



## Goats as Climate Resilient Animal and the Benefits of Goat Milk

\*Komal<sup>1</sup>, Kachave Mukund Ramesh<sup>2</sup>, Rajesh Kumar<sup>3</sup> and Amit Kumar<sup>4</sup>

<sup>1</sup>PhD Scholar, Department of Animal Nutrition, ICAR-National Dairy Research Institute, Karnal, Haryana, India

<sup>2</sup>PhD Scholar, Department of Animal Genetics and Breeding, ICAR-National Dairy Research Institute, Karnal, Haryana, India

<sup>3</sup>Assistant professor, Department of Veterinary and Animal Husbandry Extension Education, Mahatma Gandhi Veterinary College, Bharatpur, Rajasthan, India

<sup>4</sup>Assistant professor, Department of Veterinary Biochemistry, Mahatma Gandhi Veterinary College, Bharatpur, Rajasthan, India

\*Corresponding Author's email: [dalalkomal07@gmail.com](mailto:dalalkomal07@gmail.com)

Goats are emerging as one of the most climate resilient livestock species, capable of thriving in drought prone, semi-arid, and harsh environments where other dairy animals struggle. Their unique physiological, behavioral, and metabolic adaptations help maintain milk production even under heat stress, water scarcity and poor-quality fodder. This article explores how goats cope with extreme climates, the scientific basis behind their resilience, and how these attributes influence milk yield and quality. It also highlights the benefits of goat milk as a sustainable dairy option in world.

**Key Words:** Goat, Climate Resilience, Nutrition, Milk production

### Introduction

Climate change is considered to be a major threat to sustainability of livestock production systems throughout the world. The Rising temperatures, erratic rainfall, shrinking grazing lands, and forage scarcity pose serious challenges to dairy animals, particularly high-yielding cattle. In this scenario, goats stand out as “climate-smart dairy animals.” Known for their hardiness and low resource requirements, goats contribute significantly to rural livelihoods and nutrition, especially in arid and semi-arid regions of India, Africa, and West Asia. While cows and buffaloes show marked declines in milk yield under heat or feed stress, goats often continue producing milk even if at moderate levels. Understanding their resilience is essential for farmers, nutritionists aiming to build sustainable dairy systems.

### Why Goats Are Naturally Climate Resilient?

Resilience is the ability of a species to survive and recover from a perturbation/stressful conditions or ability to adapt well in the face of different sources of stress/acquisition of positive. Goats are among the most climate-resilient livestock species, possess remarkable survival traits shaped by evolution in harsh and dry environments. Their ability to survive, produce milk, and reproduce under extreme climatic stress makes them uniquely suited for present day challenges such as rising temperatures, water scarcity and shrinking grazing resources.

#### a. Superior thermoregulation

One of the key reasons for goat's climate resilience is their highly efficient thermoregulatory system. Goats can maintain a relatively stable core body temperature even under intense heat stress. They possess a higher density of sweat glands per unit skin area compared to large ruminants like cattle and buffaloes, which enhances evaporative cooling. In addition, goats

rely on panting as a supplementary heat dissipation mechanism, allowing them to regulate body temperature without excessive metabolic strain. Coat characteristics further support heat tolerance. Dark-coated goats absorb solar radiation during cooler hours, while light-colored coats reflect heat during peak sunlight.

#### b. Low water requirement and efficient water use

Goats are exceptionally efficient in water conservation, making them ideal for drought prone regions. Unlike cattle, goats can tolerate 20–30% loss of body weight due to dehydration without severe physiological disturbances. They have ability to rapidly rehydrate once water becomes available, without causing osmotic imbalance in blood or tissues. This is supported by their efficient renal function which produces highly concentrated urine and their digestive system which excretes dry faeces, minimizing water loss.

#### c. Ability to utilize poor-quality and diverse forage resources

Goats are natural browsers with a highly selective feeding behavior. They can consume a wide range of vegetation, including shrubs, tree leaves, weeds, thorny plants, and drought-resistant species that are typically ignored by other livestock. Goats have a highly adaptable rumen microbial ecosystem capable of degrading fibrous, lignified, and even tannin-rich feeds. Some goat breeds produce salivary proteins that bind tannins, reducing their negative effects on digestion. This enables goats to efficiently extract nutrients from low-quality forages during fodder scarcity.

As a result, goats can sustain milk production and body condition even when conventional green fodder or concentrate feeds are unavailable, making them invaluable under climate-induced feed shortages.

#### d. Smaller body size and energy efficiency

Goats have a smaller body size and lower maintenance energy requirements compared to larger ruminants such as cows and buffaloes. This translates into reduced feed demand, lower metabolic heat production and improved tolerance to thermal stress. Their compact body structure allows better heat dissipation and reduces internal heat load during high ambient temperatures. Furthermore, goats are highly agile and can efficiently move across hilly, rocky, desert and forested terrains, where mechanized farming or larger livestock are impractical. This energy efficiency ensures that a greater proportion of consumed nutrients is diverted towards production and survival rather than maintenance, reinforcing goat's resilience in climate vulnerable regions.

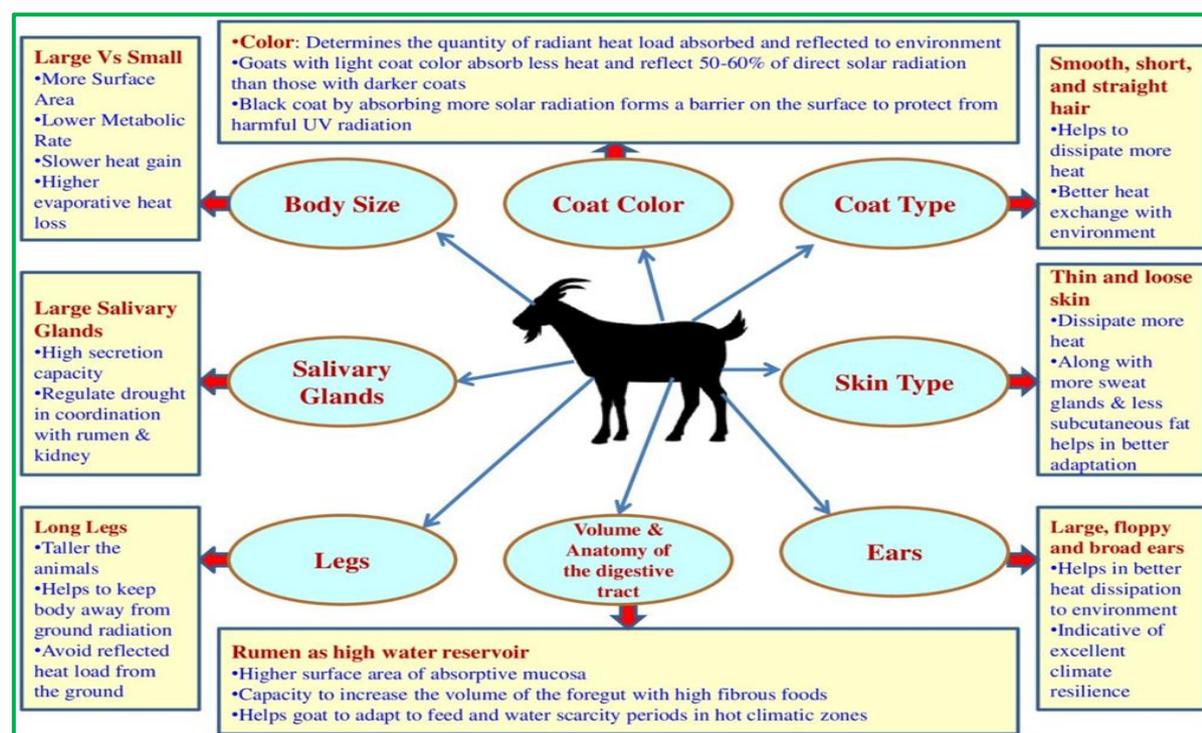


Fig. 1. Morphological characteristics associated with climate resilience in goats

## How Climate Resilience Influences Goat Milk Production?

Climate resilience in goats plays a crucial role in sustaining milk production under rising temperatures, erratic rainfall, and increasing feed and water scarcity. Unlike highly specialized dairy cattle that are sensitive to climatic stress, goats exhibit a combination of physiological adaptability, efficient nutrient utilization and reproductive robustness that allows them to maintain milk output even under challenging environmental conditions.

### a. Stable milk production under heat stress

Heat stress is one of the major constraints to dairy production in tropical and subtropical regions. In high-yielding dairy cows, elevated temperatures often lead to reduced feed intake, negative energy balance, hormonal imbalance and decline in milk yield. Goats, however, show greater tolerance to heat stress, enabling them to sustain relatively stable milk production during hot months. Heat-adapted Indian breeds such as Beetal, Sirohi, Jamunapari, Jakhrana, Barbari etc. are known to perform satisfactorily even when ambient temperatures exceed 40°C. Although a slight decline in milk yield may occur during extreme heat or prolonged drought.

### b. Milk composition remains less affected by climate stress

In addition to maintaining milk yield, goats also preserve milk quality under climatic stress. Goat milk composition tends to remain relatively stable during heat and drought conditions compared to cow milk. Goat milk naturally contains higher proportions of medium-chain fatty acids which are easily digestible and rapidly metabolized for energy. These fatty acids contribute to better digestibility and lower allergenic potential, making goat milk suitable for children, elderly people, and individuals with digestive sensitivities.

### c. Advantage in Drought and Semi-Arid Regions

One of the greatest strengths of goats is their ability to continue lactation during droughts, when cattle often cease milk production or require costly feed supplementation. Goats can survive on sparse vegetation, agricultural by-products, and tree leaves, allowing them to maintain milk secretion even under feed scarcity.

As a result, goat milk serves as:

- A consistent source of nutrition for rural and tribal households
- A buffer against food insecurity during climate extremes
- A reliable option for milk cooperatives operating in arid and semi-arid zones

This makes goat milk particularly valuable in regions where climate variability threatens conventional dairy farming.

### d. Better reproductive efficiency supports consistent milk flow

Goats also exhibit superior reproductive efficiency, which directly supports continuous milk availability. They have shorter generation intervals, higher kidding rates and a faster return to estrus after kidding compared to larger ruminants. These reproductive traits ensure more frequent kidding and lactation cycles, enabling farmers to maintain a steady milk supply throughout the year. Even when individual lactation yields are modest, the cumulative milk production over time remains reliable and economically viable.

### e. Management Practices to enhance milk production under climate stress

Goats are inherently resilient, appropriate management can further enhance milk yield under climatic stress:

#### i. Providing Shade and Cooling

Low-cost sheds, agroforestry plantations, and shade trees reduce heat load. In organized farms, misting or foggers can be used to improve comfort during peak summer.

#### ii. Strategic nutrition

Feeding drought-resistant fodder crops such as bajra, sorghum, subabul etc. along with mineral mixtures and vitamins, helps maintain productivity. Supplementation with bypass protein during lactation supports milk synthesis under stress conditions.

#### iii. Clean and adequate water access

Ensuring continuous access to clean drinking water improves feed intake, milk yield, and thermoregulation.

#### iv. Health and Parasite Control

Heat stress compromises immunity. Regular deworming, vaccination and ectoparasite control are essential to sustain milk production.

#### Benefits of Goat Milk

As climate change intensifies, goat milk is gaining global importance due to its nutritional, environmental, and socio-economic advantages. Goat milk is easy to digest because of its smaller fat globules and favorable protein profile, making it suitable for children, elderly people, and individuals with mild lactose intolerance or milk sensitivity. It is also rich in bioactive compounds, essential minerals, medium-chain fatty acids, and vitamins that support gut health, immunity, and metabolic functions. Goat milk serves as an excellent raw material for a wide range of value-added products such as cheese, yogurt, ice cream, ghee, infant foods, and nutraceutical formulations, thereby enhancing its commercial potential. In urban areas, goat milk is increasingly perceived as a health food and positioned as a premium product rather than a subsistence commodity. For smallholders, women farmers, and landless families, goat dairying offers a sustainable, low-risk, and climate-smart livelihood option with quick returns, year-round income, and minimal investment. Goats play a crucial role in enhancing nutritional security, employment generation, and resilience against climate-induced production shocks. Today, goat milk is no longer viewed as “poor man’s milk”; instead, it is emerging as a health conscious, environmentally sustainable, and future-ready dairy solution capable of addressing the dual challenges of nutrition security and climate change across the world

#### Conclusion

Goats represent one of the most climate-resilient livestock species, capable of maintaining milk production where cows and buffaloes struggle. Their thermoregulatory efficiency, browsing ability, drought tolerance, and stable milk composition make them ideal dairy animals for world. With proper management, breed selection, and support from dairy development programs, goat-based dairying can play a crucial role in ensuring food security, nutrition, and sustainable livelihood especially in climate-vulnerable regions. As climate change continues to impact agriculture, investing in goat milk production is not just practical, it is a scientifically sound and future ready approach.

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