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Review

The effects of climate change on livestock production, current situation and future consideration

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Review work was conducted to assess the climatic effect on livestock productions. Worldwide reviewers stated that the performances of animals are strongly correlated to environments. Currently climate change is a great challenge in the world. Intergovernmental panel meeting on climate change underlined that the poorest vulnerable groups are the worst and affected groups. Indirectly climate change has significant impact on feed resources on livestock productivity, carrying capacity of rangelands, and feeds, feeding options and grazing managements. Changed temperature increases the lignifications of plant tissues and reduces the digestibility and rates of degradations. Livestock is also directly exposed to tresses of the mortality, growth, reproduction and maintenances. Climatic change aggravates the water scarcity and accelerates the poverty level. The response of changing environments is increased. Water intake of Bos Indicus cattle was increased from about 3 kg DM intake at 10 °C to 5 kg at 30°C and to about 10 kg at 35°C. Climate change influenced other factors associated with vector populations and their distributions. Awareness creation on the consumption of livestock products related to environmental effects is important mitigation measures. The future directions of livestock production will be increased for the production of foods for the efficient transformation of livestock production to the international markets.

Key words: Climate Change, Effects, Livestock Production, Prospect, Recent.

INTRODUCTION

In the developing world, livestock production is rapidly changed in response to a variety of environments. Globally, human population is expected to increase from around 6.5 billion today to 9.2 billion by 2050. From thus more than 1 billion of this incensement will occur in Africa. Rapid urbanization 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). The potential impact of these drivers change on livestock systems and the resource-poor people who depend on them for their livelihoods is considerable. These impacts will be influenced by both supply-side shifts in natural resource use as well as market- led demand changes. Given the complexity of livestock and in most cases crop–livestock systems in developing countries, a mix of technological, policy and institutional innovations will be required. On the technology side, improvements will be linked to a combination of feed and nutrition, genetics and breeding, health and environmental management options with different appropriate systems.

At the same time, the significant climate changes are changing the physical and biological systems that have already occurred in all continents mostly observed in oceans (Rosenzweig et al., 2008). Smallholder, subsistence farmers, pastoralists and artisanal fisher folk will suffer in localized climatic change due snow-pack decrease, particularly in the Indo-Gangetic Plain and Sea-Level Rise (IPCC, 2007). Furthermore, changes in frequency and severity of extreme climate events have significant consequences for food production and food security (IPCC, 2007).

On the future the investigators stated that about 1.3 billion poor people, at least 90% of them are located in Asia and sub Saharan Africa and climate change will have major impacts on more than 600 million livestock dependant people (Thornton et al., 2002). According to the reviewed result, the impacts are included the productivity of rain fed crops and forage, water availability and, distribution of important human, livestock and crop diseases. Major changes anticipated in livestock species, crops grown, feed resources and feeding strategies.

Climate change could be particularly damaging countries which are dependent on rain fed agriculture and under heavy pressure from food insecurity and often famine caused by natural disasters (Deressa, 2006). Thus reviewed information is not well organized and not presented in a comprehensive way. Therefore the objective of this paper is to assess and organize the effects of climate change on livestock production, current situation and future consideration that conducted in different part of the world.

The Nature and Factual Basis of Climate Change

Global climate change is facing the greatest environmental challenge to the world. Concerned with the implications of global climate change, several governments came together in 1988 and formed the International Panel on Climate Change (IPCC). This led to the United Nations Framework Convention on Climate Change (UNFCCC), which was tabled in 1992 at the United Nations Conference on Environment and Development. The objective of the UNFCCC is to achieve stabilization of the concentrations of greenhouse gases in the atmosphere that would prevent dangerous anthropogenic interference with the climate system (The South African Government Ratified the UNFCCC in August, 1997).

Although often referred to as global warming and climate change are more serious disruptions of the entire world's weather and climate patterns including impacts on rainfall, extreme weather events and sea level rise rather than moderate temperature increases (South African National Climate Change Response Strategy, 2004).

Livestock and Climate Change

According to Intergovernmental Panel on Climate Change IPCC (2007) climate change is real and becoming worse and most vulnerable people will be affected. The International Fund for Agricultural Development (IFAD) acknowledges climate change as one of the factors affecting rural poverty and challenged to address. While climate change is a global phenomenon, its negative impacts are more severely felt by poor people in developing countries who rely heavily on the natural resource base for their livelihoods. Agriculture and livestock keeping are amongst the climate-sensitive sectors.

Presence of adverse climate change is supposed to be one of the major constraints on livestock production in the tropics. The seasonal pattern of rainfall results in large fluctuations in availability and quality of pasture over the year with high temperatures, high humidity and intense solar radiation, lead to heat stress, discomfort and reduced feed intake and depresses production and animal health (Baylis et al., 1995).

Impacts of Climate Change's on Livestock Production

Feeds Resources

One of the most important effects of climate change on livestock production is changing the animal feed resources. Although indirect effects on feed resources can have a significant impact on livestock productivity, carrying capacity of rangelands, buffering ability of ecosystems and their sustainability, prices of stovers and grains, trade in feeds, changes in feeding options, greenhouse gas emissions and grazing management including:-

Changes in the primary productivity of crops, forages and rangelands: This is probably the most visible effect of climate change on feed resources for animals. Thus also cusses of changes in species composition in rangelands and some managed grasslands that is an important determinant of livestock productivity. As temperature and CO_2 levels change due to climate change, the optimal growth ranges for different species also change; species alter their competition dynamics and mixed the composition of grasslands.

Quality of plant materials: Minson (1990) shown that increased temperature, increase lignifications of plant tissues and reduce the digestibility and degradation of plant species. This leads to reduced nutrient availability for animals and reduced livestock production, which may have impacts on food security and reduced the production of milk and meat for smallholders.

Heat Stress: Easterling and Apps (2005) stated that lack of appropriate physiological models that related to climate and animal physiology is limited the confidence that can be placed in predictions of impacts. It is clear, however, that warming will alter the heat exchange between animal and environment in feed intake, mortality, growth, reproduction, maintenance and productions (SCA, 1990). Sirohi and Michaelowa (2007) cited from Hahn (1999) in giving the thermal comfort zone for temperate-region adult cattle is ranged 5–15 ^{0}C. Whereas McDowell (1972) noted that significant change in feed intake and numerous physiological processes do not occur in the range 5–25^{o}C. However, the thermal comfort zone is influenced by a range of factors and much higher in tropical breeds because of both better adaptation to heat and the lower food intake of most domestic cattle. Clearly, hot and humid conditions can cause heat stress in livestock, which will induce behavioral and metabolic changes, including reduced feed intake and thus a decline in productivity.

Rotter and van de Geijn (1999) suggest that impacts of heat stress may be relatively minor for the more intensive livestock production systems where some control can be exercised over the exposure of animals to climate. Similarly, the impacts of increased frequencies of extreme heat stress on existing livestock breeds are not known, nor do us know if there are critical thresholds in the relationship between heat stress and physiological impacts (Sere et al., 2008).

Water: Water scarcity has become globally significant over the last 40 years and accelerating conditions for 1-2 billion people (MEA, 2005). Population growth, economic development and climate change impacts the global water availability in the future. Today's food production and environmental trends continue into the future, they will lead to crises in many parts of the world (Comprehensive Assessment, 2007). The response of increased temperature on water demand by livestock is well-known. For Bos Indicus, water intake increases from about 3 kg per kg DM intake at 10 °C ambient temperature, to 5 kg at 30°C, and to about 10 kg at 35°C (NRC, 1981). For Bos Taurus, intake at the same three temperatures is about 3, 8 and 14 kg/kg DM intake. Some of this water intake comes from forage and forage water content itself will depend on climate-related factors: forage water content may vary from close to 0–80%, depending on species and weather conditions (Masike, 2007). The same source indicated that groundwater will more important in the future in the face of climate change.

Livestock Diseases and Vectors: The complexity of climate change is associated with so many factors like vectors (McDermott et al., 2001). Tsetse are very sensitive to environmental change, either due to climate or direct human impacts on habitat but the impacts are vary in major species groups. Forest and riverine species are much more sensitive to climatic factors that savannah species while riverine species are much more adaptable to increasing human population densities than the other groups. Sleeping sickness, particularly the gambiense type, will continue, as now, to be a major problem, if concerted control efforts are not implemented. The impacts of changes in ecosystems on infectious diseases is depend on change in ecosystems, the type of land-use, disease specific transmission dynamics, and risky and susceptibility of the populations (Patz et al., 2005). According to Baylis and Githeko (2006) discussed that climate change may affect infectious diseases on their pathogens and higher temperatures may increase the rate of development of pathogens or parasites (Harvell et al., 2002).

Other pathogens are sensitive to high temperature and their survival may decrease with climate warming. Similarly, those pathogens and parasites that are sensitive to moist or dry conditions may be affected by changes to precipitation, soil moisture and the frequency of floods. Changes to winds could affect the spread of certain pathogens and vectors (Wittmann and Baylis, 2000).

World health organization (1996) stated that climate change is indirectly affecting the abundance and distribution of the competitors, predators and parasites of vectors themselves, thus influencing patterns of disease. It may also be that changes in ecosystems, driven by climate change and affect land-use, could give rise to new mixtures of species, thereby exposing hosts to novel pathogens and vectors and causing the emergence of new diseases. As Baylis and Githeko (2006) note, climate change-driven alterations to livestock husbandry in Africa, if they occur, could have many indirect and unpredictable impacts on infectious animal disease in the continent. It has been observed that combinations of drought followed by high rainfall have led to wide-spread outbreaks of diseases such as Rift Valley Fever and bluetongue in East Africa and of African horse sickness in the Republic of South Africa.

Biodiversity: The loss of genetic and cultural diversity in agriculture is as a result of the forces of globalization (Ehrenfeld, 2005). Animal and plant genetic resources are the ultimate nonrenewable resource; once gone, they are gone for good (Sere et al., 2008). Their importance is critical, but the complexity of ecosystems means that it is extremely difficult to assess the impacts of climate change on biodiversity. Given that this change is very rapidly in the future, it makes much sense for any consideration to emphasize conservation as well as mitigation activities on biodiversity aspects (IPCC, 2002). Pastoralists and smallholders are the guardians of much of the world's livestock genetic resources (CGRFA, 2007).

According to FAO (2007) and CGRFA (2007) indicated that about 20% of animal genetic resource breeds are now classified as at risk and that almost one breed per month is becoming extinct. Much of this genetic erosion is attributed to global livestock production practices and the increasing marginalization of traditional production systems and associated local breeds. The drivers of these changes in developing countries depend on the system (Seré et al., 2008).

Indirect Impacts (Live Stock / Human Health)

In addition to the direct impacts of climatic change on many aspects of livestock and livestock systems, there are various indirect impacts that can be expected to impinge on livestock keepers. As with livestock diseases, the changes wrought by climate change on infectious disease burdens may be extremely complex on human health and sensitivity to ecological change (Patz et al, 2005). Impacts of climate change on malaria distribution are likely to be largest in Africa and Asia (Van Lieshout et al., 2004). While climate change impacts may have few direct impacts on other important diseases such as HIV/AIDS, climate variability impacts on food production and nutrition can affect susceptibility to HIV/AIDS and other diseases (Williams, 2004). HIV/AIDS is a major development issue facing sub-Saharan Africa: the epidemic deepens poverty, reverses human development achievements, worsens gender inequalities, erodes the ability of governments to maintain essential services, reduces labor productivity and supply, and puts a brake on economic growth (Drimie, 2002).

Migration has been a catalyst in the rapid spread of HIV, particularly in southern Africa (Anantram, 2006). There are several links between migration and HIV/AIDS prevalence, including the high vulnerability of migrants who are often marginalized from health and social services. Climate change is likely to be a driving factor of migration, because of displacement due to extreme weather events and deteriorating agricultural productivity (Anantram, 2006).

Responses to Climate Change Impacts in Livestock Production

If the European Union target of stabilizing climate temperature increases to 2 ^{o}c above pre-industrial levels is to be met, this is likely to require stabilization of the CO_2 concentration below 450 ppm. This is certainly possible, and some see this as an economically attractive goal (Stern, 2006). Meeting this target will need to involve the implementation of stringent climate policies and very substantial cutting of greenhouse-gas emissions. Given that there are considerable lags in the earth system, climate change impacts are inevitable in the coming decades, even if all emissions were cut tomorrow. Particularly for vulnerable people, adaptation options will be needed if households are to cope with the changes brought about. Some of these options may be able to reduce the negative impacts of livestock on climate (mitigation) while at the same time increasing household food security, income and system adaptation. In this section, we highlight some key researchable issues related to adaptation and mitigation associated with livestock systems in the tropics and subtropics.

Adaptation: adaptation is available, but more extensive adaptation than currently occurring is needed to reduce vulnerability to future climate change (IPCC, 2007). There is a great variety of possible adaptive responses including:-

- Micro-level adaptation options, including farm production adjustments such as diversification and intensification of crop and livestock production; changing land use and irrigation; and altering the timing of operations.
- Income-related responses that are potentially effective adaptation measures to climate change, such as more drought-tolerant crops, livestock and flood insurance schemes, credit schemes and income diversification opportunities.
- Institutional changes, including pricing policy adjustments such as the removal or putting in place of subsidies, the development of income stabilization options, agricultural policy including agricultural support and insurance programs; improvements in (particularly local) agricultural markets and the promotion of inter-regional trade in agriculture.
- Technological developments, such as the development and promotion of new crop varieties and livestock feeds, improvements in water and soil management, and improved animal health technology (Kurukulasuriya and Rosenthal, 2003).

Adaptation Strategies of Agro- Pastoral Communities in Response to Droughts:

Crop-based households: Plant drought resistant crops and cultivars are used short cycle crop species and cultivars and plant in widely dispersed fields, pursue intricate re-seeding calendars, and send more family members on migration collect and eat wild plants and animals.

Livestock-based households:- sell animals to buy cereals are invested in multiple livestock species, entrust animals to other herders to maximize herd dispersal, moving animals to maximize access to pastures, and send more family members on migration and assistance from family/close relations.

Mitigation

Many of the existing technological options that can mitigate climate changes is from bottom-up (specific mitigation options) and top-down (economy-wide) that could offset the projected growth of global emissions or even reduce emissions below current levels (IPCC, 2007). All sectors could contribute, and there is ‘‘medium” agreement that agricultural practices collectively could make a significant contribution at low cost to increasing soil carbon sinks and by contributing biomass feed stocks for energy use. Mitigation potential is using improved crop and grazing land management to increase soil carbon storage, and improved livestock and manure management to reduce methane emissions (Steinfeld et al., 2006). Reid et al (2004) stated that increasing the demand for livestock products will be met partly from increased productivity of livestock but also through increases in livestock populations. In terms of CO_2, protection is already playing a major role for carbon sequestration in pastoral lands, particularly in Africa, where most of the protected areas are located in less productive lands.

As Reid et al. (2004) point out; this conversion can result in a 95% loss of the above-ground carbon and 50% loss of below-ground carbon. Considerable amounts of carbon can be sequestered from improved management in grasslands. Such management would include conversion of cropland to grassland, reduction in grazing intensity and biomass burning, improving degraded lands and reducing erosion and changes in species mix. In terms of methane mitigation in pastoral systems, probably the only effective way is reducing livestock numbers.

Specific Instruments to Mitigate the Negative and Enhance the Positive Effects

There are some general principles, to enhance the positive and mitigate the negative effects of livestock development: This could include:

- Promotion on greater awareness creation about the linkages between the consumption of livestock products, health and environmental effects. This is strongly advocated by environmental groups, although experience indicates that, up to a consumption level of about 60 kg meat and 100 kg milk per year, meat and milk products has a very high incomes elasticity of demand and restricting consumption in the developing world.
- The promotion of environmentally friendlier technologies, such as organic farming and low external input sustainable farming.
- For the most effective opportunities lie in the promotion of greater environmental awareness at producers' level. Farmers and especially young farmers education on the possibilities of more sustainable production forms has large payoffs. Farmers aware of nutrient loading and led to more targeted and lower fertilizer applications in Netherlands, Primary education inputs into village level natural resource management in Burkina Faso is one of the key factors in successful land management activities.

Future Directions of Development of Livestock Production

Developed countries are facing the trend of increased production of food and decreasing consumers on the market by permanent decrease of prices. Based on existing situation in livestock production, as well as previous domestic and international practice, a quick and efficient transformation of livestock production is necessary in order to be competitive on the international market (Aleksic et al., 2005; Aleksic et al., 2007). It is necessary to improve the production potential of certain species and breeds of domestic animals using genetic-selection measures are the future direction of the globe (Petrovic et al., 2005). Therefore, future livestock production will be based on private farm production with market orientation with indispensable quantities of high quality livestock food (forage and concentrated) (Cmiljanic et al., 2006). Incentives to market oriented producers to produce more efficiently and, better quality and credits for livestock producers under lower interest rates and longer grace period also contribute to faster development of livestock production.

CONCLUSION

A billion of the world's poorest people depend on animals for food, fiber, income, social status, security and companionship. Climate change is caused an increment of weather-related disasters and extreme weather events, such as droughts, heat waves, storms, desertification and increases in insect infestations. Long-term changes in climate will jeopardize the future of all animals, including those in oceans, on farms, in forests, in wilderness areas and in our homes. All climate change related hazards and their related disasters have a negative impact on animals.

Climate changes have severe impacts in many parts of the tropics and Sub-tropics. Despite, the importance of livestock to poor people and the magnitude of the changes are likely to be failed livestock systems. In this review explored that the intersection impact of climate change and livestock production is a relatively neglected area. Little is known about the interactions of climate and increasing climate variability with other drivers of change in livestock systems and development trends.

Climate change requires, the farmers adapted reductions of both farm-level greenhouse emissions and improve agriculture's environmental performances. In the context of the review of the Common Agricultural Policy, the need to ensure favorable conditions for the adaptation of agriculture and rural areas must be examined. Effective adaptation and adoption of new technologies, which contribute both to mitigation and the long term viability of farming, will require investments and planning efforts capacity of individual farms. Public authorities will have a role to play in supporting and facilitating climate change adaptation policies.

In order to continue, livestock industries need to anticipate these changes, be prepared for uncertainty and develop adaption strategies now. Some governments are more active than others in addressing climate change issues. For climate adaption to occur people need to be aware that climate change is real what the practical impacts will be and how it will affect businesses.

RECOMMENDATIONS

- Require consultation and guidance from welfare scientists and experts for drafting climate change policy, such as how to reduce green house gases emissions, agriculture management, mitigation strategies and disaster response:

- Include animal welfare policies in development programmes, compare these programmes to different climate change scenarios and include strategies for minimizing the risk to animals from climate changes and
- It needs review on the impacts of climate change on livestock and their welfare, including increased risk of livestock disease and starvations

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