

## Impact of Climate Change on Livestock Production

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### ABSTRACT

*Climate change is one of the global challenges of this century. There is increase in large number of climate related events. Livestock sector has also been affected by changing climate due to which there is increased loss of livestock assets and several other indirect losses. Some of the effects of climate change in livestock include thermal and cold stress, increased diseases incidences and decrease in the feed, fodder and water availability. This results in decreased animal production and productivity. The paper mainly reviews the impacts of climate change on livestock production.*

**Keywords:** Climate change, Livestock, Livestock production

### INTRODUCTION

A long-term shift in temperature, radiation, wind and rainfall of a place in a long term of time is climate. It is the change in climatic conditions over time due to either anthropogenic or nature induced causes, which remains for decades or longer and shows distinct variations in its mean (IPCC 2007). The issue of events caused by climate change is seen frequently nowadays. It is causing huge loss of lives and economy of various countries. As greenhouse gas is increasing in the atmosphere leading to increase in the temperature of earth, there is a prediction that there will be an increase in temperature by 1.5<sup>0</sup>C to 2<sup>0</sup>C in future may cause loss of 20 to 30 percentages of animal and plant species (Thronton, 2010). This shows that to survive in future changing climate, plant and animal species need to alter their behavior and distribution patterns and get acclimatized to changing climate. Direct and indirect effects of temperature, humidity, rainfall and other climate factors influence animal performance: growth, milk production, wool production and reproduction (Houghton *et.al.*, 2001).

Livestock system is one of the major sources of nutrition to the increasing population of the world. Human populations largely depend on animals and animal products like milk, meat, eggs, fibers, wool, and feather. Animals are also used for transport, draft and their manure. Livestock production is adversely affected by various events of extreme climatic conditions. This paper focuses in the effect of climate change on livestock production.

### Climate Change

Climate change is a phenomenon due to emissions of greenhouse gases from fuel combustion, deforestation, urbanization and industrialization (Upreti, 1999) resulting variations in solar energy, temperature and precipitation. It is a real threat to the lives in the world that largely

affects water resources, agriculture, livestock, coastal regions, freshwater habitats, vegetation, forests, melting of snow-covered mountains and increase in climatic events such as landslide, desertification and flood. Around the world the three major components of climate change already evident and escalating in magnitude and significance are; Warming, altered patterns of precipitation and increased incidence of extreme climatic events.

### **Effect of Climate Change on Livestock**

The effect of climate change is found to be real and is affecting livestock population in many ways. Climate change is expected to cause increase in weather-related disasters and extreme weather events, such as droughts, heat waves, storms, desertification, and increases in insect infestations (Khanal, 2010). Long-term changes in climate will affect the future of all animals including those in oceans, on farms, in forests, in wilderness areas, and in our homes (Khanal, 2010). Warmer and wetter weather (particularly warmer winters due to climate change) will increase the risk and occurrence of animal diseases, as certain species who serve as disease vectors, such as biting flies and ticks, are more likely to survive year-round. At higher temperature, numerous diseases display greater virulence. As a result of climate change the environment becomes favorable for the disease agent (bacteria, virus, etc.) and the host will become susceptible easily. The epidemiological triad between agent, host and environment becomes imbalanced and - different diseases which were not present in -an ecological region may be seen, and certain existing parasitic diseases may also become more prevalent, or their geographical range may spread, if rainfall increases.

Increased temperature may cause thermal stress in terrestrial and aquatic animals, leading to reduced growth, sub optimal behaviors, decrease productivity and reduced immune competence of the animals. Higher temperatures tend to reduce animal feed intake and lower feed conversion rates (Rowlinson, 2008) and extra investment cost to keep animal warm or cool during climatic extremes is forecasted to increase. Unusual climatic changes and variability such as rising temperature, irregular monsoon, precipitation and erratic rainfall patterns have led to loss of large number livestock species ultimately affecting the income and food security of marginalized people. Climate change can be expected to have several impacts on forage, feed crops, grazing system, and emergence of unpalatable forage species in the rangeland and decrease the byproducts of agriculture and forage causing scarcity of fodder and forage for livestock.

### **Climate Influence on Livestock Productivity**

The influence of climate change on livestock productivity is categorized on following headings.

#### **Milk Production**

High production animals are highly influenced by heat stress (Martello *et.al.*, 2010). The threshold level of temperature humidity index (THI) for the high milk yielding cow is around THI 72 in tropical and subtropical climates. However, recent studies on THI in temperate climate emphasized that the THI lower than 68 is suitable for cattle performance (Gauly *et.al.*, 2013). Early heat stress signs in dairy cows include panting and sweating and longer standing. These factors lead to cows failing to eat as much as usual.

Heat stress decreases the quality and composition of milk. This can result in a rapid decline in milk yield up to 40%. Heat stress increases body temperature and affects the fat synthesis in mammary gland and components like fat (%), solid-non-fat, protein, casein and lactose content is altered. Somatic cell count is also increased causing reduction in the quality of milk. Further, heat stress can also cause imbalance in the levels of prolactin, thyroid hormones, glucocorticoid, growth hormone, estrogen, progesterone and oxytocin which ultimately affects the milk production (Prathap *et.al.*, 2017).

Heat stress increases udder temperature and can cause mastitis in dairy cows. In addition, heat stress during dry period might trigger mammary gland involution accompanied with apoptosis and autophagy and decreased amount of mammary epithelial cells can ultimately cause decline in milk yield (Prathap *et.al.*, 2017).

As temperature rises above 35°C stress response systems are activated and there is reduced feed intake declining the milk synthesis (Wheelock *et.al.*, 2010). Moreover, maintenance energy requirement is also increased by 30% in heat stressed dairy animal. Energy intake will not be enough to cover the daily requirements and milk production. This results in negative energy balance is created deteriorate health condition of the animal (West *et.al.*, 2003). A reduction in dry matter intake by 0.85 kg with every 1°C rise in air temperature decreases milk production approximately by 36% (Rhoads *et.al.*, 2009).

### **Growth Performances**

Exposure of animals to hot or cold stress reduces growth and feed efficiency (Ames *et.al.*, 1980). Cold climate during winter causes metabolic acclimatization, resulting in decreased animal performance and production efficiency (Young, 1981; Birkelo *et.al.*, 1991). Cold stress increases concentrations of plasma corticosteroids (Alvarez and Johnson, 1973) and circulating nonesterified fatty acid (NEFA) concentrations (Broucek *et.al.*, 1987; Nonnecke *et.al.*, 2009). Heat stress has an effect on the uterine environment reducing the total embryo cell number and placental size and small sized calf are born. Temperatures ranging between 15°C and 29°C seem to have no effect on growth performance. High ambient temperature decreases the anabolic activity and increase in tissue catabolism (Marai *et.al.*, 2007). Reduced anabolism activity decreases voluntary feed intake and increase tissue catabolism causes fat depots resulting in adverse effect in growth performance.

### **Reproductive Performance**

Reproductive performances of livestock are vulnerable to climate change. It has adverse effect in both female and male reproductive system. Heat stress reduces the length and intensity of oestrous cycle and besides increases incidence of anestrus and silent heat in animals (Kadokawa *et.al.*, 2012). There is increase in adrenocorticotrophic hormone and cortisol secretion (Singh *et.al.*, 2013), resulting in blockage of estradiol-induced sexual behavior (Hein, K.G. and Allrich, R.D. 1992). When the body temperature exceeds 40°C, follicles suffer damage and become non-viable (Roth *et.al.*, 2000). When a female goat is exposed to 36.8°C temperature and 70% relative humidity for 48 hours, follicular growth upto ovulation is suppressed, accompanied by decreased LH receptor level and follicular estradiol synthesis activity. Infertility is seen in high-temperature as there is increase secretion of endometrial PGF-2 $\alpha$  (Bilby *et.al.*, 2008). Conception

rates decrease and reaches only 10-20% compared to 40% to 60% in cooler months (Cavestany *et.al.*, 1985).

Heat stress causes embryonic death by interfering with protein synthesis, oxidative cell damage reducing interferon- tau production for signaling pregnancy recognition and expression of stress-related genes associated with apoptosis (Hansen, P.J. 2009). Embryos subjected to high temperatures in vitro or in vivo until day 7 of development phase as blastocyst lowers pregnancy at day 30 and increases embryonic loss on 42 days of gestation (Cardozo *et.al.*, 2006).

Increased testicular temperature in bull from thermal stress could change the quality of the semen and alter the biochemical composition leading to infertility problems. There is a change in testicular volume, hormonal profiles, sexual behavior and semen quality that affect the reproductive performance of males (Balic *et.al.*, 2012).

## CONCLUSION

The global demand of animal and animal products is increasing with the increasing human population. However, climate change is causing negative effects in the animal production and productivity. Climate extreme hazards are increasing causing huge loss of livestock assets and there is decrease in the feed, fodder and water availability for the animals, and increase in thermal and cold stress, diseases resulting in the decrease in animal production. Proper breeding strategies should be identified so that animal become tolerant to heat and cold and survive (Hoffmann, 2008). Identifying and strengthening local breeds adapted to local climatic stress and feed sources would be one of the options to mitigate the negative effects of climate change in livestock. Likewise, early warning systems and forecasting system for livestock diseases should be developed.

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