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Livestock in Pakistan: An Insight into Climate Changes and Impacts

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LIVESTOCK IN PAKISTAN: AN INSIGHT INTO CLIMATE CHANGES AND IMPACTS

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ABSTRACT

The global livestock sector is expanding at a faster rate than any other agricultural sub-sector. It employs approximately 1.3 billion people and accounts for approximately 40 % of global agricultural output. This industry is one of the most damaging sectors to the world's increasingly scarce water resources, contributing to water pollution from animal wastes, hormones, antibiotics, chemicals from tanneries, pesticides, and fertilizers used to spray feed crop. Climate change harms livestock productivity by changing ecosystem services *i.e.* water availability, forage quality and quantity, diseases outbreak, and animals stress due to heat shock and reduction of livestock diversity and breeds. Ecosystem and animal health are under the direct influence of climate change. The prevalence and dispersal of animal illnesses and pathogens are presently on the rise due to climate change. Climate change may have a significant impact on farm animal production performance around the world. Heat stress appears to be one of the intriguing environmental variables affecting animals, making animal production challenging in many geographical locations around the world. Intake of feed can decrease at high temperatures while energy demands increase due to the activation of thermoregulation mechanisms, which harms productivity, growth, and development. This is because thermoregulation mechanisms are activated when temperatures are high. The rate at which animals digest their food is impacted, subjected to heat stress, in addition to their rate of growth and development. The animal's heart rate, rectal temperature, and respiratory rate can all be increased during expose to environments with high temperatures.

Keywords: Animal health; climate change, food security; heat stress; livestock production.

INTRODUCTION

Climate change poses a threat to Pakistan, which has happened because of various factors such as rapid industrialization and urbanization with significant geopolitical consequences. The country is in a tropical region and has warm environmental conditions. Pakistan has been ranked among the top ten countries most affected by climate change over the last 20 years. The reasons for climate change in the country are the worst drought episode (1998-2002) in Cholistan and Tharparkar, Among the reasons are the intense heat wave in Karachi in 2015, the impact of back-to-back floods since 2010, severe winds in Islamabad in June 2016, increased incidences of landslides and Glacial Lake Outburst Floods (GLOFs) in

the northern parts of the country and increased cyclonic activity. Keeping in view the above stats this review was objectivated to outline the impacts of major climatic shifts on livestock productivity and animal health.

Importance of Livestock in Pakistan

The livestock industry plays a significant role in food security and supply. Various livestock products such as eggs, milk, meat, and wool contribute 16 %-31 % of global per capita calories and minerals (FAOSTAT, 2020). People in the country raise their animals on free grazing and obtain different products (milk, meat, wool, eggs), which become the primary source of income for poor communities or residents (Herrero et al., 2013; Mansoor et al., 2021). Animals are used for different purposes, such as a source of income for poor people, a means of transport, a source of draught power, a source of nutrients for poor soils, and a form of financial capital (CIRAD, 2016). Livestock also contributes to food security and food supply.

Effects of Climate Change on Livestock

The adverse climate changes pose a significant risk for humans, livestock, and other creatures in the world. According to the investigation by Howden et al., (2008) and IPCC (2013), the 3.7 °C temperature is increasing every year globally. Different parameters such as egg, meat, milk production, weight, health status, and reproductive performance of livestock are directly or indirectly affected by the changes in climate (Henry et al., 2012; Nardone et al., 2010). A decrease of 20 to 30 % in the production of livestock is expected in the coming years due to climate change, rising temperatures, and greenhouse gases typically carbon dioxide (CO_2) absorption, resulting in milk, meat, and poultry supply crises, pushing prices beyond the reach of the average Pakistani (Henry et al., 2012; IPCC, 2014). A summary of the diverse impacts of climate change on livestock is given in table 1.

Effect of Heat Stress on Livestock

Heat stress can affect energy metabolism and the distribution of livestock. Dry matter intake (DMI) and milk production can reduce heat stress. According to Chase (2006), in commercial dairy herds, heat stress is enhanced by 20 to 30 % which ultimately reduced DMI by 10 to 20 %. It has been reported that dairy cows showed various reactions to heat waves such as a rise in body temperature, change in metabolism, reduced feed intake, increased evaporative water loss, increased water intake, increased respiration rate, and changed blood hormone profile. According to De Rensin and Scaramuzzi (2003) and Tao et al., (2011), the appetite of cows reduced at high heat stress, and milk production increased (28.9 vs. 33.9 kg/day) at heat stress cooling while milk protein levels decreased (3.01 vs. 2.87 %). The heat stress can reduce the reproduction performance such as intensity and length of the estrous period. In the months of summer, the fertility of dairy cows is reduced by the poor expression of behavioral signs of oestrus because the concentration of estradiol secretion is reduced and the calving interval becomes lengthy (Naqvi and Sejian, 2011). The growth and development of the fetus reduce by heat stress during pregnancy because the blood supply to the uterus decrease resulting availability of insufficient nutrients in the blood which become the cause of reduction in calf size and fetal growth (Naqvi et al., 2012). Severe heat stress can cause embryonic death in animals. The quality and quantity of eggs as well as sperms in the animals especially sperm concentration in bulls can be reduced by the heat stress which ultimately draws negative impacts on the next generations (Samal, 2013; Samir, 2017; Sheikh et al., 2017). The pregnancy period, embryonic development, the number of spermatozoa,

fetal growth, calf size the concentration of semen, motile cells per ejaculation, testis temperature, and fertility of sperm all are affected by change in temperature (Cardozo et al., 2020; Zhou et al., 2020; Bhakat et al., 2014; Balic et al., 2012).

Table 1: Diverse impacts (direct and indirect) of climate change on livestock with major reasons.

Type of impact	Impacts on livestock	Major reasons	References
Direct	Increased mortality	High temperature	Daramola et al., 2012
	Negative impacts on the immune system	Heat stress	Nardone et al., 2006
	Negatively impacted reproductive performance	Radiations; CH_4, N_2O	Fregly, 2011
	Reduction in meat, milk, and wool production	Heat stress	Maibam et al., 2018
	Reduction in feed intake	Heat stress	Maibam et al., 2018
Indirect	Changes in forage quality, Altered grazing system	Elevated CO_2 level, N_2O, temperature	Maibam et al., 2018; Daramola et al., 2012
	Changes in resource availability	Increased temperature	Maibam et al., 2018
	The emergence of insect pests, pathogens, and diseases	High temperature, variations in relative humidity	Nardone et al., 2006
	Non-availability of drinking and irrigation water	High temperature	Nardone et al., 2006; Daramola et al., 2012
	Variations in pasture composition and reduction in forage production	Elevated CO_2 level, CH_4	Nardone et al., 2006
	Reduction in crop production or yield	Elevated CO_2 level, N_2O	Collier et al., 2019;
	Reduction in livestock numbers	Elevated CO_2 level, N_2O, increased temperature	Thornton, 2010; Escarcha et al., 2018

Impact of Climate Change on Livestock Feed Resources

The quality and quantity of livestock feed can be highly affected by climate change. According to Fereja (2016), high temperature and humidity patterns highly affect the quality and quantity of pasture, disturbing the food cycle for livestock in the world. The digestibility factors and dry matter of grasses can decrease by increasing temperature due to climate change (Tubiello et al., 2018). It has been recorded that nutrients values of grasses (quality and quantity) can be highly influenced due to global warming as reported by Nardone et al., (2010), which badly impact the productivity of livestock Hidosa and Guyo (2017) and Samir (2017). Many researchers had reported that the quality and quantity of crop is reduced due to extreme weather events like high temperature (Myers et al., 2014; Augustine et al., 2018; Smith and Myers, 2018) which fall negative impacts on the livestock industry. The concentrations of nutrients such as proteins, carbohydrates, and many other minerals and vitamins can reduce in the crops like wheat, maize, rice, sugarcane, and many others.

Impact of Climate Change on Water Availability for Livestock Production

The water table can reduce during high temperatures because a large quantity of water can evaporate in this situation, highly affecting the water availability in rivers and canals and badly affecting animal production. The demand for water in this situation can increase in tropical and subtropical climates which become the cause of drought (Abdurehman and Ameha, 2018). Thermoregulatory processes in fodder as well as livestock can rais under severe climatic conditions (high temperature and low humidity) (Nardone et al., 2010). The need for water for animals can increase during these climatic changes which affect the metabolic process of animals, digestion, and fertility (Abdurehman and Ameha, 2018) as well as become the cause of various other disorders for livestock.

Impact of Climate Change on Breeds/ Genetic Resources of Livestock

All exotic and local breeds are affected by changes in climate (Kantanen et al., 2015). The diversity of livestock is decreasing nowadays due to variations in climate such as temperature and humidity. Thornton et al., (2009) reported that local breeds of livestock become extinct due to climate change. Due to changes in climate various pests, diseases and pathogens become serious threats to the livestock industry. The indigenous and local breeds of livestock become more susceptible to these pests and diseases. According to the survey of Thomas et al. (2004), 15 to 37 % of livestock species could be extinct worldwide resulting in malnutrition, and food insecurity, becoming the major issues for herdsmen whose survival depends on the livestock. Livestock is the major source of income for residents of the country in poor communities. Flooding, hurricanes, and droughts can cause due to climate change and will also badly affect livestock diversity, particularly breeds and species from the specific area resulting extinction of breeds.

Impact of Climate Change on Livestock Health

Climate change indirectly impacts the health of livestock which makes the animals most vulnerable to various infectious diseases (Thornton et al., 2009; Lacetera, 2012). In the world, several kinds of research have been performed to check the adverse influences of climate change on livestock immune systems which influenced the reproductive health of animals (Bett et al., 2017; Caminade et al., 2019). It has been investigated that forage production is reduced by increasing the concentration of CO_2, and temperature or even a combination of both (temperature and CO_2) (Forastiere, 2010; Sawalhah et al., 2019).

Influence of Climate Change on Livestock Production

The climatic or environmental conditions (humidity, temperature, wind speed, rainfall) play a significant impact on the reproductive performance, milk, meat, wool, eggs, weight production, fertility, and many other parameters of livestock throughout the world including Pakistan (Mansoor et al., 2021). There are specific climatic conditions that are suitable for the growth and development of livestock. For example, the 5-15 ^{o}C temperature is ideal for the growth and development of cows. The quantity of water evaporating during high temperatures can equal the concentration of water ejected into the milk (Cazer et al., 2002). According to West et al. (2003), The intake of dry matter (DM) and milk production in animals can negatively be affected by an increase in temperature (25 °C-32 °C) and heat stress.

Influence of Climate Change on Eggs, Milk, and Meat Production

Climate change has a key role in the egg, milk, and meat production of animals. Milk and meat products can also be affected by climate change, even their composition can alter with climate change. The value and amount of milk, meat, and eggs can be affected by variations in climate. It has been investigated by Berry et al., (1964) that milk production is significantly reduced at high temperatures and humidity. Fat content, lactose, protein, cheese, and casein are the main parts of milk of animals that are highly affected by climate change as reported by many scientists (Das, 2017; Summer et al., 2019). According to the investigation by Bernabucci et al. (2015), the concentration of caseins is lower in milk during the summer season as compared to others. Similar findings have been reported by Cowley et al. (2015).

Impacts of Vector-Borne Diseases/Pathogens on Livestock due to Climate Change

Livestock diseases are highly affected by climate change. Due to global warming, diseases can spread widely and directly or indirectly affect livestock health. The immunity level of livestock was reduced resulting in infections in animals (nematode infections and avian influenza), expansion rates of pathogens enhanced and increased the prevalence percentage of infectious diseases such as babesiosis caused by the attack of tick species. The population of the vector of diseases can boost under harsh conditions (high temperature and humidity). Animal health and ecosystem health are closely associated with climate change as reported by early researchers Vaghela and Mangal (2017). The incubation period of pathogens can decrease at high temperatures (Van den Bossche and Coetzer, 2008). The time duration and geographical distribution of vector-borne diseases can change with the changing in environmental conditions. Their transmission is positively linked to the wind (Lubroth, 2012; Yatoo et al., 2012). All biological and morphological parameters of pathogens are directly correlated with climate change (Morand, 2015; Desalegn, 2016). A list of livestock diseases caused due to climate change has given in table 2.

The Driver of Changes in Disease Dynamic

There are several drivers of changes in diseases dynamic, but some are the following; climate change, habitat loss, deforestation, wildlife conservation, biodiversity loss, in-migration, land purchase by foreigners, irrigation, inequality, conflict, land use, poverty, wildlife areas incursion, wildlife reservoirs, overpopulation of human, food price, social change, economic growth, and trade of animals and their products like milk, meat, eggs, and wool, etc. Among all of these, climate change is the top driver (Grace et al., 2015).

CONCLUSION AND RECOMMENDATIONS

This comprehensive review has landed to the conclusion that climate change is a grave threat worldwide due to its multifaceted effects and impact on plants, animals, humans, and the ecosystem (environment). The extensive elaboration of the previously published data revealed that the changes in global or regional climate patterns because of climate change have an impact on livestock health both directly and indirectly. In the present world Biometeorology is the key tool for the rational management of thermal stress on livestock production systems. Therefore, after this extensively elaborative review, it is strongly recommended that climate change must be addressed through developing suitable longstanding reworking policies and extenuation choices for the cattle segment. Developing and applying a workable methodology to link climate data with animal disease surveillance systems is also recommended.

Table 2: List of diseases that emerge due to climate change and most significant to livestock keepers.

Serial number	Disease/pathogen	Distribution area	References
1	Trypanosomosis (tsetse)	Africa	Grace et al., 2012; Mansoor et al., 2021; Shaw et al., 2014
2	Anthrax	Africa, Asia	Grace et al., 2012; 2015
3	Listeriosis	Africa, Asia	Grace et al., 2012;2015
4	Botulism	Africa, Asia	Grace et al., 2012;2015
5	Cryptosporidiosis	Africa, Asia	Grace et al., 2012;2015
6	Endoparasitosis	Africa, Asia	Grace et al., 2012;2015
7	Campylobacteriosis	Africa, Asia	Grace et al., 2012;2015
8	Liver fluke (fascioliasis)	Africa, Asia	Grace et al., 2012;2015
9	Salmonellosis	Africa, Asia	Grace et al., 2012;2015
10	Anaplasmosis	Africa, Asia, America, Europe	Perry, 2009; Leta et al., 2013
11	Babesiosis	Africa, Asia, America, Europe	Perry, 2009; Leta et al., 2013
12	Ehrlichiosis	Africa, Asia, America, Europe	Perry, 2009; Leta et al., 2013
13	Rift Valley fever	Kenya	Walter and Barr,2011; Grobbelaar et al., 2011; Rich and Wanyoike, 2010

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AUTHOR'S CONTRIBUTION

Each author play equal role in writing this review paper.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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