GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(Review Article)

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Outlook threat at the future climate changes on livestock resources

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GSC Advanced Research and Reviews, 2022, 10(01), 001–006

Publication history: Received on 24 November 2021; revised on 02 January 2022; accepted on 04 January 2022

Article DOI: https://doi.org/10.30574/gscarr.2022.10.1.0305

Abstract

Food availability is the most important issue that takes the priority places in the policies of all countries all over the world. Recently, more attention has been paid to livestock because of their ability to produce meat and milk, as well as it has a significant source of income for small holders and an economic contributor to the gross domestic product. Climate changes induced physiological stress, which is one of the complex factors making livestock management and husbandry challenging in many geographical locations in the world. Increased body temperature or heat stress will cause production losses in livestock and impact on their ability to maintain normal function. There is considerable research evidence that showed significant decline in animal performance when subjected to heat stress. Heat stress inflicts heavy economic losses on livestock production. The effects of heat stress is evident in feed consumption, production efficiency in terms of milk yield or weight gain per unit of feed energy, growth rate, and reproductive efficiency. The aim of this article is to discuss increasing food production to ensure food security for nearly 8 billion people, without causing further environmental damage that can be achieved by transforming systems and adopting sustainable livestock practices within a changing climate.

Keywords: Future climate changes; Livestock; Heat stress; Global warming potential; Greenhouses gas.

1. Introduction

Livestock has traditionally played a major role in all aspects of food security (production, and stability of supply). In addition, it is a significant source of income for small holders and an economic contributor to the gross domestic product [1]. Climate change presents a range of challenges for all animals' species in the globe. Livestock production will be affected by changes in temperature and water availability through impacts on pasture and forage crop quantity and quality, feed-grain production, disease and pest distributions. This article provides an overview with a focus on effects of increasing temperature, changing rainfall patterns, and increased climate variability on animal health, growth, and reproduction, including through heat stress, and potential adaptation strategies. Moreover, this article discusses the challenges and opportunities facing livestock industries in the globe in adapting to and mitigating climate change globally, the genetic variation in inputs required and outputs produced by farm animals is very large. The diversity available to breeders and farmers to utilize are:

- Diversity amongst farm animal species,
- Diversity amongst the breeds of each species (as breeds have developed, they have become highly adapted to their production environment; therefore, it is not surprising to find most of the quantitative traits (such as milk, eggs and meat) variation for characteristics of a species being unique to each breed (Compliance).
- Diversity amongst the individual animals of within each breed.

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Consequently, the utilization of the species, breed and individual animal's diversity should be an important element in livestock development within and between-human communities. Breeders should consider the following in the genetic development of livestock in future climatic conditions:

- Which breed or breeds?
- When more than one breed is chosen: How to use these breeds?
- How to develop breed(s), i.e. which animals and how to use these to maximum benefit?

The rate of adoption of adaptation strategies by livestock breeders will depend on perceptions of the uncertainty in projected climate and associated impact and risk [2]. However, management changes adopted by farmers will be significantly affected by climate change policy and national targets to address greenhouse gas emissions, since livestock are estimated to contribute to total emissions and 8–11% of global emissions, with additional farm emissions associated with activities such as feed production. More than two-thirds of emissions are attributed to ruminant animals. Raising livestock in many areas in the world is a traditional activity contributing to the livelihoods of millions of rural communities. Livestock make use of the scarce feed to convert them into nutritionally and economically valuable products. It can be noticed that although the livestock population is relatively numerous, in many developing countries, production potential is very low. This could be attributed to severe climatic conditions, feed shortage, poor genetic make-up for production and several other factors, including endemic diseases and management. There will be increasing investigation on adaptation of genetic resources to changing environmental conditions and consumer demands. Maintain of genetic diversity and its utilization as well as exchange of genetic material will be importance. The development of global biotechnology system to identify genes responsible for adaptation, acclimatization and behavior stress become important issue for safeguard future food security (genes that may be needed in a future of extreme climate change). Such system will for sure will keep animal genetic diversity and conserving genes that could be useful in the future. Simultaneously, it is important to increase animal products. For that it should be comprising between maintaining genetic resources, diversity and improving animal products. There are several constraints for livestock development such as feed resources; demographic characteristics (; harsh environment; and lack of veterinary services. Elasha [3] described the projected effects of global warming on the Middle East countries would because temperatures could increase by 4°C with a decrease in rainfall of more than 30 percent, thus making the area threatened by desiccation. Naturally, this will affect the agricultural yields, which are expected to be decreased. The forecast for the future looks alarming with increasing challenges facing the livestock sector. The demand is driven by structural factors such as increased population rate and urbanization. Within this context, trends for further intensification to meet urban demand are inescapable, while resource driven extensive systems with limited growth potential could still sustain the subsistence of millions of poor people from arid land for which, there is no alternative use. These developments will be presented below with their relative merits and shortcomings, putting a special emphasis on their impact in improving food security and food sovereignty. The sustainable livestock intensification is vital issue to increase in production to meet the rising demand and will be mostly driven by large scale intensive production farms, in what has been coined the "Livestock Revolution". These are described [4] as mostly privately owned with high input, capital and technology dependency. The growth of this system has been largely unregulated and had contributed to the negative outlook of the livestock sector blaming it for environmental damage, greenhouse gases, land and water resource degradation, deforestation, desertification, diseases, and nutritional disorders.

2. Environment and Livestock

The Food and Agriculture Organization [5 -7] criticized the message, which, mentioned that food production from animals carries a far higher environmental cost than arable farming for crops. Cattle and sheep come under special attack because of the amount of methane they produce because of rumen fermentation, methane having approximately 20 times the global warming potential of CO_2. Once again, this criticism is valid within its own terms of reference but it does not tell the whole story. It was reported that the environmental cost of production systems in terms of the land required producing a standard amount of different foods for humans of plant and animal origin. This is measured in global hectares but does not adequately account for the differing capacity of different classes of land to produce crops, e.g. grasses versus cereals. Furthermore, it does not properly account for such things as differences in the availability and therefore the value of site-specific resources, most especially, water. Problems of water supply and disposal are very different for dairy units in some areas of the world.

3. Heat Stress of Livestock and their Role in Future Climate Change

Heat stress on livestock has a devastating effect on not only their growth and reproduction, but also their food intake and production of dairy and meat. Cattle require a temperature range of 5-15 degrees Celsius, but upwards to 25 °C, to live comfortably, and once climate change increases the temperature, the chance of these changes occurring increases. Once the high temperatures hit, the livestock struggle to keep up their metabolism, resulting in decreased food intake, lowered activity rate, and a drop in weight. This causes a decline in livestock productivity and can be detrimental to the farmers and consumers. The location and species of the livestock varies and therefore the effects of heat vary between them. This is noted in livestock at a higher elevation and in the tropics, of which have a generally increased effect from climate change. Livestock in a higher elevation are very vulnerable to high heat and are not well adapted to those changes [8, 9}. As outlined in many reports the livestock development relies heavily on a supportive regulatory framework, policies and services that are needed to ensure an equitable growth of the sector aiming to satisfy the increasing demand while at the same time securing the livelihoods and food security of the rural and urban poor.

3.1. For better Food security

For moving the livestock sector toward a Food Secure in 21st century the followings are needed:

- ❖ Regulation of the intensive production systems through public policies. In order to be sustainable, intensive demand-driven production systems need to be responsible for the environmental impact of their activities. These include:
  - Mitigating environmental pollution through proper waste management.
  - Water use efficiency to optimize the output for every liter of water used.
  - Strict health and hygiene control to prevent animal and zoonotic disease outbreaks.
  - Product quality control.
  - Sustainable use of land resources with special considerations for small holders' fair access to grazing areas.

Public laws and policies are needed to enforce the above.

- ❖ Support for mixed farmers. Mixed farmers are constantly challenged by low productivity, competition and variable access to resources and services. Regulatory policies and supportive intervention are needed in order to:
  - Provide access to market. This could be achieved through initiatives for product collection and transport in refrigerated vehicles, local products labeling and promotion initiatives, and fair pricing.
  - Improve productivity. This necessitates access to technology and targeted research to serve the needs of the sector. Training and education initiatives are also needed to help the farmers make the best use of their available resources for animal production.
  - Animals' health. Veterinary services are largely lacking for small mixed farmers who either do not have access to specialists or cannot afford them. This should be amended through dedicated services by the public sector.
  - Access to capital. Small farmers would greatly benefit from targeted and facilitated investment options that would give them leverage to improve and adapt their situation in view of ever changing constraints.
- ❖ Facilitating Pastoralists, which would benefit from all the above services and support suggested for mixed farmers. In addition, they need special

Policies to support their mobility and access to grazing areas. Based on their solid knowhow, they are well equipped to make the best use of the land if given enough freedom to move their flocks between available grazing sites. National effort should be also made to preserve and improve the local breeds and their genetic resources that are at the heart of this highly adapted production system [10].

3.2. Steps to reduce greenhouse gas

Methane is a powerful greenhouses gas with a 100-year global warming potential 25 times that of CO2 [11]. Measured over a 20-year period, methane is 84 times more potent as a greenhouse gas than CO_2. About 60% of global methane emissions are due to human activities. Many plant secondary compounds such as tannins, saponins or essential oils have been shown to directly reduce methanogens and hydrogen production in the rumen. Some oils such as linseed, coconut, garlic and cotton oil are considered to be amongst the most effective additives for methane mitigation. A recent experiment from the University of California, Davis suggests that adding seaweed to cattle feed can dramatically decrease their emissions of the potent gas methane. Livestock is a major source of greenhouse gases worldwide. It can probably reduce methane by about 20-25% by altering diet. One study by researchers at the University of California, Davis, estimated it might be possible to reduce global methane emissions from cows by 15% by changing their diet. Cattle are the main agricultural source of greenhouse gases worldwide.

Methane from cattle is shorter lived than carbon dioxide but 28 times more potent in warming the atmosphere, Ruminants are the principal source of livestock methane emissions because they produce the most methane per unit of feed consumed [12]. Cow belching due to enteric fermentation (is the digestive process of converting sugars into simple molecules for absorption into the bloodstream, which produces methane as a by-product). As methane producer, a cow generates 200 liters of methane, on average, while humans who produce methane give off a fraction of a liter of methane daily. Methane is bad because not only is it a greenhouse gas, but it is a waste of feed. Steps to reduce greenhouse gas should include:

- Support organic farming practices. organic farmers keep livestock longer instead of replacing old cows with younger calves,
- Eat less red meat,
- Support farms who use "digesters",

4. Reducing methane with natural additives

Reducing the methane gas cattle generate not only cuts greenhouse gas emissions but also potentially allows more of the feed cattle consume to be directed to their body and production. That can lead to larger, stronger cows and steers, more milk and beef. Between 4 and 12 percent of the feed cattle eat is wasted through the methane gas they produce. Current research examines how natural compounds can reduce the number of protozoa in a cow's stomach, thus decreasing the amount of methane and nitrogen a cow expels. Any protein that cattle eat that's not used by their bodies comes out in their urine and manure in the form of nitrogen. Almost half the nitrogen in their urine and manure turns into ammonia gas, a toxic, potentially explosive gas, though not a greenhouse gas. Different compounds can reduce the methane generated in a cow's gut. Antibiotics are among them. However, consumers sometimes steer away from buying beef that has been given antibiotics. It was found that essential oils, including garlic, rosemary and oregano oils, as well as saponins and tannins, are effective in reducing the amount of methane cattle give off in their gas and burps. Saponins are compounds found in some vegetables, beans and herbs. Tannins are bitter-tasting organic substances derived from some plants. The essential oils, saponins and tannins reduce methane production by decreasing the numbers and activity of protozoa and methane-producing microorganisms in cattle's guts. The protozoa don't produce methane, but they help the methane producers that do, microorganisms called methanogens. Methanogens are in human guts as well, but not nearly as many as in cattle. In one study, the effect of giving cows 3-nitrooxypropanol, a white powder that can be mixed in with their feed, the additive has been shown to cut methane production by up to 20 percent. On the other hand, researchers have been given a vaccine against certain gut microbes that are responsible for producing methane as the animals digest their food. Methane is one of the most egregious of greenhouse gases, roughly 25 times more potent at trapping heat than carbon dioxide. Nowadays, research's aim is to develop vaccine, along with other anti-methane methods, in an effort to allow us to continue eating meat and dairy products while lessening the impact the livestock industry has on the environment. Another option is to give cattle probiotics, or helpful bacteria, to aid their digestion. It has been developed a probiotic to tackle methane from cattle and claims it can reduce emissions by 50%. But chemical inhibitors and probiotics like this would have to be added daily to feedstuffs, and would be hard to deliver to animals fed mostly on grass. It is likely to be an expensive option. A vaccine would potentially only need to be given once, or perhaps would need just an annual booster. Regardless of the approach used, messing with the pattern of microbial life in the gut may alter its ecology – possibly with unforeseen consequences. The gut microbe is closely related to health, and changing it can increase the risk of disease. There is even some association in humans between gut bacteria and mood, although it is unclear if reducing methane-producing bacteria would lead to depressed cows and sheep, or what effect this might have on their meat and milk [13, 14].

Current methane production from ruminants is estimated to contribute approximately 10% to the planetary production of greenhouse gases. Various approaches to the reduction of methane emissions from rumen fermentation have been considered in earlier chapters. These will have limited impact in pastoral systems, maximum impact in intensive units where cows are housed throughout lactation and fed carefully formulated total mixed rations with additives designed to modify rumen fermentation to reduce methane production. Moreover, the higher the milk yield of the individual cow, the greater the overall efficiency of utilization of feed energy, and thereby the greater the yield of milk relative to methane [15].

The biggest constraint on the expansion of individual dairy units (more and more cows) is the problem of disposal of wastes: slurry and dirty water. The principal culprits are nitrogen and phosphates present to excess in ground and surface water. As with methane production, so with pollution; the poison lies in the dose. Pollution is caused by too much fertilizer in the wrong place. An extensive or organic dairy farm, or a dairy enterprise incorporated into a mixed arable/livestock farm should have a neutral or even beneficial effect on soil fertility. A highly intensive dairy unit, perhaps 75% dependent on bought-in rather than home-grown feeds will inevitably produce more nitrogen (N) and phosphorus (P) than the land can carry so become a significant source of pollution. On grounds of sustainability, environmental quality and general good sense, the obvious solution is to restrict the number of animals to that which the land will support, both in terms of the supply of renewable resources (home grown pasture and crops) and the disposal of animal wastes. Strict interpretation of this principle is, of course, incompatible with the current economics of intensive dairy production within a free market. The European authorities have imposed legal limits on nitrate and phosphate concentrations in ground and surface water in the vicinity of dairy units, with fines for those who break the law. This has had a significant impact on intensive dairy production in, especially, Denmark and the Netherlands. Producers have responded by reducing inputs of N and P in both fertilizer and feeds, better management of slurry and dirty water and, where this has proved insufficient, radical reductions in cow numbers. Other approach can help to reduce pollution, for example, most conventional of feeds, spring grass, especially when liberally fertilized, will contain N in excess of ME, which, in these circumstances, will be lost to the cows and increase the load on the environment. This problem can be reduced now by feeding the supplements necessary to bring ME and MP into balance. In future, we hope to achieve this balance through the successful breeding of better balanced, high sugar grasses.

5. Organic Dairy Farming

Increased public concern as to the impact of intensive farming systems on the environment, human health and animal welfare has given impetus to the long-established practice of organic farming. The Soil Association has set out standards for organic dairy production in the UK and these are largely similar to those adopted by the EU. The most critical clauses within the context of sustainability are:

- Cows should be at pasture whenever possible. In UK this should average
- >200 days/year.
- A minimum of 60% of the ration should be based on fresh or conserved pasture.
- No artificial fertilisers should be used. Total application of N from faeces from grazing cows, spread slurry and manure should not exceed 170 kg of N/ha/year.

These regulations should, in normal circumstances, eliminate the risk of pollution of ground and surface water from organic dairy farms. The philosophy of the Soil Association is rooted in the principles of good husbandry, which imply proper concern for the welfare of farm animals and all life on the land. Most of this book deals with cows in modern, high-input, high output systems in the developed world. I justify this because these are the systems that have derived the most benefit from the application of science, yet are most in need of a proper, humane, non-mechanistic understanding of the dairy cow. However, most of the people in most of the world derive their subsistence from very small scale, low input, low output practices. In much of the less developed world, lactating ruminants, cows, buffaloes, are indispensable contributors to the nutrition, income and welfare of pastoral and village communities. They produce highly nutritious food in circumstances where the need is great and choices are few. The indigenous animals are well adapted to challenging environments but individual yields are low. There is some scope for improvement through cross-breeding with higher yield animals but this needs to be done with care and a proper, sympathetic understanding of local circumstances in order to create a phenotype appropriate to the local climate and availability of feed resources.

The most fruitful pathways to the production of better, kinder dairy products within traditional pastoral and village systems will be through education; science based, but sensitive and complementary to the substantial knowledge of the local people. One of the greatest problems for traditional herders is that they cannot afford veterinary care. It is in the public interest that these farming systems that contribute so much to community life should receive public support from governments or non-governmental organization to improve both productivity, welfare and sustainability through policies designed to improve animal health and management practices that avoid land degradation. Good health and good welfare ('wellbeing') are the goals of good dairy farmers and their discerning customers. The route to both of these goals, which, of course, overlap, is through good practice concentrating on prevention of problems rather than treatment as they occur. All dairy farmers need a herd health plan, arranged with their veterinary surgeons to promote good health, minimize the incidence of endemic and production diseases and the risk of acquiring infections. Dairy farmers and the retailers of dairy products also need to establish and adhere to standards of animal welfare, both for the benefit of their cows and the reassurance of their customers [13, 14].

6. Conclusion

In many countries, livestock are normally raised for meat and milk. Heat stress could affect livestock production. Future climate change will have a misbalance of weather conditions such as temperature, wind, drought and rainfall characteristics and it is likely to be one of the main challenges that humankind as well as livestock will face in future. The livestock sector is a driving force in the gas emissions effects thought to cause climate change, which is responsible for a significant amount of greenhouse gas emissions, due to of the amount of methane they produce from rumen fermentation. For moving the livestock sector toward better environmental impact via mitigating environmental pollution through proper waste management, product quality control to reduce greenhouse gas, and organic dairy farming.

Compliance with ethical standards

Acknowledgments

The author thanks Abdulaziz Abdulhameed and Dr. Rakhad Alrawi for his help and support throughout preparing of this article.

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