Climate Change Importance and Implication on Conservation of Mithun and Yak

C. Rajkhowa, A. Dhali and A, Mech.

National Research Centre on Mithun, Jharnapani, Medziphema – 797 106, Nagaland

The greenhouse effect is probably the most debatable scientific and socioenvironmental-economical issue of the recent time. The impact of greenhouse effect on earth is increased atmospheric temperature. The solar radiation passes through atmosphere and reaches earth. On the way, a part of the radiation is reflected back from the atmosphere and earth out into space. Approximately half of the solar radiation is absorbed by the earth's surface. The absorbed radiation is converted to heat energy causing the emission of long wave infrared radiation back to the atmosphere. Some of this infrared radiation passes through the atmosphere out in to space and a part of the infrared radiation is absorbed and reemitted by the greenhouse gases. As the concentration of greenhouse gases are increasing in the atmosphere, the amount of re-emitted infrared radiation is also increasing causing the temperature of the atmosphere to increase. Indeed, average global temperatures have risen considerably and prediction has been made (IPCC, 2007) for an increase of 1.8 to 3.9°C by 2100. The temperature rises are much greater than those seen during the last century, when average temperatures rose only 0.06°C per decade (Koneswaran and Nierenberg, 2008). However, the rate of increase in temperature rises has been tripled since the mid-1970. A recent report warns that climate change could lead to some impacts that are abrupt or irreversible (Koneswaran and Nierenberg, 2008).

Emission of greenhouse gases and role of livestock sector

Various greenhouse gases of the atmosphere are water vapour, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone and chlorofluro carbon (CFCs). However, three major greenhouse gases are CO₂, CH₄ and N₂O (Steinfeld *et. al.*, 2006). Although most attention has focused on CO₂, but CH₄ and N₂O are extremely potent greenhouse gases having greater global warming potential (GWP) compare to CO₂. By assigning CO₂ a value of 1 GWP, the warming potentials of other gases can be expressed on a CO₂-equivalent basis (Paustian *et. al.*, 2006; Steinfeld *et. al.*, 2006). The GWP of CH₄ and N₂O are 23 and 296, respectively (fig. 1).



Fig. 1. Global warming potential (GWP) of CO₂, CH₄ and N₂O

The burning of fossil fuels for transpiration and industrial purposes has typically been regarded as the chief contributors to the emissions of greenhouse gases and climate change. However, in recent past, FAO (2006) has highlighted a crucial role of the farm animal production sector on global warming and climate change. FAO has found that the animal agriculture sector emits nearly 18 per cent of the human-induced greenhouse gas emissions, which is more than the transportation sector (Steinfeld *et. al.*, 2006).

 CO_2 is regarded as the most important greenhouse gas and has the most significant warming impact on atmospheric temperature because of its large volume. During the period since past 250 years, the major reasons of increased atmospheric CO₂ concentrations are burning of fossil fuels and deforestation (Bierbaum et. al., 2007). Animal agriculture sector contributes approximately 9 per cent of total CO₂ emissions, which is due to fertilizer production for feed crops, on-farm energy expenditures, feed transport, animal product processing and transport and land use changes (Steinfeld et. al., 2006). Moreover, Animal agriculture is a significant catalyst for the conversion of forest areas into grazing land or cropland for feed production, which may emit 2.4 billion metric tons of CO₂ annually as a result of deforestation (Steinfeld et. al., 2006). The animal agriculture sector also contributes 35 to 40 per cent of annual anthropogenic methane emissions, which is due to enteric fermentation in ruminants and from decomposition of farm animal manures (Steinfeld et. al., 2006). The enteric fermentation by rumen microbes generates approximately 86 million metric tons of methane emissions worldwide (Steinfeld et. al., 2006). Approximately 70 per cent of anthropogenic emissions of N₂O results from crop and animal agriculture combined. Manure and urine from farm animals, once deposited on the soil, emit N₂O. The animal agriculture sector including growing feed crops contribute nearly 65 per cent of global N₂O emissions (Steinfeld et. al., 2006). According to FAO (2008), approximately 56 billion land animals are reared and slaughtered for human consumption annually throughout the world. Livestock inventories are expected to double by 2050, with most increases occurring in the developing world (Steinfeld et al., 2006). Therefore, the contribution of animal sector to global warming and climate change will be more significant in coming days.

Impact of climate change on animal production

Climate affects animal production through direct and indirect ways. The direct effect includes the impact of changes in livestock feed-grain availability and price; impact on livestock pastures and forage crop production and quality; and changes in the distribution of livestock diseases and pests. The direct effect includes the impact of weather and extreme events on animal health, growth and reproduction (Smit *et. al.*, 1996). Due to adverse effect of climate change on agricultural crop production, it is expected that the land use pattern for agricultural would change. Due to this change, the availability of required feed for animal may reduce that in turn would either reduce the performance of animals or increase the price of animal products. Due to increased atmospheric temperature the quality of fodder is expected to de degraded that in turn would affect performance of animals due to poor nutrition. Climatic restrictions on vectors, environmental habitats and disease causing agents are important for keeping many animals diseases in check (Stem *et al.*, 1989). Alterations of temperature and precipitation regimes may result in a spread of disease and parasites into new regions or produce an increase in the incidence of disease, which, in turn, would reduce animal productivity and possibly increase animal mortality (Baker and Viglizzo, 1998).

The direct effect of climate change on animal production is through the induction of heat stress. There is a range of thermal conditions within which animals are able to maintain a relatively stable body temperature by means of behavioural and physiological means through adaptation (Bucklin *et al.*, 1992). Heat stress results from the animal's inability to dissipate

sufficient heat to maintain homeothermy. High ambient temperature, relative humidity and radiant energy compromise the ability of animals to dissipate heat. As a result, there is an increase in body temperature, which in turn initiates compensatory and adaptive mechanisms to re-establish homeothermy and homeostasis. These readjustments, generally referred to as adaptations, may be favourable or unfavourable to economic interests of humans, but are essential for survival of the animal (Stott, 1981). However, these adaptation mechanisms are only relevant when the stress level is within the threshold level and animals are able to recover from stress. If stress level rises beyond the threshold, animals are unable to cope with stress by means of adaptive mechanisms and in turn their productive and reproductive performances are compromised. The response model for farm animals with thermal environmental challenges is depicted in Fig. 2.



Fig. 2 Response model for farm animals with thermal environmental challenges

Implication of climate change on conservation of mithun and yak

The implication of climate change on the performance of mithun and yak is no different from other livestock species. The indirect effects of climate change on mithun and yak production will results mainly from the alterations in the nutritional environment. Changes in climate would affect the quality and quantity of forage produced and pasture quality would be deteriorated. As a consequence, productivity of grazing animals would be adversely affected. Alterations of temperature and precipitation regimes may result in a spread of disease and parasites into new grazing areas or increase in incidence of diseases. These factors, in turn, would reduce mithuns' or yaks' productivity and possibly increase mortality. Uncertainty is the most problematic aspect of climate change, thus limiting the usefulness of impact assessments of climate change on animal production. Quantitative simulation studies estimating impacts of future climate change directly on mithun and yak are not available at present. Therefore, such studies should be undertaken immediately to assess the impact of climate change on these valuable and unique animals.

Mitigation of the effect of climate change on mithun and yak possibly can be done through three major ways: physical modification of the environment; improved nutritional management; and genetic development of strains that would be less sensitive to heat stress. Constructing suitable shed in the grazing areas for free-range mithuns and yaks are necessary to protect them from adverse climatic conditions. Moreover, at organized farms, suitable housing with necessary air circulation and cooling facilities should be provided for the animals maintained under semi-intensive conditions. The animals must be maintained on quality feed with low fibre and optimum protein and energy. Developing genetically superior animals through selective breeding that would be less sensitive to heat stress is another possible option in this regard. Although it may be time consuming, but in long-term it may be more beneficial. Approach should be made to develop animals that would maintain desired productive and reproductive performance at high range of THI (temperature humidity index). The bovine species generally come under stress, when THI value rises beyond 72. For mithun and yak, the targeted THI should be decided through detail scientific studies on the innate adaptive mechanisms of these species.



Mithun



Yak

Ideal habitat of Mithun and Yak

References

Baker B. and Viglizzo, J.F. 1998. Rangelands and livestock. Chapter 9. *In*: Feenstra, J.F., Burton, I., Smith, J.B. and Tol, R.S.J. (eds.) Handbook of methods for climate change impact assessment and adaptation strategies. IVM/UNEP Version 2.0., Available online (http://130.37.129.100/ivm/pdf/handbook range.pdf).

- Bierbaum, R.M., Holdren, J.P., MacCracken, M.C., Moss, R.H., and Raven, P.H. 2007. Confronting climate change: avoiding the unmanageable, managing the unavoidable. Washington, DC: United Nations Foundation. Available online (http://www.unfoundation.org/files/pdf/2007/SEG Report.pdf).
- Bucklin, R.A., Hahn, G.L., Beede, D.K. and Bray, D.R. 1992. Physical facilities for warm climates. In: Van Horn, H.H.; Wilcox, C.J. (eds.) Large dairy herd management. Am. Dairy Sci. Assoc., Champaign, IL 61820, pp: 609-618.
- FAO (Food and Agriculture Organization of the United Nations). 2006. Livestock a major threat to the environment: remedies urgently needed. Available online (http://www.fao.org/newsroom/en/news/2006/1000448/index.html).
- FAO (Food and Agriculture Organization of the United Nations). 2008. FAOSTAT. Available online (http://faostat.fao.org/).
- IPCC. 2007. Climate change 2007: The physical science basis. Paris: Intergovernmental Panel on Climate Change. Available online (http://www.ipcc.ch/ipccreports/ar4-wg1.htm).
- Koneswaran, G. and Nierenberg, D. 2008. Global farm animal production and global warming: impacting and mitigating climate change. Environmental Health Perspectives 116: 578-582.
- Paustian, K., Antle, M., Sheehan, J. and Eldor, P. 2006. Agriculture's role in greenhouse gas mitigation. Washington, DC: Pew Center on Global Climate Change.
- Smit, B., Mc Nabb, D. and Smihers, J. 1996. Agricultural adaptation to climatic variation. Climatic Change **33**: 7-29.
- Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. and de Haan, C. 2006. Livestock's long shadow: environmental issues and options. Rome: Food and Agriculture Organization of the United Nations.
- Stem, E., Mertz, G.A., Stryker, J.D. and Huppi, M. 1989. Changing animal disease patterns induced by the greenhouse effect. *In*: Smith, J. and Tirpack, D.A. (eds) The Potential Effects of Global Change on the United States: Appendix C - Agriculture, Volume 2. US Environmental Protection Agency, Washington, D.C., pp. 11-1 to 11-38.
- Stott, G.H. 1981. What is animal stress and how is it measured? *Journal of Animal Science* **52**: 150-153.