



A Monthly e Magazine  
ISSN:2583-2212

April, 2026 Vol.6(4), 1060-1063

Popular Article

## Climate Change & Heat Stress Management in Livestock: Challenges and Solutions for Sustainable Dairy Farming

Harsimar Preet Kour<sup>1</sup>, Anupam Soni<sup>1\*</sup>, Divyanshu Sharma<sup>1</sup> and Irusappan Ilayaraja<sup>2</sup>

<sup>1</sup> Livestock Production Management Division, NDRI, Karnal, Haryana, India

<sup>2</sup> Animal Genetics and Breeding Division, NDRI, Karnal, Haryana, India

\* Corresponding author: [vetanupam456@gmail.com](mailto:vetanupam456@gmail.com)

<https://doi.org/10.5281/zenodo.19786374>

### Introduction

Climate change has emerged as one of the most serious threats to livestock production systems across the world, including India. Rising global temperatures, erratic rainfall patterns and increasing frequency of extreme weather events are directly affecting animal health and productivity. Dairy animals, particularly high-yielding cattle and buffaloes, are highly sensitive to thermal stress. Heat stress reduces feed intake, milk production, fertility and immunity, ultimately leading to economic losses. Therefore, understanding the impact of climate change and adopting appropriate heat stress management strategies has become essential for sustainable livestock production.

### Understanding Climate Change in Livestock Context

Climate change refers to long-term alterations in temperature, humidity, wind patterns and precipitation. In livestock systems, these changes influence feed availability, water resources, disease patterns and animal comfort. Increased ambient temperature and humidity create stressful conditions for animals, especially in tropical countries like India. These environmental changes disrupt the physiological balance of animals, leading to reduced performance and increased vulnerability to diseases.

### Concept of Heat Stress in Livestock

Heat stress occurs when animals are unable to dissipate excess body heat effectively, resulting in an increase in body temperature. Normally, animals maintain thermal balance through mechanisms such as sweating, panting and heat radiation. However, under high environmental temperature and humidity, these mechanisms become insufficient. As a result,



animals experience physiological stress which negatively affects their productivity, reproduction and overall health.

### **Temperature Humidity Index (THI) and Its Importance**

The Temperature Humidity Index (THI) is widely used to assess heat stress in livestock. It combines ambient temperature and relative humidity into a single value that indicates the level of thermal stress experienced by animals. Generally, THI values above 72 indicate mild stress, while values above 80 indicate severe stress conditions. Monitoring THI helps farmers take timely management actions such as providing cooling systems, shade and adequate water to reduce the impact of heat stress.

### **Physiological Effects of Heat Stress**

Heat stress causes several physiological changes in animals, including increased respiration rate, elevated body temperature and altered hormonal balance. Animals under stress divert energy from production processes to maintain body temperature. This leads to reduced milk yield and growth rate. Additionally, prolonged heat stress weakens the immune system, making animals more susceptible to infections and metabolic disorders.

### **Impact on Feed Intake and Nutrition**

One of the immediate effects of heat stress is a reduction in feed intake. Animals consume less feed to minimize metabolic heat production, which results in decreased nutrient intake. This leads to negative energy balance, especially in lactating animals and ultimately reduces milk production. Nutritional strategies such as providing high-energy diets, bypass nutrients and feeding during cooler hours can help mitigate these effects.

### **Effect on Milk Production**

Heat stress significantly reduces milk yield and alters milk composition. High-producing dairy cows are more sensitive to heat stress due to their higher metabolic heat production. Reduced feed intake and hormonal imbalances lead to lower milk synthesis. In severe cases, milk yield can decline by 10–25%, affecting farm profitability.

### **Impact on Reproductive Performance**

Reproductive efficiency is severely affected under heat stress conditions. Elevated temperatures disrupt hormonal activity, leading to poor estrus expression and reduced conception rates. Embryonic development is also adversely affected, increasing the chances of early embryonic loss. As a result, calving intervals become longer, reducing the lifetime productivity of animals.



### **Effect on Animal Health and Immunity**

Heat stress weakens the immune system, making animals more prone to diseases such as mastitis, lameness and parasitic infections. Stress conditions also increase oxidative stress and inflammation in the body. Animals under heat stress are less capable of fighting infections, which leads to higher veterinary costs and mortality rates.

### **Behavioural Changes During Heat Stress**

Animals exhibit noticeable behavioural changes when exposed to high temperatures. They spend more time standing rather than lying down to increase heat dissipation. Water intake increases, feeding and rumination decrease. Animals also seek shade and reduce physical activity. Monitoring these behavioural changes helps in early detection and management of heat stress.

### **Heat Stress in Indigenous vs Exotic Breeds**

Indigenous breeds such as Gir, Sahiwal and Tharparkar are more heat tolerant compared to exotic breeds like Holstein Friesian. Indigenous animals have better thermoregulation mechanisms, including efficient sweating and lower metabolic heat production. In contrast, exotic breeds are more susceptible to heat stress, especially in tropical climates. Crossbreeding programs aim to combine productivity with adaptability.

### **Housing Management for Heat Stress Reduction**

Proper housing design plays a crucial role in minimizing heat stress. Well-ventilated sheds with adequate roof height and orientation help reduce heat accumulation. Use of materials with low heat conductivity, proper spacing between animals and provision of shade are essential. Orientation of sheds in east-west direction minimizes direct solar radiation.

### **Cooling Systems and Technologies**

Modern cooling systems such as fans, foggers, sprinklers and cooling pads are effective in reducing heat stress. These systems lower the ambient temperature and improve air circulation within the shed. Sprinkler systems combined with fans enhance evaporative cooling which is highly effective in hot and humid conditions. Adoption of such technologies improves animal comfort and productivity.

### **Nutritional Management Strategies**

Nutritional management is a key approach to mitigate heat stress. Feeding high-energy and easily digestible diets helps compensate for reduced feed intake. Inclusion of bypass fat, mineral mixtures and antioxidants improves animal performance. Feeding during early morning or late evening when temperatures are lower enhances feed consumption.



## **Water Management**

Adequate and clean water supply is essential during heat stress conditions. Water intake increases significantly in hot weather and animals should have continuous access to fresh drinking water. Cool water helps in maintaining body temperature and supports metabolic functions. Providing multiple water points reduces competition among animals.

## **Role of Precision Livestock Farming in Heat Stress Management**

Precision Livestock Farming technologies play a vital role in managing heat stress by providing real-time monitoring of animal behaviour and environmental conditions. Sensors can detect changes in activity, rumination and temperature, allowing early intervention. Automated systems can activate cooling devices based on environmental conditions, ensuring timely response and efficient management.

## **Genetic Approaches and Breed Selection**

Selective breeding for heat tolerance is a long-term strategy to combat climate change. Genetic improvement programs focus on developing animals that can maintain productivity under high temperature conditions. Indigenous breeds and their crosses are valuable genetic resources for improving heat tolerance in dairy animals.

## **Government Initiatives and Policies**

The Government of India has launched several initiatives to support climate-resilient livestock farming. Programs such as the National Innovations in Climate Resilient Agriculture (NICRA) promote adaptive strategies for managing climate change. These initiatives provide training, financial support and technological interventions to farmers.

## **Future Strategies for Climate Resilient Livestock Farming**

Future approaches should focus on integrating technology, genetics and management practices to build resilient livestock systems. Development of low-cost cooling systems, climate-smart housing and digital monitoring tools will be crucial. Awareness programs and farmer training will play a key role in adoption of these strategies.

## **Conclusion**

Climate change poses a significant challenge to livestock production, but its impact can be minimized through proper management practices. Heat stress management strategies such as improved housing, cooling systems, nutritional adjustments and use of modern technologies can enhance animal comfort and productivity. Adoption of these measures will ensure sustainable and profitable dairy farming in India.

