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Effect of Climate Change on Reproduction and Production of Bovine

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ABSTRACT

Climate change is prolonged abnormal weather conditions in an area. Climate change poses a threat to livestock due to heat stress. Livestock housing shelters cattle from the environment. Livestock's growth, milk production, reproduction, feeding, and behavior depend on the environment. Climate stress harms animal fertility by disrupting reproductive cycles. Heat stress impacts dairy production economically. The impact reduces feed intake and harms animal health, reproduction, and production. Environmental stress reduces milk production and reproductive capabilities in dairy animals, leading to substantial financial losses. Techniques like shading, sprinklers, ventilation, and cooling can reduce heat stress in cattle and are adaptable to climate change.

Introduction

Heat stress challenges global livestock production due to climate change. Livestock housing is crucial for managing dairy cows, protecting them from external factors like sunlight, temperature changes, moisture, rain, and frost. The shed moderates environmental interaction. The environment impacts livestock growth, milk production, reproduction, feed intake, and behavior. Climate stress harms animal reproductive functions by changing their reproductive rhythm.

Heat stress

Heat stress is when a cow can't regulate its body temperature due to poor heat dissipation. Animals have a thermal neutral zone for their ambient temperatures. Optimal temperature range for physical well-being and task performance. The upper critical temperature is the threshold where heat stress affects animals. Environmental factors cause heat stress. Heat stress reduces fertility in lactating dairy cows. Heat stress affects animals' physical health through various systems, resulting in changes in their overall performance. High temperatures hinder the feeding and utilization of food. High temperatures harm dairy livestock's health and productivity. According to an IPCC report, it can be inferred that... In warm conditions, increased body temperature and decreased productivity may occur (1).

Cow dissipate heat

Animals use physiological mechanisms to regulate their body temperature. Heat transfer occurs through conduction, whereby thermal energy is directly transferred from a warmer object to a cooler one. To occur, a cow must interact with a surface. Convection replaces warm air with cool air near the skin. Radiation transmits heat from high to low temperatures. Evaporation removes sweat or moisture from the body.

Determines the severity of heat stress

The animal thermal challenge depends on many factors. Crucial variables include temperature and humidity. Heat stress duration. The topic is ventilation and airflow. Dimensions of cattle. This study explores milk production and its link to dryness. Housing features affect living quality. Water access. Used in agriculture, animal husbandry, and botany to describe varieties of domesticated species. New breeds are created through artificial selection, where only desired individuals reproduce. The breed concept influenced societies and various industries across history (2).

Main threats due to heat stress

Several factors could influence the well-being and health of dairy animals. These encompass environmental aspects, such as temperature, housing, and hygiene, as well as nutritional flaws, metabolic disorders, and immune suppression. Moreover, reproduction and reproductive outcomes could also play an essential role in the overall health of dairy animals. Therefore, it is of utmost importance to carefully monitor and manage these factors to ensure optimal welfare and productivity of dairy animals.

Environmental factor

Numerous environmental factors possess a direct or indirect impact on the productivity of animals. According to reports, alterations in climatic conditions have a direct impact on animal production and reproductive capabilities, resulting in a decrease of approximately 58. 3% and 633%, respectively Elevated environmental temperatures give rise to alterations in animal body physiology, characterized by an increase in body temperature exceeding 102. 5 ºF and the elevation of respiration rates, exceeding 70-80 breaths per minute.

Reproduction

Heat stress impairs dairy cattle's reproduction. Changes in reproductive performance observed. Heat stress exposure affects animal reproductive function for months. Estrus phase is shorter and weaker now. Fertility rate has decreased. Study found smaller ovarian follicles with reduced growth and development. Risk of early embryo deaths has increased. Reduced prenatal development and smaller lower leg sizes in humans or animals is decreased fetal growth.

Health performance of dairy animals

Lactating cows eat less in temperatures over 25-26°C, with a more rapid decline beyond 30°C in temperate climates. At 40°C, cattle can decline by up to 40% and buffalo by 8-10%. High temperatures can increase the risk of health problems and reduce digestion. Heat stress reduces thyroid activity and metabolic heat generation. Climatic chambers reduced milk yield by 35% and 14% in mid-lactating and early-lactating dairy cows, respectively, due to heat exposure.

Nutritional management

High fiber diets have a higher dietary heat increment than low fiber high carbohydrate diets. Dairy buffaloes' metabolic energy increases in hot environments. Heat stress in animals increases their maintenance energy requirement by 20-30%. This decreases feed intake, reducing energy for milk production. Also, animals in heat stress lose important ions like sodium and potassium. Higher temperature reduces food intake and efficiency. Heat stress decreases cow DMI and milk production. Also, thermal stress affects milk composition, SCC, and mastitis frequency.

Immune suppression

The immune system evolved to protect the host from pathogens. The immune system can be affected by many factors. Heat stress can affect immune response differently depending on species, breed, age, social status, acclimation, and duration of exposure. High temperatures can affect neutrophil performance, which protects the mammary gland from infections. Mastitis is a common illness in dairy cows caused by bacterial invasion of the teat canal or injury to the udder.

Metabolic disorders

Lameness

The manifestation of lameness in dairy and beef cows can potentially be influenced by heat stress. Heat-stressed bovines exhibit alterations in their feeding patterns whereby they tend to consume meals less frequently during periods of lower ambient temperatures. However, they tend to increase their individual meal sizes during such feeding events. It has been observed that a decrease in feed consumption during periods of elevated temperatures, coupled with a subsequent increase in feeding activity in response to cooler environmental conditions, may lead to the development of acidosis a condition that is widely considered to be a significant contributor to the prevalence of laminitis.

Ketosis

Ketosis is a metabolic disorder that arises from a significant negative energy balance in an organism, characterized by the accumulation of ketone bodies resulting from the incomplete breakdown of adipose tissue. Clinical ketosis is a commonly observed metabolic disorder that predominantly affects highly productive bovines within the second to

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seventh week following parturition, primarily due to suboptimal nutritional and management practices.

Ruminal acidosis

The literature suggests that cows in the early stages of lactation face an elevated level of risk owing to a diminished absorptive capacity of the rumen, an ill-suited rumen microflora, and a sudden transition to diets that are high in energy density. The present observation highlights that cows experiencing peak dry matter intake (DMI) are at an elevated risk owing to the excess production of rumen acids.

Strategies to ameliorate heat stress

Strategic measures aimed at mitigating the detrimental effects of thermal stress on the productivity and reproductive capacity of dairy cattle involve the enhancement of housing and the implementation of management interventions geared towards minimizing the climatic implications on livestock. The present discourse delineates fundamental elements essential for the establishment of long-term viability in dairy animal production and reproduction. The manipulation of the microenvironment, implementation of nutritional management strategies and advancement in genetic improvement techniques have emerged as crucial aspects in contemporary biotechnology research (3).

Modification of Microenvironment

Heat stress reduction via microenvironmental modification is vital in high temperature environments. Our service provides shading and an evaporative cooling system using foggers, misters, sprinklers, or fans. Using various cooling techniques, along with improved feeding and reproductive practices, can boost economic success on dairy farms. In summer, cooling systems boost dairy animal milk production and reproductive success.

Nutritional management

In regions characterized by hot climates, it is recommended to incorporate an elevated dietary fat content in animal feed to optimize the efficiency and yield of milk production. To ensure the monitoring of herd health, it is imperative to conduct test-day records (TDR). The Time Domain Reflectometry (TDR) comprises of a measurement of the daily production of milk, lipid content, protein content, and the ratio of fat-to-protein. The administration of niacin supplement offers valuable support in alleviating heat stress in bovine species. Concurrently, provision of antioxidants during the heat stress phase emerges as a viable strategy to enhance fertility in cows. The aforementioned findings induce alterations in the equilibrium between acidity and alkalinity, ultimately giving rise to the onset of metabolic alkalosis.

Genetic modification

Genetic enhancement for production can increase vulnerability to high temperatures due to metabolic heat generation. Identifying heat-tolerant animals in high-producing breeds is a significant genetic research breakthrough. By selecting animals with genetic markers and crossbreeding them, genetic variability is enhanced and offspring's cooling capacity improves. Lighter-skinned cattle with shorter hair and larger hair coat pigment are better adapted to warmer conditions than darker-skinned cattle with longer hair (4).

Conclusion

Heat stress in dairy industry is an economic concern. Changes in physiology and feeding habits can affect animals' reproductive cycles, productivity, and health. Environmental stress harms dairy livestock wellbeing, known fact. Stress can harm milk production and reproduction in dairy cows, causing economic losses for stakeholders. Cooling strategies, such as shaded areas, sprinklers, ventilation, and evaporative cooling, are commonly used to alleviate heat stress in dairy cows. This response may address climate change's thermal alterations. Managing the environment and nutrition can improve animal performance in hot weather. Many modern construction projects include housing to alleviate heat stress.

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