. There is an increased pressure on forest ecosystems and species range shifts. Global warming may likely take its toll on forage crop, appetite and frequency of weight gain by growing animals as well as rate of conception and milk production of livestock in Sub-Saharan Africa. The species that are heat tolerant like goat may likely be favoured as climate gets hotter thereby replacing more susceptible species like chickens and cattle. Climate change is expected to impact the expansion and escalation of animal diseases and plant pests, apart from impacting food security negatively. Sustainable livestock production in sub-Saharan Africa therefore requires improvement in the capacity and efficiency of livestock production system. There is also a critical demand for local breeds with better adaption to the sub-region rather than introducing foreign/exotic breeds as breeding stocks from the temperate region. This does not leave out the possibility of using high milk yield of the exotic breed with the heat tolerance of the local stock through crossbreeding. These strategies must be combined with breeding strategies which has potential to reduce GHG.

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