Effect of Climate Change on Livestock Production in Pakistan

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Abstract

The climate change is affecting the animal productivity especially in resource poor localities in the region. While most of the areas suffer from the insufficiencies of the data, a few scientific measurements in some areas have proved that the effect of climate changes are adversely affecting the livestock production directly due to heat stress or indirectly due to changes incorporated in the ecosystem. Some of these may include reduced agricultural productivity, deteriorated health due to shortage of feed resources, water quality, global warming, shrinking glaciers, erratic weathers, river floods, disease prevalence, disrupted ecosystem and increase in the frequency of natural hazards and disasters. Pakistan still suffers more than 30 % Crude Protein and TDN deficiency for large and small ruminants in its feed balance. The exact Information on the losses are very much undermined and not realized by many or sometimes sorely lacking. A detailed understanding is warranted to anticipate the future impacts of the climate change in different areas on the productivity of the ruminants. Unless these losses are realized and scientifically proved, the measures needed or taken will attain less significance. Our studies revealed that there is a drastic effect on temperature change on water buffaloes and their calves. When ambient temperature reached to 32-47° C with a mean relative humidity of 33-75%, the physiological norms of the buffalo calves were significantly affected and their weekly body weight decreased as 43 kg as compared to 46 kg under open air tree shade than inside a shed with showers plus ceiling fans, body temperature was higher 101.6ºF that 101.0ºF, respiration rate was higher 28 to 26 per minute, and the pulse rate increased to 53-54 per minute under treatment with open air tree shade as compared to inside with ceiling fans and showers. This paper will delineate in length some of the effects on livestock production due to climate change in a country like Pakistan where 35-40 million rural people derive their livelihood from livestock rearing. Mitigation measures will also be suggested to save productivity losses to ensure the food supply from animal origin for the exploding population.

Keywords: climate change, heat stress, livestock productivity, mitigation, Pakistan

Introduction

Pakistan has experienced the worst drought of its history in the last decade of the last millennium which lasted until 2004. She has been ranked 16 regarding countries most vulnerable to environment change (Maplecroft, 2010). Out of total 79.6 million hectares (MH), 27 % is cultivated area i.e. about 21 (MH), containing 19.12 (MH) are irrigated and 3.67 (MH) are rainfed. The irrigated area consumes about 80% of the country's freshwater. Figure 1 shows this distribution along with 62% of the country areas are rangelands (Quraishi et al. 1993). Agriculture sector being the back bone of the economy will be more probable stake holder of aftermaths of environmental changes. The climate change affected the livestock in two ways (i) by affecting the forage production, (ii) directly affecting the livestock kept under different production systems. The losses suffered by the animals not only due to heat stress but also in the form of disasters in the previous years. This thematic paper explains the possible problems faced by the livestock due to heat stress, impact of climate change and the different ways and means to mitigate the effect of environment on livestock productivity.

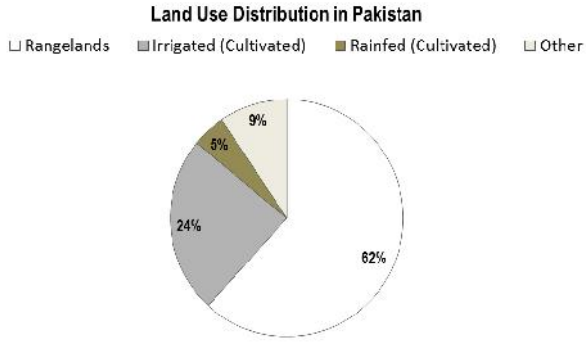

Figure 1. Showing the different classification of the areas of Pakistan

The Climatic Zones and Water Resources of Pakistan

The environment and livestock production systems are closely related (Nardone and Gibon, 2000). The agriculture sector depends on the availability of the water for irrigation and annual precipitation. Based on the annual precipitation six Agro-Ecological Zones (AEZ) has been defined by Quraishi *et al*. (1993), Chaudhry and Rasul (2004) is summarized in the Table 1. Environment changes are affecting the glaciers in the northern part of the country and affecting the Indus Basin system badly. In combination with the predicted heavy rainfall, it likely to exacerbate the already serious problems of flooding and draining, especially in the lower parts of the Indus basin in the next few decades, when the glacial reservoirs will be empty, and there are likely to be dramatic decreases in river flows (World Bank, 2005).

Table 1. Classification of the areas according to precipitation

Sr #	Type of area	Amount of Precipitation (mm)
1	Humid	>1000-2000
2	Sub-Humid (wet)	700-1000
3	Sub-Hummid (dry)	>500-700
4	Semi-Arid (wet)	300-500
5	Semi-Ard (dry)	200-300
6	Arid	Less than 200-250

Source: Adopted from Quraishi *et al*. (1993)

Environmental Temperature and Rain Pattern

Farooqi *et al.* (2005) have further analyzed the climate change perspective in Pakistan and concluded that annual mean surface temperature is on consistent rising trend since the beginning of 20th century. Charlotte (2011) further added that the major risk from the climate change in South Asia is increased summer precipitation, intensity in temperate regions, increase flash-flood prone areas and further added that the arid and semi-arid regions would be drier in summer, which could lead to severe droughts.

Effect of Droughts and Floods

Pakistan had the fully operational irrigation system and enough water from the rivers flowing through it. But quite recently the water was seldom enough to meet the requirement of end users. The population growth had started putting unprecedented pressure on the irrigation system (UN, 2001). Livestock population is affected greatly by the droughts and their growth has been declined in last decade especially during 2003-04 (SBP, 2003-04). The researchers of Balochistan have also reported that drought has affected whole of the country; Balochistan province being the worst-hit and resulted in the loss of life (Shafiq and Kakar, 2007). During the recent years, due to the change of precipitation, the floods have adversely affected the country especially Punjab and Sindh. A latest report by FAO (2012) confirmed these notions by explaining that 116,000 heads of livestock died by the flood hit in the Sindh province.

Effect of Heat Stress on Dairy Animals

The most drastic effect of heat stress is in the form of change in the energy metabolism and partitioning coped with decreased in DMI. This results in the low

milk production response. There is 20-30% increase in the maintenance energy requirement and heat stress combined with the DMI decrease by 10-20% in the commercial dairy herds (Chase, 2006). Formulation for adequate nutrient intake challenging for heat stress cow depends on optimizing then rumen undegradable protein to improve milk production response. The forage level must decrease due to high heat of increment (West, 1999). De Rensin and Scaramuzzi (2003) found that appetite and dry matter intake are reduced so by this way it prolonged the postpartum negative energy phase in dairy cows. Tao *et al*. (2011) found that cooling of heat stress can increase milk production (28.9 vs 33.9 kg/day) and lower milk protein (3.01 vs 2.87%). The physiological change regarding milk synthesis during heat stress may be due to hepatic glucose preferentially used for process other than milk synthesis (Baumgard *et al*., 2011). Climatic factors for example temperature, precipitation frequency and severity of extreme events affects the livestock and crop yield (Thornton *et al.,* 2008). Temperature Humidity Index (THI) has been used as indicator of heat stress. The critical values of THI is 72 (Igono et al. 1992) while the studies of Dikeman and Hanson, 2009 showed that dry bulb temperature could also be used to predict the rectal temperature of lactating Holstein cows in sub-tropical environment. The increase in thermal load above the thermal neutral zone affects the animal performance. The animal fails to dissipate excess heat to maintain homeothermy (West, 1999). Mukherjee et al. 2011 found that the decrease in lymphocytes in heat stress cows. Physiologically there will be increase in rectal temperature and respiration rate due to increase in ambient temperature beyond the thermoneutral zone (Chase, 2006). Gwazdauskas (1985) found that estrous hormones were found lower during heat stress and resulted in shortening of estrus duration. He further investigated that lower fertility in heat stressed male cattle are due to the impaired spermatogenesis and testosterone during exposure to hyperthermia. Baumgard and Rhoads (2007) said that there is negative effect of heat stress on a variety of dairy parameters, including milk yield and reproduction causing a significance of financial burden. Increase in thermal load decreases the reproductive efficiency (Fuquay, 1981, Imtiaz Hussain *et al*., 1992). Most of the reproductive problems are decrease duration and intensity of estrus (Her *et al*., 1988), lower conception rate (Stott *et al*., 1972) and high embryo mortality (Wise *et al*., 1988).

The change in environmental temperature affects the animal body. Many scientists have investigated the dynamics of animal body changes due to heat stress. The earlier studies on heat stress in Pakistan were conducted at the University of Agriculture, Faisalabad, under PL-480 schemes (Qureshi *et al*., 1978). They concluded that there is drastic effect of temperature change on Buffalo (*Bos Bubalus bubalis*). From five years (1973-78) long trials, they concluded that combined use of showers and fans as a thermal relief measure in dairy buffaloes was found to be significantly useful as compared to the use of fans or showers alone as improved milk yield and the occurrence of estrus was more pronounced in given treatment of

combined use of fans and showers. Similar observations were recorded in the follow up studies (Younas et al. 1979) indicated that under the environmental temperatures of 32-47ºC with a mean relative humidity of 33-75 %, the physiological norms of the buffalo calves were significantly affected and their weekly body weight decreased as 43 kg as compared to 46 kg under open air tree shade than inside a shed with showers plus ceiling fans, body temperature was higher 101.6 ºF than 101.0 ºF, respiration rate was higher 28 to 26 per minute, and the pulse rate high which was 53 to 54 per minute under treatment with open air tree shade as compared to inside with ceiling fans and showers. The final conclusion from these studies was that declining effect of thermal stress on certain components of milk and blood, however, could not be solely ascribed due to heat stress. The growth of buffalo calves as determined from increase in their body weights manifested an interesting contrast in the effect of various treatments used. The highest average body weight was observed in group of calves provided ceiling fans alone as thermal relief whereas in trials with adult buffaloes, combined use of fans showered proved better. The influence of thermal stress on blood picture of buffalo-calves was also seen. Blood glucose, total lipids and phospholipids content were found to consistently increase whereas, cholesterol levels decreased in the entire group with exception of group 1 in which a slight increase was observed (Younas et al. 1982).

In a follow up study, the lactating and cycling Holsteins in each of two summers were assigned randomly to pens in a free-stall barn either with or without overhead fans to study the effect of fan cooling on certain endocrine and behavioral responses during the estrous cycle (Younas *et al*., 1993). Rectal temperatures were lower in the group cooled by fans than in the control group each summer. Luteal progesterone secretion tended to be greater in the fan group each summer; area under the luteal phase curve was significantly higher than for controls during the second summer. There was tendency for more pre-ovulatory surges of LH and higher estrous responses rates in the fan group during the second summer. Thus, fan cooling of lactating dairy cows for several weeks before anticipated breeding provides potential for more efficient reproductive performance during the summer.

Conclusions

The countries like Pakistan require change in policies regarding the livestock production. Keeping in view the effects of climate change, the production systems in the country need to be re-visited and revolutionized. There is no best way than managing the dairy animals in a wise and economical way during the hot summers enabling them to dissipate their body heat and facilitating the animals comfort as much as possible. Correct management decisions will enable the dairy animals to grow faster, pronounced estrual behavior, improved conception rates, reproduce on time and produce their maximum when they are wet. The measures like prediction

of monsoon; protection from rain and sun; feeding management like grazing during cool hours, offering succulent varieties, decreased DMI, use of silage and hay, nutrient density, avoiding excess with normal rumen function; provision of fresh and clean water; genetic selection; housing management like forced/tunnel ventilation, sprinkling, showering, misting; use of ecological modeling and innovations with appropriate strategic management decisions; risk analyses and devising some innovative methods to provide comfort to the animals can help in minimizing the effect of heat stress on dairy animals.

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