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Popular Article

Climate Change and Animal Nutrition: Challenges and Strategies for Sustainable Dairy Farming

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Introduction

In India, where dairy farming supports millions of small and marginal farmers, climate change poses a serious threat to livestock productivity and farmer income. It has emerged as a major global challenge affecting agriculture and livestock production, including the dairy sector. Increasing environmental temperatures, irregular rainfall patterns, and frequent extreme weather events such as heat waves and droughts have a direct impact on dairy animal productivity. Heat stress is one of the most serious consequences of climate change, which reduces feed intake, milk production, growth, and reproductive efficiency in dairy animals. It also weakens the immune system, making animals more susceptible to diseases. In addition, climate change affects the availability and quality of feed and fodder, further reducing animal performance. Proper nutritional management, including balanced ration, mineral supplementation, and use of quality fodder, plays an important role in helping dairy animals cope with climate stress and maintain productivity. Therefore, adopting climate-smart feeding strategies is essential for sustainable and profitable dairy farming.

Impact of Climate Change on Dairy Animals

Climate change has significant adverse effects on dairy animals, mainly through increased environmental temperature, irregular rainfall, and extreme weather events. These changes negatively affect animal health, productivity, and overall farm profitability. The major impacts of climate change on dairy animals are discussed below:

a. Heat Stress

Heat stress is one of the most serious consequences of climate change affecting dairy animals, especially in tropical countries like India. When environmental temperature rises above the comfort zone, animals experience physiological stress, which reduces their feed



intake. Lower feed intake leads to insufficient nutrient availability, resulting in decreased milk production and poor growth. Heat stress also affects reproductive performance by causing irregular estrus cycles, reduced conception rate, and increased infertility problems. In addition, animals under heat stress use more energy to maintain normal body temperature, which further reduces milk production and productivity.

b. Reduced Feed Availability

Climate change affects the availability and quality of feed and fodder due to drought, irregular rainfall, and seasonal variations. Reduced rainfall and drought conditions limit the growth of green fodder crops such as maize, sorghum, and berseem. This results in fodder scarcity and increased feed cost. In addition, poor climatic conditions reduce the nutritional quality of fodder by increasing fiber content and reducing digestibility. This negatively affects animal nutrition efficiency and productivity.

c. Increased Disease Risk

Climate change also increases the risk of diseases in dairy animals. Heat stress weakens the immune system, making animals more susceptible to infections and metabolic disorders. Changes in climate also favour the growth and spread of disease-causing organisms and parasites. As a result, animals suffer from more frequent diseases, reduced productivity, and increased veterinary expenses. Therefore, climate change poses a serious threat to dairy animal health and production.

Impact of Climate Change on Feed and Fodder Quality

Climate change has a direct impact on the quality and nutritional value of feed and fodder available for dairy animals. Rising temperatures, drought, and irregular rainfall affect the growth and composition of fodder crops such as maize, sorghum, and berseem. Under heat and water stress conditions, fodder plants produce lower amounts of essential nutrients, particularly protein and energy, which reduces their feeding value. This leads to inadequate nutrient intake by dairy animals and affects their productivity.

In addition, climate stress increases the fiber content of fodder, making it more coarse and less palatable. High fiber content reduces feed intake and slows down digestion in the rumen. As a result, animals are unable to utilize nutrients efficiently. Climate change also reduces fodder digestibility due to increased lignin content, which limits the availability of nutrients to rumen microbes. Poor digestibility results in lower milk production, reduced growth, and poor animal performance.



Therefore, climate change negatively affects both the availability and quality of feed and fodder, making proper nutritional management essential to maintain dairy animal productivity and health.

Nutritional Strategies to Reduce Climate Stress in Dairy Animals

Proper nutritional management plays a crucial role in reducing the negative effects of climate change, especially heat stress, on dairy animals. Providing balanced nutrition helps maintain animal health, productivity, and resistance to stress. The following nutritional strategies can help dairy animals cope with climate stress:

a. Balanced Ration Feeding

Feeding a balanced ration that provides adequate energy, protein, minerals, and vitamins is essential for dairy animals under climate stress. During heat stress, animals reduce feed intake, which lowers nutrient availability. Therefore, providing nutrient-dense and balanced feed ensures that animals meet their nutritional requirements even with lower intake. Adequate energy and protein help maintain body condition, support milk production, and improve overall productivity. Balanced feeding also improves feed efficiency and reduces the negative impact of heat stress on animal performance.

b. Mineral and Vitamin Supplementation

Minerals and vitamins play an important role in improving immunity and helping animals cope with stress conditions. Supplementation of essential minerals such as calcium, phosphorus, zinc, and selenium, along with vitamins like A, D, and E, strengthens the immune system and protects animals from diseases. These nutrients also help reduce the harmful effects of heat stress and improve reproductive performance and productivity.

c. Feeding High-Quality Fodder

Providing high-quality green fodder and good-quality roughage improves digestibility and nutrient availability. Quality fodder ensures better feed intake, efficient digestion, and proper rumen function. This helps maintain milk production, growth, and overall animal health even under adverse climatic conditions. Therefore, feeding high-quality fodder is essential for improving climate resilience in dairy animals.

Heat Stress Condition	Effect on Dairy Animals	Recommended Feeding Strategy
High environmental temperature	Reduced feed intake	Provide nutrient-dense balanced ration
Reduced feed intake	Lower energy and protein intake	Increase energy density of diet



Excessive sweating and panting	Mineral loss	Provide mineral mixture and electrolytes
Reduced rumen activity	Poor digestion	Use probiotics and buffers
Increased body temperature	Heat stress	Provide cool, clean drinking water
Fodder scarcity during drought	Limited feed availability	Use silage, hay, and conserved fodder
Poor quality fodder	Reduced digestibility	Supplement with concentrates and quality green fodder
Weakened immunity	Higher disease risk	Provide vitamins and antioxidants

Use of Climate-Resilient Feed Resources in Dairy Animal Feeding

Climate change has increased the risk of fodder scarcity due to drought, irregular rainfall, and extreme weather conditions. Therefore, the use of climate-resilient feed resources is essential to ensure continuous feed availability for dairy animals. Climate-resilient fodder crops such as sorghum, bajra, and napier grass are more tolerant to drought and high temperatures. These crops can grow well under adverse climatic conditions and provide a reliable source of nutritious fodder throughout the year.

In addition to fodder crops, agro-industrial by-products such as mustard oil cake, rice bran, wheat bran, and molasses can be used as economical alternative feed resources. These by-products are rich in nutrients and help meet the nutritional requirements of dairy animals at a lower cost.

Fodder conservation methods such as silage and hay making are also important climate-resilient strategies. These methods help preserve excess green fodder during the surplus season for use during fodder scarcity. The use of climate-resilient feed resources ensures continuous feed supply, reduces feeding costs, and helps maintain milk production and animal health under changing climatic conditions.

Role of Feed Additives in Reducing Climate Stress

Feed additives play an important role in improving the nutritional status and stress tolerance of dairy animals under changing climatic conditions. Climate change, especially heat stress, negatively affects feed intake, digestion, and overall animal productivity. The use of suitable feed additives such as probiotics, antioxidants, and buffers helps improve animal performance and reduce the harmful effects of heat stress.



Probiotics are beneficial microorganisms that improve rumen health, enhance digestion, and increase nutrient utilization. They help maintain a healthy microbial balance in the rumen, which improves feed efficiency and milk production. Antioxidants such as vitamin E and selenium help protect animal cells from oxidative damage caused by heat stress and strengthen the immune system. Buffers such as sodium bicarbonate help maintain proper rumen pH, which improves digestion and prevents digestive disorders during stress conditions.

Overall, the use of feed additives improves digestion, enhances nutrient utilization, reduces the negative effects of heat stress, and helps maintain animal productivity and health under climate stress conditions.

Importance of Water in Climate Change Management

Water plays a vital role in maintaining the health and productivity of dairy animals, especially under climate change and heat stress conditions. Rising environmental temperatures increase the water requirement of animals, as water is essential for regulating body temperature and maintaining normal physiological functions. Providing clean, fresh, and cool drinking water helps animals dissipate excess body heat through sweating and respiration, which reduces heat stress. Adequate water intake also improves feed consumption and digestion. When animals have access to sufficient clean water, their feed intake increases, which ensures proper nutrient utilization and supports milk production. On the other hand, lack of water or poor-quality water reduces feed intake, milk yield, and overall animal performance.

Therefore, ensuring continuous access to clean and cool drinking water is one of the simplest and most effective strategies to help dairy animals cope with climate stress and maintain productivity under changing climatic conditions.

Conclusion

Climate change has a significant impact on dairy animal productivity by causing heat stress, reducing feed intake, lowering milk production, and affecting animal health and reproduction. Changes in climate also reduce the availability and quality of feed and fodder, which further affects animal performance. However, proper nutritional management is an effective and practical tool to reduce the negative effects of climate stress. Providing balanced ration, mineral supplementation, high-quality fodder, and adequate water helps animals maintain productivity and health under adverse climatic conditions.

Scientific and climate-smart feeding practices improve feed efficiency, enhance immunity, and support sustainable dairy production. The use of climate-resilient feed resources and fodder conservation methods ensures continuous feed availability and reduces



feeding costs. Therefore, farmers should adopt proper nutritional and feeding strategies to improve productivity, increase farm profitability, and ensure sustainable dairy farming under changing climate conditions.

