# IMPACT OF TEMPERATURE AND RAINFALL VARIABILITY ON FODDER AVAILABILITY AND ITS CONSEQUENCES ON LIVESTOCK NUTRITION IN JHAJJAR

**Monika**
Research Scholar, Department of Zoology, Shri JJT University, Jhunjhunu, Rajasthan, India.

**Dr. Imran Khan**
Research Guide, Department of Zoology, Shri JJT University, Jhunjhunu, Rajasthan, India.

## Abstract
*This study investigates the impact of temperature and rainfall variability on fodder availability and the resulting consequences for livestock nutrition in the district. Jhajjar experiences a semi-arid climate, making its fodder production highly sensitive to climatic fluctuations. Rising temperatures and erratic rainfall patterns have led to decreased pasture yields, shortened growing seasons, and a shift in fodder crop composition. These changes have significantly reduced the quantity and nutritional quality of available fodder, adversely affecting livestock health, milk yield, and overall productivity. Smallholder farmers, who rely heavily on rain-fed fodder sources, are disproportionately affected. The study emphasizes the urgent need for adaptive strategies, including climate-resilient fodder crops, improved storage techniques, and policy support for sustainable fodder management. Addressing these challenges is vital for securing livestock-dependent livelihoods and ensuring food security in climate-vulnerable regions like Jhajjar.*

***Keywords:*** *Temperature variability, Rainfall variability, Fodder availability, Livestock nutrition, Climate change, Jhajjar, Haryana*

## Introduction
Agriculture and livestock rearing form the backbone of rural livelihoods in India, particularly in semi-arid regions like Jhajjar district in the state of Haryana. Among the critical challenges facing livestock farmers in this region is the increasing variability in climate parameters, especially temperature and rainfall. Climate variability has emerged as a significant threat to the sustainability of livestock production systems, largely due to its direct impact on fodder availability. In Jhajjar, where a majority of livestock depend on rainfed fodder resources, erratic rainfall patterns and rising temperatures have drastically affected the quantity and quality of available forage. This, in turn, has serious implications for livestock health, productivity, and rural economic stability.

Fodder availability is intrinsically linked to climatic conditions. In regions like Jhajjar, where agricultural and fodder crops are largely dependent on monsoonal rainfall, any deviation from normal rainfall patterns—such as delayed onset, early withdrawal, or prolonged dry spells—can significantly reduce fodder yields. Similarly, increased temperature not only affects crop physiology but also accelerates soil moisture evaporation, leading to reduced pasture growth and lower biomass accumulation. The interplay between these climatic factors and traditional fodder production practices has led to a precarious situation where livestock farmers face chronic shortages of green and dry fodder during critical periods of the year.

The consequences of reduced fodder availability are manifold. Nutritional stress in livestock becomes evident in the form of reduced body weight, decreased milk production, lower reproductive performance, and increased susceptibility

to diseases. Malnourished animals are less productive and require longer recovery periods, which translate into reduced incomes for farmers and heightened food insecurity for rural households. Moreover, the pressure to meet livestock nutritional needs during periods of fodder scarcity often compels farmers to purchase commercial feed, further burdening their already strained financial resources. In extreme cases, it forces distress sale of animals or even abandonment of livestock farming altogether.

Understanding the relationship between climatic variability and fodder availability is therefore crucial for formulating effective mitigation strategies. It calls for a comprehensive assessment of how changing temperature and rainfall patterns are influencing forage production across seasons, the adaptive capacities of local farming systems, and the broader socio-economic repercussions on livestock-dependent communities. Jhajjar serves as a representative case where traditional knowledge and scientific insights must converge to develop context-specific interventions such as climate-resilient fodder crops, improved pasture management, water conservation techniques, and early warning systems for droughts.

This study aims to explore the dynamic interactions between temperature and rainfall variability and their impact on fodder availability in Jhajjar district. It also seeks to analyze the consequent effects on livestock nutrition and overall farm productivity. Through this exploration, the paper endeavors to inform policy decisions and support climate adaptation planning in livestock farming systems, thereby contributing to the resilience and sustainability of rural livelihoods in the face of climate change.

**Climate Trends in Jhajjar**

**Temperature Variability**

Jhajjar has been experiencing gradual warming, with average summer temperatures crossing 45°C during peak months. Winters are becoming shorter and warmer. The increase in night-time temperatures, crucial for plant recovery and growth, has disrupted crop cycles. According to long-term meteorological data, the region has seen a consistent increase in mean annual temperatures over the past three decades.

**Rainfall Patterns**

Rainfall in Jhajjar is characterized by high inter-annual variability and a heavy reliance on the southwest monsoon (June–September), which contributes around 70–80% of the annual precipitation. However, rainfall distribution has become increasingly erratic—short spells of high-intensity rain are replacing long-duration moderate rainfall events. Late onset and early withdrawal of monsoons further exacerbate water scarcity and reduce the growing window for fodder crops.

**Climate Variability in Jhajjar**

Jhajjar has been experiencing notable changes in climatic patterns over the last few decades. Temperature records suggest an upward trend in both average and extreme temperatures. Summers have become hotter, with daytime temperatures often soaring above 45°C, while winters are becoming milder. Simultaneously, rainfall patterns have shifted, with monsoon rains becoming increasingly erratic. There are years of deficient rainfall followed by instances of unseasonal or excessive precipitation, which leads to

poor germination, stunted growth, or even complete crop failure of fodder varieties.

This variability has significant implications for the region's agricultural calendar. The sowing and harvesting windows for fodder crops are sensitive to weather patterns, and deviations from expected norms can disrupt the entire cycle of production. For instance, a delayed monsoon may postpone sowing, reducing yields, while unexpected rains during harvesting can lead to post-harvest losses through spoilage and fungal infestation. Such factors reduce the quantity of available green fodder and diminish its nutritive value, compounding the challenges for livestock farmers.

**Fodder Availability and Livestock Nutrition**

Fodder is the cornerstone of livestock productivity. It ensures not only maintenance but also optimal growth, reproduction, and milk yield. In Jhajjar, where traditional grazing grounds have diminished due to urbanization and land use changes, stall-feeding using cultivated or collected fodder is increasingly the norm. Hence, any fluctuation in fodder availability directly affects livestock nutrition.

Climate-induced shortages of green and dry fodder have forced many farmers to depend on alternative feed sources such as commercial concentrates. However, such feed is often unaffordable for marginal and small-scale farmers, leading to underfeeding and malnutrition among livestock. Chronic under nutrition in animals manifests as reduced milk yield, poor body condition, increased disease susceptibility, and lower reproductive performance—all of which translate into economic losses for farming households.

Moreover, livestock nutritional needs vary by species, age, physiological status (e.g., lactating vs. non-lactating), and workload. A shortfall in essential nutrients—particularly energy, protein, and minerals—due to poor-quality fodder directly undermines livestock performance. This concern is exacerbated during lean seasons, particularly summer and late winter, when green fodder is scarce. These seasons are increasingly being extended or made more erratic due to climate variability, putting further pressure on fodder systems.

**Research Methodology**

The study was conducted in Jhajjar district of Haryana, India, a region characterized by a semi-arid climate, with agriculture and livestock farming forming the primary livelihood sources. The district typically experiences hot summers, mild winters, and variable rainfall, making it an ideal case for studying climate-induced variability in fodder production. Daily and monthly temperature and rainfall data from 2005 to 2023 were collected from the Indian Meteorological Department (IMD) and State Agriculture Department records.

Livestock nutrition indicators including body condition score (BCS), milk yield, and weight gain were collected seasonally from sample households and veterinary clinics. A sample size of 300 livestock animals (buffaloes, cows, and goats) was monitored.

**Results and Discussion**

**1. Climate Variability in Jhajjar**

Table 1: **Rainfall and Temperature Trends (2005–2023)**

| **Parameter** | **Mean (2005–** | **Mean (2011–** | **Mean (2017–** | **Trend** |
|---|---|---|---|---|

| | 2010) | 2016) | 2023) | |
|---|---|---|---|---|
| Annual Rainfall (mm) | 510 | 480 | 455 | Decreasing ↓ |
| Mean Max Temp (°C) | 34.5 | 35.2 | 36.1 | Increasing ↑ |
| Mean Min Temp (°C) | 15.4 | 15.9 | 16.5 | Increasing ↑ |

Rainfall in Jhajjar showed a decreasing trend, especially during the Kharif season. Temperature showed a consistent rise over the years, particularly in summer months. This shift has shortened the growing period for fodder crops like sorghum, bajra, and berseem.

**2. Impact on Fodder Availability**

Table 2: **Seasonal Fodder Yield Trends (tonnes/hectare)**

| Crop | 2005 – 2010 | 2011 – 2016 | 2017 – 2023 | % Decrease |
|---|---|---|---|---|
| Sorghum | 22.5 | 19.6 | 17.2 | 23.5% |
| Bajra | 18.4 | 16.1 | 14.3 | 22.3% |
| Berseem | 28.2 | 25.3 | 21.7 | 23.0% |

All major fodder crops witnessed a decline in yield, largely due to erratic rainfall and increased heat stress. Sorghum and bajra, grown in summer, were particularly affected due to shortened rainy periods and delayed monsoons.

**3. Correlation between Climate and Fodder Yield**

Table 3: **Correlation between Rainfall, Temperature, and Fodder Yield**

| Variable Pair | Correlation Coefficient (r) | Significance |
|---|---|---|
| Rainfall vs Sorghum Yield | +0.78 | $p < 0.01$ |
| Max Temp vs Berseem Yield | -0.69 | $p < 0.05$ |
| Rainfall Variability Index | -0.52 | $p < 0.05$ |

There is a strong positive correlation between rainfall and fodder yield. Conversely, increased maximum temperature negatively impacted berseem, a rabi crop sensitive to temperature stress during flowering.

**4. Consequences on Livestock Nutrition**

Table 4: **Average Milk Yield and Body Condition Score (BCS)**

| Season | Milk Yield (L/day) | BCS (1-5 scale) |
|---|---|---|
| Monsoon | 7.2 | 3.4 |
| Winter | 6.4 | 3.2 |
| Summer | 5.1 | 2.8 |

Livestock suffered seasonal nutritional stress, particularly in the summer months, when fodder scarcity coincided with high temperatures. Milk yields were 22–30% lower in summer compared to monsoon due to decreased dry matter intake and heat stress.

**5. Farmer Perception and Adaptive Practices**

Table 5: **Adaptation Strategies Adopted by Farmers (% Respondents)**

| Adaptation Strategy | % Adoption |
|---|---|
| Fodder preservation (silage) | 38% |

| | |
|---|---|
| Use of fodder crops hybrids | 42% |
| Crop diversification | 27% |
| Use of mineral supplements | 33% |
| Migration or herd reduction | 16% |

FGDs revealed that while awareness of climate impacts is high, adaptation is constrained by cost, landholding size, and lack of extension support. Some progressive farmers used silage pits and hybrid fodder seeds, but most relied on crop residues, which are low in nutritional value.

**Discussion**

The findings show that temperature rise and rainfall irregularity have significantly impacted fodder production in Jhajjar. The direct link between declining fodder availability and livestock productivity demonstrates a fragile agro-livestock system highly sensitive to climate shocks.

While rainfed areas face higher deficits, irrigated zones are not immune—due to rising input costs and evapotranspiration losses. Livestock nutrition has worsened, with significant declines in milk yield, weight gain, and reproductive performance noted in focus group discussions.

Moreover, traditional feeding systems based on grazing and crop residues are increasingly inadequate, especially for high-yielding breeds. The study also highlights a gender dimension, as women, often primary caretakers of livestock, reported increased drudgery and time burden in sourcing fodder.

**Conclusion**

The variability in temperature and rainfall has a significant impact on fodder availability in Jhajjar, a region heavily reliant on agriculture and livestock. Unpredictable weather patterns, including prolonged dry spells and erratic rainfall, have led to reduced pasture productivity and irregular fodder supply. This directly affects livestock nutrition, resulting in lower milk yields, poor animal health, and increased susceptibility to diseases. Small and marginal farmers, who form the backbone of Jhajjar's rural economy, are particularly vulnerable to these climatic challenges. Addressing this issue requires a multifaceted approach, including the promotion of climate-resilient fodder crops, improved storage techniques, efficient water management, and extension services for farmers. Building adaptive capacity and resilience among livestock-dependent communities is crucial to sustaining livestock productivity and ensuring food security in the face of ongoing climate variability.

**References**

1. *Aggarwal, P. K., & Mall, R. K. (2002). Climate change and rice yields in diverse agro-environments of India. Environmental Modeling & Assessment, 7(2), 81–100.*
2. *Bhatt, B. P., Singh, R. D., & Roy, S. S. (2012). Impact of climate change on fodder productivity in Indian Himalayas. Indian Journal of Animal Nutrition, 29(3), 239–245.*
3. *Birthal, P. S., Jha, A. K., Taneja, V. K., & Thorpe, W. (2006). Smallholder livestock production in India: Opportunities and challenges. Proceedings of the International Conference on Livestock Services for the Poor, 5–6 December 2006, Nairobi, Kenya.*
4. *Datt, C., & Pathak, N. N. (2004). Impact of seasonal variation on the nutrient composition of fodder in Jhajjar district, Haryana. Indian Journal of Animal Sciences, 74(12), 1300–1303.*
5. *Dhaka, B. L., & Chayal, K. (2010). Farmers' perception and adaptation strategies in climate change. Indian Research Journal of Extension Education, 10(3), 114–117.*
6. *Ghosh, P. K., & Mohanty, M. (2012). Climatic variability and fodder crop productivity in*

*semi-arid tropics of India. Indian Journal of Agricultural Sciences, 82(10), 859–863.*

7. *Khan, S. A., Khan, M. A., & Mir, M. R. (2020). Climate change and its impact on livestock and fodder production in India. Journal of Pharmacognosy and Phytochemistry, 9(2), 195–199.*
8. *Raju, S. S., & Chand, R. (2008). Climate change and its implications for livestock and fodder production in India. Policy Paper, National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi.*
9. *Sirohi, S., Michaelowa, A., & Dash, S. K. (2005). Economic impact of climate change on agriculture in India: A Ricardian approach. Global and Planetary Change, 57(3–4), 229–244.*
10. *Thornton, P. K., van de Steeg, J., Notenbaert, A., & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. Agricultural Systems, 101(3), 113–127.*