General Article

CLIMATE SMART LIVESTOCK PRODUCTION

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KEYWORDS:
Livestock, Climate change, Sustainable livestock farming

ARTICLE INFO
Received on:
05.09.2018
Revised on:
26.02.2019
Accepted on:
28.02.2019

ABSTRACT

According to the Intergovernmental Panel on Climate Change (IPCC) climate change is true, irreversible, will worsen in future. Anthropogenic activities are one of the chief causes of climate change. Climate change has substantial impact on the environment and the natural resources on which the livestock sector depends. Climatic change in terms of increased ambient temperature, altered rainfall and shifts in precipitation patterns, heat waves, heat stress, droughts, floods and erratic changes in seasonal patterns are emerging challenges for crop and livestock production. Indirect effects of altered climate are being observed through reduced yields and quality of feeds and fodder, possible increased incidences of diseases and competition for the available resources. Though the negative impacts of climate change is a global concern, but our country India where almost 70 percent of livestock are owned by small and marginal farmers and landless labourers is at high risk. According to world bank by 2020, the pressure on air, water, soil and forests is expected to be highest across globe. Minimizing the effects of climate change is thus essential to attain sustainable development and poverty eradication. Implementation of policies and formulations of strategies for improved adaptation pathways for livestock production towards the changing climatic scenario will promote sustainable livestock farming and poverty eradication. Adopting several strategies like genetic improvement of animals, use of molecular genetic markers for heat tolerance in selection programme, provision of scientifically designed housings, improving diets, better herd management to improve output, better management of grassland, establishment of weather forecasting system for earlier warning of farmers regarding alarming weathers etc will help in combating with the changing climate.

INTRODUCTION

Climate change is a serious threat to livestock sector. Increased ambient temperature, erratic shifts in rainfall distribution and increased incidences of extreme weather events like heat waves, flood, drought etc are expected to aggravate the negative impact of climate change on the production and reproduction performances of livestock. These adverse impacts can be the direct result of increased heat stress and reduced water availability, competition for the available resources, increased incidences of diseases (FAO, 2009; Thornton, 2010; Thornton and Gerber, 2010). The impacts of climate change on livestock are extensive. Most serious impacts are expected to be in grazing systems due to its high dependency on climate and limited adaptation opportunities (Aydinalp and Cresser, 2008). The effects are anticipated to be most severe in arid and semi-arid grazing systems at low latitudes, where higher temperature and lower rainfall are likely to reduce yields and increased land degradation (Hoffmann and Vogel, 2008). Climate change is a very fast growing problem in the world. However, it is more alarming in India as over two-third of the population of farmers are small-scale farmers and it is difficult for them to cope up with the changing climatic condition which needs adaptation and mitigations strategies. Financial constraint is one of the major backward force pulling the farmers deep down. Over the period of 1901-2010 in India, overall rainfall has been reduced. But, there has been increase in the extreme rainfall in certain

parts of central India and many other areas. Total green house gas production from livestock sector has been increased from 225 $x10^9$ kg carbon dioxide eq. in 1961 to 392 $x10^9$ kg carbon dioxide eq. in 2010 while these values for world is 1769 $x10^9$ kg carbon dioxide eq. in 1961 to 2771$x10^9$ kg carbon dioxide eq. in 2010 (Patra, 2014). The contribution of enteric methane emission from livestock in world was estimated to be 1537.5 $x10^9$ kg carbon dioxide eq. in 1961 and 2372.5 $x10^9$ kg carbon dioxide eq. in 2010. The corresponding values for India have been estimated as 209.5 $x10^9$ kg carbon dioxide eq. in 1961 and 357.5 x109 kg carbon dioxide eq. in 2010, respectively. Estimates of methane emissions from manure of world livestock were 170.25 $x10^9$ kg carbon dioxide eq. in 1961 and 285.35 $x10^9$ kg carbon dioxide eq. in 2010 and for India the respective values were 13.0 $x10^9$ kg carbon dioxide eq. and 27.4 $x10^9$ kg carbon dioxide eq. respectively (NAAS, 2016). Of most concern in the anthropogenic factors is carbon dioxide emissions from fossil fuel combustion and industrial processes, which together contributed 78% of total GHG emissions increase from 1970 to 2010 (NAAS, 2016). Expected rise in average temperature from late 20^{th} century to mid and late 21^{st} century is 7^0C for south asia while that for world is 3.7^0C (IPCC, 2014).

The FAO has defined climate-smart agriculture is one that "sustainably increases productivity, enhances resilience (adaptation), reduces/removes greenhouse gases (mitigation) and enhances achievement of national food security and development goals". Livestock production covers two-thirds (34 Mkm^2) of the world´s agricultural land (49 Mkm^2) for production of animal feed (grazed pastures 80%, and feed crop 20%), while a quarter (3.5 Mkm^2) of the crop area (15.2 Mkm^2) used for animal feed (FAO, 2006). Vithlani *et al*., 2018 reported that the monsoon seasonal rainfall, runoff and crop evapotranspiration were enhancing @ 24.12mm/decade, 11.55 mm/decade and 2.52 mm/decade whearas annual and monsoon seasonal potential evapotranspiration were declining @ 14.20 mm/decade and 5.46 mm/decade, respectively in Junagarh. Climate change potentially affects quality and availability of feed and fodder and may cause fast degradation of grazing land and in turn cause more drought or flood as well as disease incidences because of warmer temperatures. In Indian condition the stress of livestock production in adverse climatic condition can be negotiated by adopting several strategies, such as: genetic improvement of animals, balance diet, better herd management to improve output, including better herd health management with less dependence on antibiotics, better management of grassland (e.g. sowing improved varieties of pasture, rotational grazing) etc (Gerber *et al*., 2013).

IMPACT OF CLIMATE CHANGE ON LIVESTOCK PRODUCTION

Increase in ambient temperature alter heat exchange between animal and environment and has negative impact on feed intake, growth, milk production, egg, wool production, reproduction and health of the animals. Productive animals are more vulnerable to heat stress and further rise in temperature due to climate change will have aggravate the impact. The methane emission per unit of dry matter intake reduced under moderate heat stress and increased under severe heat stress (Yadav *et al*., 2012).In India average stress hours, i.e. hours above THI 72, during hot months of the year are likely to increase. This will lead to decreased milk, meat and egg production. The reproductive performance of female and male animals is affected by climatic heat directly as well as indirectly through feed and fodder and proneness to diseases. Abrupt rise or fall in environmental temperature above critical level reduces the conception rates. Compared to other species of domestic animals, poultry is more sensitive to high ambient temperatures as they do not have sweat glands, have a higher basal metabolic rate per unit body weight and body is covered with feathers. To mitigate the heat stress condition in birds additional expenditures will be done by use of air cooler or sprinklers on roof (NAAS, 2016).

Climate change will put extra pressure on farmers due to heat waves, drought, and cyclones. These natural calamities will damage fodder production in India. Increase frequencies of extreme weather conditions will make the grasslands more prone to drought and flood. Crop production will be damaged due to sudden or lack of rainfall. The crops produced in these scenarios will have a low nutritional quality than that of standard fodder. Lack or abundance of water will also affect the fodder productivity. Even if the green fodder is available from other regions, that will cost high leading to increased cost of production. These factors will put extra pressure on animals to meet the energy and protein requirement, which may lead to reduced productivity. In India there is shortage of feed and fodder availability by 40 % dry fodder, 36 % green fodder and 52 % concentrate on dry matter basis (DAHDF, 2014-15), which is a prime constraint for full genetic potential expression.

Minimization of climatic stress on livestock and improving their adaptability to the changing climatic scenario - Adaptations and Mitigation strategies:

Possible adaptive responses include: technological options (e.g. more drought-tolerant crops and livestock); behavioural modifications (e.g. changes in dietary choices); managerial choices (e.g. different farm management practices); and policy alternatives (e.g. planning regulations and infrastructural development).

Climate smart livestock:

Improving efficiency of the use of resources: Efficiency in the use of natural resources is measured by the ratio between the use of natural resources as input to the production system and the output from production. Higher yields per hectare, higher water productivity, higher feed efficiency, improved management of manure and fertilizers and reduced losses along the food chain should be achieved by efficient use of the resources (Westhoek *et al.*, 2011). Improving the feed conversion efficiency in animal production systems is a basic strategy for improvising the environmental sustainability of the livestock sector. A large volume of food is wasted even before it reaches the consumer, which should be checked for improving the efficiency.

Building resilience: Long term strategies by the farmers that inhibit huge loss due to lack of productivity is avital arena of the adaptation strategies. These strategies can include system changes (e.g. alteration in the set of commodities produced or the change from extensive to mixed systems) or the implementation of new technology that is currently unavailable. There may be long lag times between the identification of a problem and the formulation of readily available and applicable technology. Research conducted today needs to fit to the environment 20-30 years ahead. These systemic changes will lead to slow buffering of the adverse effect of climate change on the animals (Burke *et al*., 2009).

Feeding management: farmers need to minimize the heat loss from the body, which is waste of energy. A lot of energy is wasted during utilization of poor quality forages, straws, crop residues etc and proportionately higher amount of heat per unit feed intake is produced. This extra heat also is to be lost from body to maintain thermal balance. Similarly, the particle size of fodder affect the amount of heat produced per unit weight of dry matter consumed. So economic feed processing techniques such as wetting of grasses, cropping and chopping of green, grinding, pelleting, use of urea-molasses will reduce the energy loss in the digestion and decrease the heat loss for maintenance of body temperature. Use of available green fodder during summer or efficient use of non-conventional feed resources or newer feed resources will help to negotiate the fodder scarcity produced due to adverse climatic condition.

Breeding Management:

- Identifying climatic stress tolerant species and breeds that are most adaptable / suitable for each bioclimatic zone in consultation with livestock owners. Use of molecular genetic markers for high tolerance to environmental stress as well as production ability in animal selection programme.
- Encouragement of farmers by providing incentives for active participation in improvement programme of prioritized breeds in the form of artificial insemination services at farmers door without charge, health coverage, animal insurance at nominal charges and institutional credit at zero percent interest for procurement of animals of prioritized breeds.
- Establishment of mother bull farms of prioritized breeds of cattle and buffalo in major climatic zones.
- Training of rural women and youth in improved feeding technologies and reproductive management.
- Establishment of regional demonstration units for climate resilient livestock production system and technologies with government support. (Policy PAPER - 81, NAAS, 2016).

Housing Management

- A good housing with proper design, height, orientation and with good open space for ventilation and comfortable space per animal will provide cooler microenvironment inside the house.

Heat ameliorative measures

- During periods of high temperatures, farmers should use water to bring down the inside temperature within the animal shelters and increase the evaporative heat loss from animal body.
- Use of fans inside animal house is very efficient but more expensive.
- Use of sprinklers and plantations around the animal houses can give thermal comfort to the animals.
- Allowing animals to graze during cooler part of the day.
- Provision of clean cool water for drinking inside the animal house.
- The animals in arid zone are allowed to graze in the fields during day and are exposed to more heat stress because of scarce feed and fodder. Provision of community shelters in these areas will alleviate heat stress in these animals by allowing them to take rest during peak hot hours (Policy paper 81 NAAS, 2016).

Building shelters at flood and cyclone prone areas

- The coastal low lying areas are very much prone to rise in sea level and cyclonic storms. Hence, it is very crucial to build well planned structures to protect these low lying areas. Provision of suitable shelters in flood and cyclone prone areas can check morbidity and mortality of animals in these areas (Policy paper 81 NAAS, 2016).

Weather forecasting and early warning system

- Weather forecasting and early warning of bad weathers are very crucial to allow the farmers to take necessery preventive measures to protect the animals from bad weather conditions like severe heat wave, cold wave, heavy precipitation and thunderstorm, cyclone, flood and disease outbreaks. (Policy PAPER - 81, NAAS, 2016)

CONCLUSION

Climate change has become a global problem today. Erratic weather conditions, increased frequency of extreme weather events like cyclone, flood, heat waves, shifts in rain fall etc has negative impact on animal's reproductive and production efficiency. Increased air temperature disturbs heat exchange between animal and environment that in turn imparts negative effect on dry matter intake, growth, milk production, egg, wool production, coneption rate, estrous and overall health of the animals. The climatic stress on livestock production can be reduced by developing climate smart livestock production system. Formulation and adoption of several direct and indirect heat stress mitigation strategies like improvement of genetic potential of the animals, introduction of marker assisted selection for heat tolerance in selection programme will help to combat heat stress. Improving diets, construction of scientifically designed animal houses, plantation around shed, setting up of weather forecasting systems for earlier alarming of farmers about bad weathers will help in mitigating the negative effects of changing climate.

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How to cite this article?
Rajalaxmi Behera, S. Rai, D. Sathpathy, A. Sahu, M. Karunakaran, A. Talokdar, A. Singh and A. Mandal. 2019. Climate smart livestock production . *Innovative Farming*, **4**(1): 015-018.