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IMPACT OF CLIMATE CHANGE ON PRODUCTION AND REPRODUCTION OF DOMESTIC ANIMALS

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Global warming and climate change are poised to significantly impact the productivity and reproductive efficiency of domestic animals worldwide. In many regions, heat stress has emerged as one of the most critical environmental factors affecting animal performance (Koubkova et al., 2002). While ongoing research continues to enhance our understanding of how animals adapt to these changing conditions (Hahn et al., 2003), effectively managing the impacts of climate-induced stress remains a persistent challenge. One widely used tool in this effort is the Temperature Humidity Index (THI), which has been applied in countries like India to assess how rising temperatures influence animal stress levels (Upadhyay et al., 2008). The thermoneutral zone, a specific temperature range within which animals can function without stress, becomes crucial in this context. Climate projections for India suggest that the number of days with a THI above 80, indicating heat stress, could rise dramatically—from 40 days (10.9%) to 104 days (28.5%)—with a 4˚C temperature increase, leading to both direct and indirect declines in livestock productivity (Chauhan & Ghosh, 2014). In this article, we will briefly discuss the impacts of climate change on production and reproduction of domestic animals.

Production

Climate change has a direct impact on cattle, including milk production. With the number and frequency of stressful days (THI > 80) rise, cattle and buffalo output and production are negatively affected (Upadhyay et al., 2007). Higher temperature significantly reduces milk yield, especially in high-producing dairy cows. Direct heat stress on cattle in India results in an annual loss of around 1.8 million tonnes of milk, valued at ₹2661.62 crores. This is roughly 2% of the country's total milk supply. Ravagnolo and Misztal (2000) discovered that milk output decreased by 0.2 kg per unit rise in THI beyond 72. Although specific data is not evident, these values will be much more in coming days. The drop in milk output in heat-stressed cows is caused by a combination of variables that interact with high air temperatures. Milk yield losses are positively connected with cow production level, indicating that increased milk yield increases susceptibility to heat stress and reduces the temperature at which milk losses begin (Gauly et al., 2013; Berman, 2005). Berman (2005) found that in warmer conditions, high-yielding cattle produce more metabolic heat, resulting in an increased respiratory rate and a consequent decrease in milk output. Furthermore, Molee et al. (2011) discovered that Holstein crosses with indigenous breeds in tropical and subtropical climates outperformed purebred Holsteins and were more resistant to heat stress. The stage of lactation also determines how dairy cows react to heat stress. Johnson et al. (1998) discovered that mid-lactating dairy cows were more susceptible to heat than cows in early or late lactation. When exposed to heat, mid-lactating cows produced 38% less milk. However, Upadhyay et al. (2007) found that the reduction in milk production during mid-lactation was less dramatic than in the early or late periods. Milk output in Murrah buffaloes fell between 10-30% during the first lactation and 5-20% during the second or third lactation (Chauhan & Ghosh, 2014).

Less attention has been paid to the consequences of heat stress in small ruminant species because of their comparatively tiny contribution to the world's milk supply, reduced selection for high output, and perceived higher resilience to hot settings. Compared to THI readings, there seems to be a larger negative association between milk production features in ewes and direct measurements of temperature or humidity. Across sheep breeds, there are considerable differences in the THI threshold at which ewes start to feel heat stress. In the milk of Comisana ewes, solar radiation has a significant effect on the yield of casein, fat, and clot hardness but has less of an effect on milk output overall (Sevi et al., 2001). Goats are similarly impacted by high temperatures, which results in decreased milk supply and milk component composition.

Reproduction

Animals can adjust to hot weather, but although these defence systems help them survive, they frequently impair their ability to reproduce and be productive. It is believed that reproduction is a "luxury function"- best performed when the animal's physiology is in a state of appropriate homeostasis. Many agricultural animals have infertility and poor reproductive outcomes as a result of heat stress brought on by high ambient temperatures and summertime humidity. THI levels frequently surpass 80 in India during the hot, humid (July-September) and hot, dry (March-June) seasons. Cattle and buffaloes have different oestrous cycles as a result of this. According to Upadhyay et al. (2009), most buffaloes engage in sexual activity between October and February, when the temperature usually stays below 72.

In buffaloes, temperature increase of more than 2°C can have a negative impact on endocrine processes, specifically affecting hormone activities and the pineal-hypothalamo-hypophyseal-gonadal axis disruption (Upadhyay et al., 2009). Even in the absence of heat stress, cattle's fertility is affected by heat stress far into the fall (October and November) (Drew, 1999). According to studies there is a 12.8% drop-in conception rates for every 0.5°C increase in uterine temperature. Buffaloes are less stressed in the hot dry season than in the hot humid season because of low overnight temperatures and thermally heated intervals (THI) in the summer (April and May) that help them disperse heat more efficiently at night (Upadhyay et al., 2009). Heat stress reduces motor activity and other oestrous symptoms (Nebel et al., 1997) but increases the incidence of anestrus and silent ovulation (Chauhan & Ghosh, 2014)

Male animals' reproductive systems are particularly vulnerable to disturbance by heatwaves; the most notable effects include decreased fertility and sperm production, both in terms of number and quality. The semen parameters affected by heat stress are sperm concentration, total sperm output, sperm viability, semen volume, sperm motility, sperm morphology, seminal plasma composition, pH, osmolality etc (Pal et al., 2023). There were not any noteworthy effects of humidity or ambient temperature on semen and sperm production quality (Chauhan & Ghosh, 2014).

Feed and Fodder Availability

Climate change affects the amount and quality of feed that is available, which influences livestock output. According to Thornton et al. (2009), it is anticipated to change the species composition of grasslands, impacting genetic resources, biodiversity, and the digestibility and nutritional value of fodder. Furthermore, severe feed shortages can result from droughts and extremely variable rainfall, especially in dryland areas, which can have a substantial effect on cattle numbers. Certain regions' livestock systems may be more severely impacted by climate change than others due to reduced feed intake and quality, which can lead to lower feed intake and subsequent adverse effects on the body functions of livestock.

Health

As a possible effect of climate change, livestock systems are susceptible to shifts in the prevalence and distribution of illnesses and parasites. Dhakal et al. (2013) have highlighted the key problem in warm temperate climates as the incidence of external parasites, which impact 43.3% of cattle. According to studies conducted in India, 52% of the seasonal variations in Foot and Mouth Disease (FMD) in cattle in the hyper-endemic region of Andhra Pradesh and 84% in the meso-endemic region of Maharashtra can be attributed to meteorological factors like temperature, humidity, and rainfall (Ramarao, 1988). Furthermore, Boophilus microplus, Haemaphysalis bispinosa, and Hyalomma anatolicum infestations in cattle are made worse by hot, muggy weather (Basu and Bandhyopadhyay, 2004; Kumar et al., 2004). Certain diseases or parasites that have life cycle phases outside of their animal hosts may grow more quickly as a result of rising temperatures brought on by climate change. Pathogen and parasite populations may rise as a result of this acceleration, which may decrease generation durations and perhaps increase the overall number of generations annually (Harvell et al., 2002).

Impact on Poultry

Due to varying temperatures that affect their physiology and behaviour, poultry flocks are especially sensitive to climate change. For them to continue producing at their best levels for human consumption, birds can only withstand very low temperature ranges. Temperature, relative humidity, and light are three important environmental variables that have an impact on chicken performance. The performance and survival of poultry are greatly impacted by ambient temperatures. According to a study, when ambient temperatures climb to 34°C, death rates in broilers increase by 8.4% owing to heat stress. Furthermore, at 31.6°C, feed consumption drops to 108.3 g/bird/day; at 37.9°C, it drops to 68.9 g/bird/day, resulting in a 6.4% decrease in egg production. Thus, it is essential to comprehend and control environmental factors for sustainable and economic poultry farming (Ahaotu et al., 2019).

Conclusions

In conclusion, climate change poses significant threats to livestock productivity, reproductive efficiency and overall animal health. Rising temperatures and increased incidences of heat stress will continue to negatively impact milk production, fertility and feed availability, particularly in vulnerable regions like India. Heat stress affects not only large animals such as cattle and buffalo but also smaller ruminants and poultry. They are equally sensitive to temperature fluctuations and stressful environments. As global temperatures rise, it is important to adopt strategies that mitigate the adverse effects of climate-induced stress to ensure sustainable livestock production systems.

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