International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 21-06-2026, Accepted: 22-07-2026, Published: 06-08-2026
Volume 11, Issue 3, 2026, Page No. 253-256

Sustainable sericulture for climate resilience: Emerging practices and adaptive strategies

Anitha H R
Department of Zoology, Tara Government College (Autonomous), Sangareddy, Telangana, India

Abstract
Sericulture is an important agro-based rural enterprise that provides sustainable livelihood opportunities and contributes significantly to employment generation, income diversification, and rural economic development. In India, sericulture plays a vital role in several states, including Telangana, where it serves as an important source of income and employment for small and marginal farming households. The state's favorable agro-climatic conditions have supported the expansion of mulberry cultivation and silkworm rearing; however, the sector has become increasingly vulnerable to climate variability and extreme weather events. As a climate-sensitive production system, sericulture depends on favorable environmental conditions for successful mulberry cultivation and silkworm rearing. Variations in temperature, humidity, rainfall, and seasonal patterns directly influence mulberry growth, leaf quality, silkworm health, cocoon productivity, and silk quality. The increasing frequency of climate-related stresses, including rising temperatures, erratic rainfall, prolonged droughts, and extreme weather events, has emerged as a major challenge to the sustainability of the sericulture sector. In Telangana, these climatic changes have affected mulberry productivity, increased the incidence of pests and diseases, and reduced cocoon yield and quality, thereby impacting the livelihoods of sericulture farmers. Promoting sustainable sericulture through climate-resilient approaches has therefore become a strategic priority. Emerging practices such as the cultivation of climate-resilient mulberry varieties, efficient water and nutrient management, integrated pest and disease management, precision farming, agroforestry-based production systems, and the adoption of digital climate advisory services can enhance the adaptive capacity of sericulture. Consequently, sustainable sericulture offers a practical pathway for enhancing climate resilience while supporting ecological sustainability, economic stability, and rural livelihoods, particularly in sericulture-producing regions such as Telangana.

Keywords: Sustainable sericulture, climate change, adaptive strategies and Telangana state

Introduction

Agriculture remains a fundamental sector of the global economy, particularly in developing countries include India where it supports food security, rural livelihoods, and economic development. Beyond conventional crop and livestock production, agriculture encompasses several allied sectors, including horticulture, fisheries, apiculture, and sericulture, all of which contribute to income diversification and sustainable rural employment (Popkin BM *et al*.,2012) [17]. Sericulture is intrinsically linked to climatic conditions, making it one of the most climate-sensitive agricultural enterprises (Zhang Y. 2018) [27]. The successful cultivation of mulberry and rearing of the silkworm (*Bombyx mori* L.) depend on stable environmental conditions, particularly optimum temperature, relative humidity, rainfall distribution, and seasonal patterns (Manisankar G, *et al*., 2008)) [14]. These climatic factors regulate mulberry growth, leaf nutritional quality, silkworm physiology, cocoon formation, and ultimately silk productivity. Even minor deviations from the optimum environmental conditions can adversely affect the biological performance of both the host plant and the silkworm, leading to reduced cocoon yield and inferior silk quality (Lesk C *et al*.,2016) [12]. the increasing impacts of climate change, characterized by rising temperatures, erratic rainfall, prolonged droughts, and frequent extreme weather events, have intensified the vulnerability of sericulture production systems (Zandalinas SI *et al*., 2021) [26]. In major sericulture-producing regions, including Telangana, changing climatic conditions have become an important constraint to sustainable silk production, highlighting the need for resilient production systems.

The integration of these adaptive strategies not only minimizes climate-related production risks but also improves resource-use efficiency, environmental sustainability, and the long-term economic viability of the sericulture sector. Consequently, adopting climate-resilient and sustainable sericulture practices is essential for ensuring stable silk production while strengthening the livelihoods of farming communities under changing climatic conditions. Climatic variables such as temperature, rainfall, relative humidity, and atmospheric carbon dioxide concentration play a decisive role in determining agricultural productivity by influencing crop growth, soil health, pest and disease dynamics, and the performance of beneficial insects. Anthropogenic emissions of greenhouse gases, particularly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), have accelerated global climate change, resulting in a steady rise in average surface temperatures and an increase in the frequency of extreme weather events. Climate projections indicate that continued warming will intensify environmental variability, posing significant challenges to climate-sensitive agricultural systems. Climate variability in Telangana including heat waves, drought, and irregular rainfall reduces mulberry productivity and silkworm performance. Climate-resilient cultivars, efficient water management, improved rearing, integrated pest management (IPM), and climate-based advisories are essential for sustainable sericulture and farmer livelihoods.

Material and Methods

Climate Change and Its Impacts on Sericulture

Climate change has become a major challenge to sustainable sericulture worldwide. Rising temperatures, irregular rainfall, prolonged droughts, heat waves, and changing humidity patterns adversely affect mulberry cultivation and silkworm rearing (Rahmathulla, V. K. 2012) [19, 20]. These climatic changes reduce mulberry leaf yield and quality, impair silkworm growth and cocoon production, and increase the incidence of pests and diseases. In Telangana, climate variability has become more pronounced, with frequent heat waves, erratic monsoon rainfall, and extended dry periods. These conditions reduce mulberry productivity and expose silkworms to heat and humidity stress, leading to lower cocoon yield and silk quality (Natikar P *et al*., 2023) [15]. Therefore, adopting climate-resilient mulberry varieties, efficient water management, improved rearing technologies, integrated pest and disease management, and climate-based advisory services is essential to enhance resilience, sustain cocoon production, and improve the livelihoods of sericulture farmers (Bhat MR *et al*., 2024) [1].

1. Stress Factors Affecting Mulberry Host Plants

Mulberry growth is highly sensitive to climatic stress. High temperatures, drought, irregular rainfall, waterlogging, and strong winds reduce leaf yield, moisture, and nutritional quality, leading to poor silkworm growth and lower cocoon production. Excess moisture also increases the risk of root diseases and pest infestation, further affecting mulberry productivity. In Telangana, frequent heat waves, prolonged dry spells, and erratic monsoon rainfall intensify these stresses, making mulberry cultivation more vulnerable (Sarma K *et al*., 2025 & Das SK, *et al*., 2020) [3, 22]. Sustainable adaptation measures, including climate-resilient mulberry varieties, efficient irrigation, soil moisture conservation, and improved crop management, are essential to maintain leaf quality and ensure stable silk production.

2. Physiological Stress in Silkworms under Climate Variability

Silkworms are highly sensitive to changes in temperature and humidity. Heat stress, low or high humidity, and poor ventilation reduce feeding, growth, cocoon weight, shell quality, and silk yield while increasing disease incidence and larval mortality (Khan, M. M. 2014) [11]. These effects are most severe during the late larval stages (Sisodia, N. S *et al.*, 2017) [24]. In Telangana, rising summer temperatures and fluctuating humidity frequently expose silkworms to thermal stress. Therefore, maintaining optimal rearing conditions through climate-controlled rearing houses, proper ventilation, humidity regulation, and heat-tolerant silkworm breeds is essential for improving cocoon production and silk quality (Nath, B. B. 2025) [16].

3. Biological of Mulberry to Climate Stress

Mulberry plants respond to heat and drought through physiological and biochemical adaptations, including improved water-use efficiency, antioxidant activity, and stress-responsive gene expression. Climate-tolerant varieties maintain better growth, leaf quality, and productivity under adverse environmental conditions (Li R, *et al.,* 2022) [13]. Developing and promoting climate-resilient mulberry cultivars with improved tolerance to heat and drought is an effective strategy for sustaining leaf production and supporting stable silkworm rearing under changing climatic conditions, particularly in Telangana.

4. Impact of Environmental Variability on Sericulture

Environmental variability significantly influences sericulture by affecting mulberry growth and silkworm rearing. Climatic factors such as temperature, humidity, rainfall, and seasonal changes determine leaf quality, silkworm development, cocoon yield, and silk quality. As mulberry leaves are the only food source for silkworms, any adverse effect on mulberry cultivation directly reduces silkworm productivity and overall silk production (Debnath A *et al*., 2022) [4]. In Telangana, increasing climate variability highlights the need for climate-resilient and sustainable sericulture practices. Temperature is a key factor affecting sericulture. High temperatures reduce mulberry leaf quality and cause heat stress in silkworms, leading to poor feeding, slower growth, increased larval mortality, and lower cocoon and silk quality. Low temperatures delay larval development and extend the rearing period. Maintaining optimal temperature through climate-resilient rearing practices is essential for improving cocoon production and silkworm health, particularly under the changing climatic conditions of Telangana.

5. Improved Silkworm Rearing Infrastructure

Improved rearing infrastructure helps minimize the effects of climate variability on silkworm production (Sekarappa, B. M *et al.,* 2009) [27]. Climate-controlled rearing houses with proper ventilation, humidity regulation, sanitation, and regular disinfection maintain optimal conditions for silkworm growth, reduce disease incidence, and improve cocoon quality. Adoption of modern rearing equipment and hygienic practices further enhances productivity (Rahmathulla VK *et al*., 2012) [19, 20].

6. Integrated Pest and Disease Management

Integrated pest and disease management (IPDM) is essential for sustainable sericulture. Regular monitoring, early disease detection, resistant mulberry varieties, biological control agents, and eco-friendly pest management practices help reduce pest and disease outbreaks. Combining these approaches improves mulberry health, silkworm survival, cocoon yield, and environmental sustainability, particularly under changing climatic conditions in Telangana.

Table 1: Major climatic factors affecting sericulture and climate-resilient adaptation strategies with relevance to Telangana

Climatic factor	Impact on sericulture	Climate-resilient adaptation strategies	Relevance to Telangana
Temperature (mean temperature, heat waves, and extreme events)	High temperatures reduce mulberry leaf quality, impair silkworm growth, increase larval mortality, and lower cocoon yield and silk quality.	Use heat-tolerant mulberry, cooling systems, and seasonal rearing to reduce heat stress.	Summer heat in Telangana lowers mulberry productivity and silkworm survival.
Relative humidity	Unsuitable humidity impairs silkworm growth, promotes disease, and lowers cocoon quality.	Maintain optimal humidity through ventilation and monitoring.	Seasonal humidity extremes in Telangana reduce cocoon quality and increase disease.
Rainfall, drought, and soil moisture	Climate extremes reduce mulberry productivity and disrupt silkworm rearing.	Water-saving irrigation, mulching, and drought-tolerant mulberry.	Irregular rainfall and drought in Telangana make water conservation essential for sericulture.
Atmospheric CO_2 and other greenhouse gases	Climate change affects mulberry quality, pests, and diseases, reducing silk production.	Climate-smart practices and continuous crop monitoring.	Warming temperatures may alter mulberry growth and pest occurrence.
Photoperiod and light intensity	Light regulates silkworm development and cocoon spinning; unsuitable conditions reduce productivity.	Optimize lighting and rearing timing.	Seasonal daylight and summer heat require optimized silkworm rearing in Telangana.
Air movement and wind	Wind lowers leaf quality, and poor airflow promotes disease.	Windbreaks, proper ventilation, and climate-controlled rearing	Hot summer winds reduce mulberry leaf quality in Telangana.

Result and Discussion

The results indicate that climate variability has a significant influence on mulberry cultivation and silkworm rearing, directly affecting cocoon yield and silk quality (Talukdar, M., *et al.,* 2025) [25]. Among the climatic factors, temperature appears to be the most critical, as high temperatures and heat waves reduce mulberry leaf quality, increase larval mortality, and lower cocoon production. These effects are particularly evident in Telangana, where prolonged summer temperatures frequently exceed the optimum range for silkworm rearing (Jordan, N. 2002) [9]. Relative humidity is another important environmental factor influencing silkworm health. Both low and high humidity adversely affect larval growth, cocoon formation, and disease incidence. Maintaining optimum humidity through proper ventilation and environmental monitoring can substantially improve cocoon quality and reduce disease outbreaks (Hussain, M *et al*., 2011) [7, 8]. Rainfall variability, prolonged drought, and declining soil moisture also pose major challenges to sustainable sericulture. Water scarcity reduces mulberry leaf yield and nutritional quality, while excessive rainfall disrupts field management and silkworm rearing (Ravindra, B *et al.,* 2018) [21]. Therefore, water-efficient practices such as drip irrigation, mulching, and drought-tolerant mulberry varieties are essential adaptation strategies, especially in Telangana where irregular monsoon rainfall is common (Biram, S.N.M., *et al*., 2009) [2]. Climate change associated with increasing atmospheric CO_2 and greenhouse gases further alters mulberry growth and favours pest and disease outbreaks, indirectly reducing silk productivity. Climate-smart farming practices and continuous crop monitoring are therefore necessary to minimize these risks (Habib-ur-Rahman *et al*., 2022) [5]. Photoperiod and light intensity regulate silkworm feeding, growth, and cocoon spinning (Pandey, P *et al.*, 2008) [18]. Seasonal changes in daylight, together with high summer temperatures, require optimized rearing schedules to maintain productivity (Hussain, M *et al*., 2011b) [7, 8]. Similarly, strong winds reduce leaf moisture and quality, while poor ventilation in rearing houses promotes disease development. Windbreaks, adequate ventilation, and climate-controlled rearing facilities help create favourable conditions for silkworm growth (Kaushik, A*et al*., 2025) [10]. Overall, the findings demonstrate that climate-resilient sericulture requires an integrated approach combining climate-tolerant mulberry varieties, efficient water management, improved rearing infrastructure, environmental monitoring, and integrated pest and disease management. These measures are particularly important for Telangana, where increasing climate variability threatens the sustainability and profitability of sericulture. Adoption of these strategies can improve cocoon yield, enhance farmer income, and strengthen long-term resilience of the sericulture sector (Hultgren, A., *et al.*, 2025) [6].

Conclussion

Climate change has emerged as a major challenge to sustainable sericulture by affecting mulberry cultivation, silkworm health, cocoon production, and silk quality. Rising temperatures, irregular rainfall, drought, humidity fluctuations, and other climatic stresses reduce productivity and increase the incidence of pests and diseases. These impacts are particularly evident in Telangana, where climate variability threatens the livelihoods of small and marginal sericulture farmers. The review highlights that climate-resilient strategies including the use of heat- and drought-tolerant mulberry varieties, efficient water management, climate-controlled silkworm rearing, integrated pest and disease management, and climate-smart farming practices—can substantially improve the resilience of sericulture production systems. In addition, environmental monitoring, precision farming, and climate-based advisory services can support timely management decisions and reduce production risks. Overall, sustainable sericulture provides an effective pathway for improving cocoon productivity, conserving natural resources, enhancing rural livelihoods, and ensuring the long-term resilience of the sericulture sector, particularly in climate-vulnerable regions such as Telangana.

References

1. Bhat MR, Radha P, Faruk AA, Vas M, Brahma D, Bora NR, *et al*. Climate change and its impact on sericulture. International Journal of Zoology and Applied Biosciences,2024:9(4):13-25.
2. Biram SNM, Tribhuwan S, Beera S. Occurrence of unfertilized eggs in the mulberry silkworm, *Bombyx mori* L. (Lepidoptera: Bombycidae). International Journal of Industrial Entomology,2009:18:1-7.
3. Das SK, Sahu BK, Singh D. Host plant diversity of non-mulberry silkworms: a review. Journal of Pharmacognosy and Phytochemistry,2020:9(3):109-113.
4. Debnath A. Hormonal crosstalk and signal transduction mechanisms regulating plant reproductive development. Agricultural Reviews, 2022. https://doi.org/10.51470/AR.2022.1.1.05
5. Habib-ur-Rahman M, Ahmad A, Raza A, Hasnain MU, Alharby HF, Alzahrani YM, *et al*. Impact of climate change on agricultural production; issues, challenges, and opportunities in Asia. Frontiers in Plant Science,2022:13:925548. https://doi.org/10.3389/fpls.2022.925548
6. Hultgren A, Carleton T, Delgado M, Gergel DR, Greenstone M, Houser T, *et al*. Impacts of climate change on global agriculture accounting for adaptation. Nature,2025:642(8068):644-652. https://doi.org/10.1038/s41586-025-09085-w
7. Hussain M, Muhammad N, Khan SA, Bhatti MF, Muhammad M. Studies on the influence of temperature and humidity on biological traits of silkworm (*Bombyx mori* L.; Bombycidae). African Journal of Biotechnology,2011:10(57):12368-12375.
8. Hussain M, Naeem M, Khan SA, Bhatti MF, Munawar M. Studies on the influence of temperature and humidity on biological traits of silkworm (*Bombyx mori* L.; Bombycidae). African Journal of Biotechnology,2011:10(57):12368-12375.
9. Jordan N. Studies on the effect of varied temperature on silkworm various stages: an important laboratory tool. In: Tazima Y, editor. The Silkworm. Tokyo: Kodansha Ltd; 2002. p.121-157.
10. Kaushik A, Borah G, Saikia S, Kaushiki B, Phukan T. Climate-resilient sericulture: strategies for sustainable silk production in a changing climate. International Journal of Advanced Biochemistry Research,2025:9:891-897.
11. Khan MM. Effects of temperature and R.H. % on commercial characters of silkworm (*Bombyx mori* L.) cocoons in Anantapuramu district of AP, India. Research Journal of Agricultural and Forestry Sciences,2014:2(11):1-3.
12. Lesk C, Rowhani P, Ramankutty N. Influence of extreme weather disasters on global crop production. Nature,2016:529(7584):84-87.
13. Li R, Su X, Zhou R, Zhang Y, Wang T. Molecular mechanism of mulberry response to drought stress revealed by complementary transcriptomic and iTRAQ analyses. BMC Plant Biology,2022:22(1):36.
14. Manisankar G, Ujjal M, Aniruddha M. Effect of environmental factors (temperature and humidity) on spinning worms of silkworm (*Bombyx mori* L.). Research Journal of Chemistry and Environment,2008:12(4):12-18.
15. Natikar P, Sasvihalli P, Halugundegowda GR, Sarvamangala HS. Effect of global warming on silk farming: a review. Pharma Innovation Journal,2023:12(3):3714-3719.
16. Nath BB. Physiological adaptations of insects exposed to different stress conditions. Volume II. Frontiers in Physiology,2025:16:1582575.
17. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutrition Reviews,2012:70(1):3-21.
18. Pandey P, Tripathi SP. Effect of humidity in the survival and weight of *Bombyx mori* L. larvae. Malaysian Applied Biology,2008:37:37-39.
19. Rahmathulla VK. Management of climatic factors for successful silkworm (*Bombyx mori* L.) crop and higher silk production: a review. Psyche,2012:2012:1-12.
20. Rahmathulla VK. Management of climatic factors for successful silkworm (*Bombyx mori*) crop and higher silk production: a review. Psyche: A Journal of Entomology,2012:2012:1-12. https://doi.org/10.1155/2012/121234
21. Ravindra B, Raghunath M, Reddy Y. Climate variability and its effects on mulberry production in South India. Sericologia,2018:58(1):45-56.
22. Sarma K, Chetry V, Bawri A, Borah KJ, Khanikor B, Kalita T, *et al*. Ensemble distribution model of Muga Silkworm (*Antheraea assamensis*) and its primary host plant Soalu (*Litsea monopetala*) in defined climate space. Scientific Reports,2025:15(1):22080.
23. Sekarappa BM, Gururaj CS. Management of silkworm rearing during summer. Indian Silk,2009:27(12):16.
24. Sisodia NS, Gaherwal S. Effects of temperature and relative humidity on commercial product of silkworm (*Bombyx mori* L.) in Indore region of (MP) India. International Journal of Zoology Studies,2017:2(5):52-55.
25. Talukdar M, Kaushik A, Saikia B, Sangma A, Dehingia S. Molecular mechanisms of climate stress tolerance in silkworms: insights for sustainable sericulture among farmers. Journal of Advances in Biology & Biotechnology,2025:28(11):813-827.
26. Zandalinas SI, Fritschi FB, Mittler R. Global warming and environmental pollution: multifactorial stress combination. Trends in Plant Science,2021:26(6):588-599.
27. Zhang Y. Determination of optimal temperature for production of quality eri silkworm cocoon and seed. Agricultural Research & Technology: Open Access Journal,2018:17(3):2-9.