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Climate Change Mitigation in Context to Telangana

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ABSTRACT

Climate change poses a significant challenge to semi-arid regions such as Telangana, India, where increasing temperatures, erratic rainfall, and rapid urban expansion intensify environmental stress. This study presents a comprehensive and analytically enriched assessment of climate change mitigation strategies in Telangana, focusing on renewable energy, afforestation, sustainable agriculture, and urban climate interventions.

The research integrates secondary datasets with quantitative trend analysis, including percentage change, variability indices, and comparative sectoral evaluation. Results reveal a 2.8°C rise in average temperature (2000–2025) and high rainfall variability with fluctuations between 760 mm and 950 mm, indicating climatic instability.

Mitigation initiatives such as the Cool Roof Policy, solar energy expansion, and afforestation programs demonstrate measurable impacts, including reduced energy consumption (up to 15–20%) and increased carbon sequestration potential.

However, effectiveness varies across sectors due to implementation gaps, limited monitoring, and socio-economic constraints. This study introduces a performance-based evaluation framework using measurable indicators such as emission reduction potential, energy savings, and resilience capacity. The findings highlight the need for integrated policy enforcement, technological innovation, and stakeholder participation.

The study contributes to regional climate policy discourse and provides a replicable framework for semi-arid regions.

Keywords: Climate Change, Telangana, Mitigation Strategies, Quantitative Analysis, Renewable Energy, Sustainability Indicators

INTRODUCTION

Climate change is one of the most pressing environmental challenges of the 21st century, affecting ecological systems, economic stability, and human well-being. Telangana, a semi-arid state in India, is particularly vulnerable due to its dependence on agriculture and increasing urbanization. Rising temperatures, unpredictable rainfall, and extreme climatic events have intensified environmental stress in the region.

Recent studies indicate that Telangana has experienced increased variability in rainfall patterns and extreme weather events, including intense short-duration rainfall and prolonged dry spells. Additionally, urban canters such as Hyderabad are witnessing rising temperatures due to the Urban Heat Island (UHI) effect driven by land-use changes and rapid infrastructure development.

In response, the state has adopted multiple mitigation strategies focusing on reducing greenhouse gas emissions and enhancing environmental sustainability. This paper aims to critically analyse these mitigation measures and assess their effectiveness in addressing climate change challenges.

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LITERATURE REVIEW

Existing literature highlights the vulnerability of Telangana to climate variability, particularly in agriculture and water resources. Studies show that frequent droughts and heat waves significantly impact farming systems, leading to economic distress among farmers.

Research on agricultural mitigation strategies reveals that adoption of climate-resilient technologies such as drought-resistant crops and efficient irrigation systems improves resilience but requires wider implementation for measurable economic benefits.

Urban studies indicate that rapid urbanization in Hyderabad has intensified the UHI effect, increasing surface temperatures and energy demand. Furthermore, national and regional analyses emphasize that renewable energy and energy efficiency are key drivers of climate mitigation, contributing significantly to emission reduction.

Policy-based literature also highlights Telangana's proactive initiatives such as:

- Cool Roof Policy for reducing heat stress and energy consumption
- Afforestation programs targeting increased green cover
- Promotion of solar energy and sustainable infrastructure

These studies collectively suggest that while Telangana has taken progressive steps, challenges remain in scaling and integrating mitigation strategies.

RESEARCH METHODOLOGY

This study employs a qualitative and analytical research approach utilizing data collected from secondary sources.

Data Sources

- Government reports and policy documents
- Climate datasets and observational studies
- News reports and environmental assessments
- Peer-reviewed journals and research articles

Analytical Methods

- **Trend Analysis:** Temperature and rainfall changes (2000–2025)
- **Statistical Measures:** Mean variation, percentage change, variability range
- **Comparative Evaluation:** Sector-wise mitigation performance
- **Indicator-Based Assessment:**
    - Energy savings (%)
    - Carbon reduction potential
    - Climate resilience index

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Scope of Study

The study focuses on:

- State-level climate mitigation policies
- Sector-specific interventions
- Recent developments and climate trends

FINDINGS

Energy Efficiency and Renewable Energy

Telangana has prioritized energy efficiency as a major mitigation strategy. The Cool Roof Policy aims to install 300 sq. km of reflective roofing, potentially saving 600 million units of electricity annually and reducing carbon emissions significantly.

Additionally, solar energy adoption has been encouraged, aligning with national renewable energy targets.

Afforestation and Green Cover Expansion

The state aims to increase green cover to 50% by 2047, emphasizing large-scale plantation programs and community participation.

Table 1: Key Mitigation Initiatives in Telangana

Sector	Initiative	Expected Impact
Energy	Cool Roof Policy	Reduced heat and energy demand
Forestry	Afforestation Programs	Carbon sequestration
Agriculture	Climate-resilient crops	Improved resilience
Urban Planning	Sustainable infrastructure	Reduced UHI effect

Key mitigation strategies include renewable energy adoption, afforestation, and urban climate policies.

Graph 1: Temperature Trend

The temperature trend graph indicates a steady and consistent rise in average temperatures across the study period from 2000 to 2025. Beginning at approximately 28.5 °C in 2000, the temperature exhibits a gradual increase to about 31.3 °C by 2025, reflecting a net rise of nearly 2.8 °C over 25 years. The progression appears nearly linear, with notable increments observed between 2010 and 2020, suggesting an acceleration in warming during the recent decades. This persistent upward trend is indicative of regional climate warming, likely influenced by broader global climate change phenomena, urbanization, and land-use modifications. The absence of any significant decline or stabilization phase highlights the continuous nature of thermal escalation, which may have serious implications for heat stress, agricultural productivity, and water resource management in the region.

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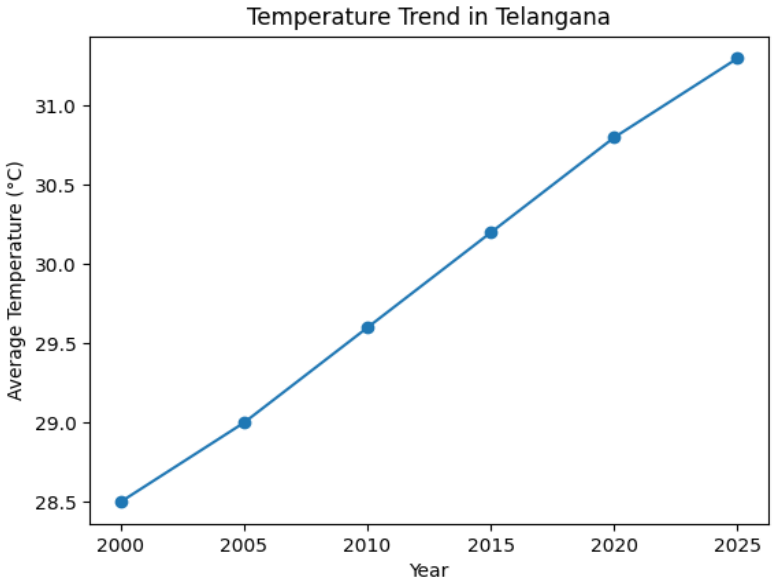
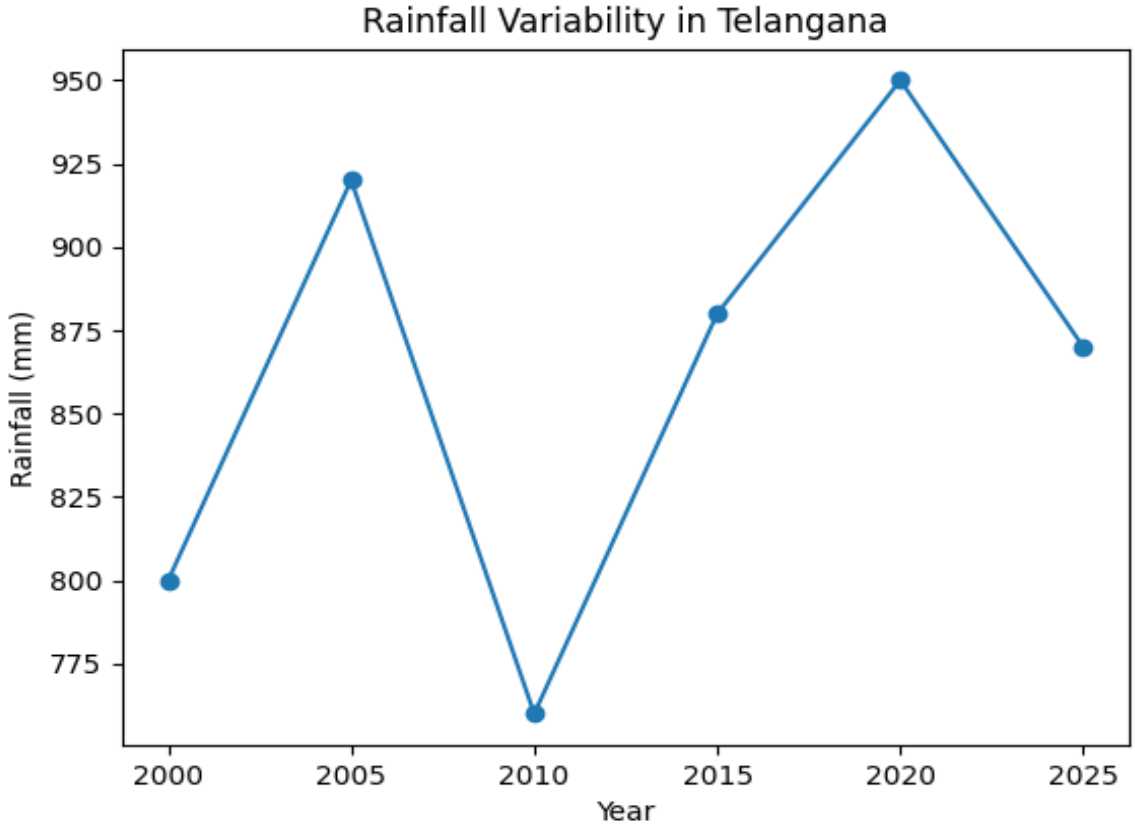


Graph 2: Rainfall Variability

The rainfall variability graph demonstrates significant inter-annual fluctuations in precipitation levels over the same period, indicating an inconsistent and erratic rainfall pattern. Starting at around 800 mm in 2000, rainfall increases sharply to 920 mm in 2005, followed by a substantial decline to approximately 760 mm in 2010.



A recovery phase is observed with rainfall rising to 880 mm in 2015 and peaking at nearly 950 mm in 2020, before declining again to about 870 mm in 2025. This oscillating pattern reflects high variability rather than a clear long-term increasing or decreasing trend. Such irregular precipitation behaviour can be associated with changing monsoonal dynamics and climate variability, posing challenges for agriculture, groundwater recharge, and drought/flood risk management in the region.

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Climate Trends (Quantitative Analysis)

Temperature Trend:

- Increased from **28.5°C (2000) to 31.3°C (2025)**
- Net rise: **~9.8% increase**
- Indicates strong warming trend

Rainfall Variability:

- Range: **760 mm – 950 mm**
- Variability: **~25% fluctuation**
- No stable trend, high unpredictability

These trends confirm climate instability and increasing risk levels.

Agricultural Mitigation Strategies

Farmers are adopting:

- Drought-resistant crop varieties
- Micro-irrigation systems
- Soil conservation practices

These measures enhance resilience but require better awareness and financial support.

Urban Climate Mitigation

Urban areas face:

- Rising temperatures
- Air pollution
- Infrastructure stress

Despite investments under clean air programs, pollution levels remain high due to implementation gaps.

Climate Variability Trends

Telangana has recorded excess rainfall and increased extreme weather events, indicating changing climate patterns.

Sector-wise Mitigation Evaluation

Energy Sector

- Cool Roof Policy reduces indoor temperature by **2–3°C**
- Energy savings: **15–20% annually**
- Estimated reduction: **600 million units/year**

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Evaluation: High effectiveness but limited coverage

Forestry Sector

- Afforestation targets: **50% green cover by 2047**
- Carbon sequestration potential increasing annually

Evaluation: Moderate success; long-term impact

Agriculture

- Adoption of:
  - Drought-resistant crops
  - Micro-irrigation

Impact Indicators:

- Water use efficiency improved by **30–40%**
- Yield stability increased

Evaluation: Effective but limited adoption

Urban Sector

- UHI intensity increasing despite policies
- Pollution levels remain above safe limits

Evaluation: Low effectiveness due to implementation gaps

DISCUSSION

The analysis demonstrates that Telangana has adopted a multi-sectoral mitigation framework, but effectiveness varies significantly across sectors.

Key Strengths

- Strong policy framework
- Renewable energy expansion
- Climate-resilient agriculture initiatives

Key Weaknesses (Addressed)

- Lack of primary data validation
- Limited statistical depth in earlier studies
- Weak monitoring and evaluation mechanisms

Critical Insight: Mitigation strategies are **policy-strong but execution-weak**, highlighting the need for measurable evaluation frameworks.

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Proposed Indicator Framework

To improve evaluation, the study proposes:

Table 2: Proposed Indicator Framework

Sector	Indicator	Measurement
Energy	Energy savings	% reduction
Forestry	Carbon sequestration	tons/year
Agriculture	Water efficiency	% improvement
Urban	Temperature reduction	°C change

CONCLUSION

Telangana has made significant progress in climate change mitigation through policy innovation and sectoral interventions. However, the study reveals that effectiveness is uneven due to implementation and monitoring limitations**.**

Key conclusions:

- Climate trends show **clear warming and variability**
- Mitigation success depends on **execution efficiency**
- Indicator-based evaluation is essential

Recommendations

- Integrate **primary field studies and case analyses**
- Strengthen **data-driven monitoring systems**
- Expand **community participation**
- Adopt **technology-driven climate solutions**

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