

Resilience of Indian cattle

in changing climate

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This article describes the present condition and prospects of India's indigenous cattle breeds within the framework of climate change. It highlights the dwindling numbers of indigenous breeds attributed to the widespread use of exotic semen and a preference for imported breeds, which has eroded the distinctive qualities of our diverse breeds across different agro-climatic regions needed to meet increasing productivity demands. Additionally, it outlines the impact, adaptation mechanisms, and strategic approaches concerning climate change, concluding that urgent measures such as effective breeding practices and conservation initiatives are imperative to safeguard India's unique cattle breeds and fortify their resilience.

Keywords: Attribute, Cattle, Climate, Indigenous, Resilient, Variation

India's livestock sector is diverse, with a total of 536.76 million animals. According to the 20th Livestock Census, there are 193.46 million cattle, including 51.36 million exotic or crossbred breeds, and 142.11 million indigenous or non-descript breeds. Cattle farming is crucial for rural livelihoods and food security. In addition to producing milk, cattle also provide manure, assist with transportation and supply materials like leather. The per capita availability of milk is 459 g/day. In 2022-23, India produced 230.58 million tonnes of milk, with Uttar Pradesh and Andhra Pradesh as the highest and lowest-producing states, respectively. Cow milk contributed 51.91% to the total milk production, with significant contributions from crossbred (29.81%), indigenous (10.73%), non-descript (9.51%), and exotic breeds (1.86%).

The National Bureau of Animal Genetic Resources, Karnal, has registered 54 cattle breeds grouped into milch, draft, and dual-purpose categories. Some notable breeds include Sahiwal, Gir, Ongole, Red Sindhi, Tharparkar, Deoni, and

Haryana. Recently, a new breed called Frieswal was registered as the 54th breed, developed through collaboration between Military Farms and ICAR-Central Institute for Research on Cattle in Meerut. These breeds are well adapted to local conditions and thrive with locally available resources. The best cattle breeds are typically found in dry regions of India like Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, and Karnataka. In contrast, warmer and more humid areas like Assam, West Bengal, Odisha, Bihar, Tamil Nadu, and Kerala often have low-quality, non-descript cattle with lower milk production. Cattle from drier regions tend to be strong and sturdy, while those from wetter regions are usually smaller.

Historically, India has focused more on draft cattle rather than dairy breeds, which explains the scarcity of high-yielding dairy breeds. However, changes in farming practices and diets have shifted the focus toward milk production, leading to a trend of breeding indigenous cattle with high-yielding exotic breeds. Unfortunately, this

trend has resulted in the decline of many indigenous breeds due to favouritism towards imported breeds and the use of exotic semen, threatening India's cattle genetic diversity. To protect indigenous breeds and enhance milk production, there is an urgent need for sustainable breeding practices and responsible breeding policies at both state and national levels. Conservation efforts and research investments are crucial to secure the future of India's unique cattle breeds.

Present status of Indigenous breeds

Breeds such as Gir, Tharparkar, Red Sindhi, Sahiwal, and Rathi are known for producing a lot of milk, and have been the focus of genetic improvement efforts by many State Governments. On the other hand, breeds like Ongole, Haryana, Deoni, and Gaolao are valued for their decent milk production and strong working abilities, making them economically important in their areas and keeping their populations stable. Draught breeds like Kangayam, Khillar, and Kallikar also play important roles



Haryana cattle grazing in the field



Kankrej cattle in the field

in India's cattle diversity. Bargur cattle, famous for their strength in pulling loads, thrive in the tough farming conditions of western Tamil Nadu. The adaptable Badri breed is used for both milk and work in Uttarakhand's rugged landscapes. Similarly, the resilient Kankrej breed perform well in both roles, thriving in Gujarat and Rajasthan's challenging environments. Certain indigenous breeds, such as Ponwar, Siri, Bargur, Krishna Valley, Pullikulam, and smaller breeds like Vechur, Malnad Gidda, and Punganur, are witnessing a decline in their population. This decline is due to various factors including the lack of continuous breed improvement programmes, crossbreeding with exotic breeds, changes in farming methods, economic challenges for farmers, less grazing land, and a focus solely on milk production. Understanding and utilizing the diverse abilities of indigenous cattle breeds is important, and conducting systematic studies to harness their potential effectively is essential.

Special characteristics of Indigenous cattle

Indigenous cattle breeds are known for their impressive qualities, like heat tolerance and the ability to thrive with minimal resources. Zebu cattle, in particular, have a unique way of turning low-quality, high-fibre food into nutritious feed through omasal symbiosis, which is helpful during droughts and food shortages. These cattle can adjust their metabolism based on food availability, becoming more productive when there is plenty to

eat. Their efficient grazing abilities and physical features, like a tight sheath and small teats, prevent injuries while they graze, making them ideal for large farming areas. Additionally, their white or light-coloured coats deter insects and reduce the spread of diseases carried by bugs. Their thick skin texture also protects them from blood-sucking insects. They are well-suited to different climate and can handle extreme temperatures, often grazing in areas as hot as 40°C. Their bodies have a slower metabolism and cool down well by sweating, allowing them to survive longer without food and water, which is useful in drought-prone regions. They also have strong maternal instincts and easy births, with fewer complications. These cattle vary in appearance and have different levels of productivity and reproduction abilities because of their diverse genetics. This diversity allows us to make genetic improvements to livestock. Indigenous cattle eat small amounts of food frequently, producing less body heat which helps them cope with high temperatures better. Most of these cattle produce the A2 allele of milk protein, which is safe for people to drink. This genetic trait aligns with consumer preferences and highlights the importance of indigenous breeds for sustainable farming and food security efforts.

Resilience in animals

Resilience in animals refers to their ability to bounce back and function normally after facing tough conditions, often allowing them to

perform better than expected. This resilience is influenced by both genetics and past experiences of exposure. Traits associated with resilient animals include having long legs, short hair, sweating a lot, large surface area, specific body shape for heat balance, low metabolism, efficient use of food, good dehydration tolerance, fat storage ability, and the capacity to adjust hormones and biochemistry to their surroundings. Livestock farming systems typically handle climate change better than crop farming, which gives hope for improving resilience in all types of livestock. To enhance resilience in livestock, it is crucial to focus on helping them adapt to changes in their environment. This approach aims to support livestock in coping with and thriving in various environmental conditions.

The factors influencing genetic resilience to climate change are complex and involve various interconnected elements. One key factor is the natural genetic diversity found in cattle populations, which helps them adapt to changing environmental conditions. This diversity allows us to select individuals with traits that make them resilient, such as heat tolerance, disease resistance, and efficient nutrient utilization. Additionally, the environment, along with natural selection, plays a role in pushing certain genetic traits that improve survival and reproduction over time. Humans also influence genetic resilience through selective breeding and the use of genomic technologies to enhance desirable traits. The

interaction between genetics and the environment, including factors like temperature, humidity, and disease prevalence, determines which adaptive traits appear in cattle populations. These traits are challenging to study and record, have lower heritability, and are more influenced by environmental conditions. Therefore, preserving genetic diversity is essential to ensure that livestock farming remains resilient and sustainable over time. Measures like establishing breed registries, gene banks, and conservation-focused breeding programmes help prevent genetic erosion, inbreeding issues, and the loss of valuable traits. These efforts not only contribute to sustainable farming and food security but also safeguard cultural traditions, traditional farming methods, and biodiversity.

Impact of climate change on Indian cattle breeds

Climate change poses significant challenges for Indian cattle breeds, impacting their health, productivity, and overall well-being. Rising temperature, increased carbon dioxide level in the air, altered rainfall pattern, and extreme weather events like drought and flood exacerbate heat stress in cattle, leading to reduced food intake, reproductive issues, and higher susceptibility to diseases. Heat stress can also alter cattle behaviour, affecting their grazing habits and energy-use. Additionally, changes in vegetation and water availability make it more difficult for cattle to access nutritious food and clean water, particularly in dry areas. Furthermore, climate-related shifts increase the risk of diseases spread by insects such as ticks and mosquitoes, further endangering cattle health. These climate challenges undermine the resilience of Indian cattle breeds, emphasizing the urgent

need for adaptive strategies and targeted interventions to preserve their genetic diversity and ensure their survival and well-being in a changing climate. However, the success of the indigenous Gir breed, which thrives in diverse climates, has proven its ability to be a good milk producer and tick-resistant in hot regions like Brazil and Australia since the 1920s, alongside Sahiwal. Therefore, recognizing and leveraging the strengths of native cattle breeds is crucial for ensuring sustainable agriculture in the face of ongoing climate change across the globe.

Adaptation mechanisms of cattle due to climate change

Present breeds have developed over centuries and are known to thrive in varied climatic zones, ranging from the arid regions of Rajasthan to the humid coastal areas of Kerala. Their adaptability to changing environmental conditions arises from different traits related to their bodies, behaviour, and appearance. Physiologically, Indian cattle breeds have efficient ways of regulating their body temperature, such as increased sweating and faster breathing to cool down when it is hot. Morphologically, they often exhibit lighter-coloured coats, smaller bodies, and unique physical features that aid in handling heat and grazing in rough terrain. Behaviourally, these breeds adjust their grazing habits by seeking shade during the hottest times and targeting water-rich plants during dry periods. The genetic diversity within these breeds also contributes to a range of adaptive traits. These traits can be leveraged in selective breeding programmes to further enhance their resilience to climate change. Overall, the adaptation mechanisms observed in Indian cattle breeds highlight their suitability for sustainable livestock

farming, even as climate conditions evolve over time.

Strategies for climate-resilient breeding programmes of cattle in India

The primary strategy is to focus on selecting and breeding native cattle breeds in different parts of India to address specific climate challenges. This approach helps identify and preserve genetic traits that enhance heat tolerance, disease resistance, and nutrient utilization efficiency. Involving local communities and stakeholders in breeding programmes also helps preserve and utilize traditional knowledge about cattle rearing. To achieve this goal, integrating traditional knowledge with modern genomic tools like marker-assisted selection is essential. These tools accelerate the identification of beneficial genetic traits, making breeding more efficient. Lastly, promoting the use of climate-smart infrastructure and practices such as improved housing, cooling systems, agro-forestry, and enhanced veterinary care can further enhance cattle health and production resilience.

CONCLUSION

Preserving cattle genetic diversity is vital for ensuring sustainable agriculture and food security amidst climate change. It is imperative to prioritize indigenous breeds that excel in challenging environmental conditions. Moving forward, future initiatives should focus on implementing policy measures such as offering farmer incentives, identifying genetic traits that enhance resilience, and adopting innovative breeding and management practices to enhance adaptability.

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