



Sustainable Livestock Management: NICRA's Climate-Resilient Innovations

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Abstract

Climate change poses significant challenges to the livestock sector, necessitating adaptive strategies for sustainable and resilient animal husbandry. National Innovations in Climate Resilient Agriculture (NICRA), launched by the Indian Council of Agricultural Research (ICAR), focuses on developing technologies to mitigate and adapt to climate-induced stress in agriculture and livestock rearing. This article explores the concept of climate-resilient smart livestock rearing with a special focus on NICRA's innovations. The role of veterinary physiology in ensuring the health, productivity, and adaptability of livestock in fluctuating environments is also discussed.

Keywords: National Innovations in Climate Resilient Agriculture (NICRA); Livestock

Introduction

The livestock sector is vital for food security, rural livelihoods, and economic development, particularly in India. However, climate change, characterized by rising temperatures, erratic rainfall patterns, and increased frequency of extreme weather events, significantly impacts livestock productivity. Heat stress, water scarcity, and the spread of diseases are just a few challenges exacerbated by changing climatic conditions. Therefore, there is an urgent need to adapt livestock rearing practices to be climate resilient.

Climate-resilient smart livestock rearing integrates technology, physiological understanding, and adaptive management to mitigate the adverse effects of climate change on livestock. This article highlights the role of NICRA in developing technologies that enable livestock producers to build climate resilience in

their operations. This article emphasizes the critical physiological aspects influencing livestock adaptation to climate stressors, alongside NICRA's role in fostering innovations for sustainability [2].

Role of veterinary physiology in climate resilience

Understanding the physiological response of livestock to environmental stressors is essential for developing climate-resilient livestock systems. Climate change directly affects the thermoregulation, metabolism, and overall health of animals. Heat stress, for example, leads to altered metabolism, decreased feed intake, and lower reproductive efficiency.

Heat stress adaptation

Livestock species, particularly those in tropical regions like India, must be able to cope with high ambient temperatures. Physiological mechanisms such as sweating, panting, and altering

metabolic rates help animals maintain homeostasis. However, prolonged heat stress can impair immune function, milk yield, and fertility. Research in veterinary physiology can help in selecting heat-tolerant breeds or developing supplements that enhance heat tolerance.

Nutritional modulation

Nutrition plays a vital role in helping livestock cope with environmental stresses. Feed supplements that support antioxidant defense mechanisms or boost energy metabolism during heat stress can improve animal welfare and productivity. Investigations into dietary interventions that promote gut health, immune function, and thermoregulation are critical.

Water management

Climate change affects the availability and quality of water resources, which are crucial for livestock health. Veterinary physiology informs water intake requirements under varying environmental conditions, ensuring that livestock maintain hydration and electrolyte balance, even during extreme heat.

Technologies developed by NICRA for climate resilient livestock rearing

NICRA has been at the forefront of developing climate-resilient technologies for Indian agriculture and livestock. These technologies focus on improving adaptive capacities, reducing climate vulnerability, and increasing productivity in changing climatic conditions. Below are key innovations developed under the NICRA initiative:

Heat stress management technologies

NICRA has developed low-cost shelter modifications, such as improved housing designs with proper ventilation, roofing materials, and sprinkling systems. These shelters help reduce the thermal load on animals, particularly during summer. Portable shades and cooling devices, tailored to Indian conditions, have also been promoted.

Genetic improvement for climate resilience

Selective breeding programs under NICRA focus on improving the genetic potential of livestock for better heat tolerance and disease resistance. Indigenous breeds like Gir, Sahiwal, and Tharparkar have been emphasized for their natural resilience to heat and drought. Additionally, crossbreeding programs with high-

yielding exotic breeds aim to combine productivity with climate resilience [3].

Disease surveillance and management

Climate change influences the epidemiology of livestock diseases, with increased risks of vector-borne diseases due to rising temperatures and changing rainfall patterns. NICRA has developed early warning systems and disease surveillance networks to track the spread of livestock diseases. Vaccination programs and disease management protocols are critical components of this effort.

Feed and fodder security

Ensuring feed availability during extreme weather conditions is crucial for maintaining livestock productivity. NICRA has introduced climate-resilient fodder crops like drought-tolerant grasses and forage species. Additionally, technologies for fodder preservation such as silage and hay-making have been widely disseminated to address seasonal feed scarcity.

Water management strategies

Technologies for improving water use efficiency, such as rainwater harvesting systems, have been implemented under NICRA to ensure a reliable water supply during droughts. NICRA also promotes efficient watering systems to minimize wastage and ensure that livestock have access to clean water.

Livestock insurance

Climate variability increases the risk of livestock mortality due to disasters like floods, droughts, and extreme heat. NICRA has advocated for livestock insurance programs to protect farmers from economic losses, ensuring the sustainability of livestock operations under climate uncertainty [1].

Climate-smart practices promoted by NICRA

In addition to technological innovations, NICRA emphasizes the promotion of climate-smart livestock practices, including:

- **Grazing management:** Rotational grazing practices are encouraged to prevent overgrazing and ensure the sustainability of pasturelands.
- **Integrated farming systems:** Combining livestock rearing with crop production and agroforestry enhances the resilience of farming systems by diversifying income sources.

- **Capacity building:** NICRA conducts extensive training programs to educate farmers on climate-resilient livestock management techniques.

Conclusion

Climate change poses significant risks to the livestock sector, particularly in tropical regions where heat stress, water scarcity, and disease outbreaks are prevalent. However, with advancements in veterinary physiology and the innovative technologies developed under the NICRA program, there is hope for building a climate-resilient livestock system. Combining these physiological insights with NICRA's technological advancements can help safeguard livestock productivity, animal welfare, and rural livelihoods in a changing climate. Continued investment in climate-smart technologies, genetic improvements, and capacity-building efforts will be crucial for the future of sustainable livestock farming in India.

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