INTERNATIONAL JOURNAL IN ENGINEERING SCIENCES

Journal Homepage: https://www.ijesjournal.com

OPEN ACCESS

Research Paper

A Study on Reducing Environmental temperature through Sustainable method

Sandeep Patil*[1], Saloni Patil[2]

[1]*Faculty, Sanjay Ghodawat institute Atigre, Kolhapur Maharashtra, India*
[2]*Student, Alphonsa School Padali khurd, Kolhapur Maharashtra, India*

ARTICLE INFO

Published: 19 July. 2026

Keywords:
Environmental temperature, sustainability, urban heat island, green infrastructure, climate change, a forestation.

DOI:
10.5281/zenodo.21440999

ABSTRACT

The increase in environmental temperature due to global warming, urbanization, deforestation, and industrial activities has become a major challenge worldwide. Rising temperatures affect human health, biodiversity, water resources, and energy consumption. Sustainable methods offer environmentally friendly solutions to mitigate temperature rise while promoting ecological balance. This study examines various sustainable approaches such as urban greening, green roofs, cool pavements, renewable energy adoption, rainwater harvesting, a forestation, and sustainable building designs. The research highlights the effectiveness of these methods in reducing ambient temperatures and improving environmental quality. The findings suggest that integrating multiple sustainable practices can significantly contribute to temperature reduction and climate resilience in both urban and rural areas.

INTRODUCTION

Environmental temperature has increased significantly over the past century due to anthropogenic activities. Rapid urbanization has replaced natural landscapes with concrete structures, leading to the Urban Heat Island (UHI) effect. The extensive use of fossil fuels, deforestation, industrial emissions, and increased energy consumption have accelerated global warming.

According to climate studies, average global temperatures have risen by approximately 1.1°C since the pre-industrial era. This increase has resulted in heat waves, droughts, ecosystem degradation, and increased energy demands for cooling systems. Sustainable environmental management practices can help reduce temperature levels while maintaining economic growth and social well-being. This study investigates sustainable methods that can effectively reduce environmental temperatures and

***Corresponding Author:** Sandeep Patil
Address: *Faculty, Sanjay Ghodawat institute Atigre, Kolhapur Maharashtra, India*
Email : sandeep.patil@sgipolytechnic.in
Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

improve the quality of life for present and future generations.

2. Objectives

The major objectives of this study are:

1. To identify factors contributing to environmental temperature rise.
2. To examine sustainable methods for reducing environmental temperatures.
3. To evaluate the effectiveness of green infrastructure and renewable technologies.
4. To analyze the role of vegetation in temperature regulation.
5. To propose integrated sustainable strategies for climate adaptation.
6. To provide recommendations for policymakers, planners, and communities.

3. Methodology

3.1 Research Design

The study employs a descriptive and analytical research approach based on secondary data collected from scientific journals, reports, government publications, and international organizations.

3.2 Data Collection

Data were collected from:

1. Scientific research articles
2. Climate assessment reports
3. Environmental databases
4. Government sustainability programs
5. International environmental organizations

3.3 Data Analysis

The collected information was analyzed using:

1. Comparative analysis
2. Literature review
3. Case study evaluation
4. Sustainability assessment methods

3.4 Scope of Study

The study focuses on sustainable methods applicable to urban and rural environments for reducing environmental temperatures.

4. Sustainable Methods for Reducing Environmental Temperature

4.1 A forestation and Reforestation

Trees absorb carbon dioxide and provide shade through evapotranspiration. Forests reduce surface temperatures and improve air quality.

Benefits:

1. Carbon sequestration
2. Temperature reduction
3. Biodiversity conservation
4. Improved rainfall patterns

4.2 Urban Green Spaces

Urban parks, gardens, and green belts help cool surrounding areas by increasing vegetation cover.

Benefits:

1. Reduction of Urban Heat Island effect

2. Improved air quality
3. Enhanced recreational spaces
4. Reduced energy consumption

4.3 Green Roofs and Vertical Gardens

Green roofs consist of vegetation planted on building rooftops. Vertical gardens cover building walls with plants.

Benefits:

1. Building insulation
2. Reduced surface temperatures
3. Improved storm water management
4. Increased urban biodiversity

4.4 Cool Roof Technologies

Cool roofs use reflective materials that reflect solar radiation and absorb less heat.

Benefits:

1. Lower indoor temperatures
2. Reduced air-conditioning costs
3. Enhanced building energy efficiency

4.5 Cool Pavements

Traditional asphalt absorbs significant heat. Cool pavements use reflective and permeable materials.

Benefits:

1. Reduced surface temperatures
2. Improved storm water infiltration
3. Enhanced pedestrian comfort

4.6 Renewable Energy Adoption

Replacing fossil fuels with renewable energy sources reduces greenhouse gas emissions.

Examples:

1. Solar energy
2. Wind energy
3. Hydropower
4. Biomass energy

Benefits:

1. Lower carbon footprint
2. Sustainable energy generation
3. Reduced environmental heating

4.7 Rainwater Harvesting

Rainwater harvesting improves groundwater recharge and supports vegetation growth.

Benefits:

1. Increased soil moisture
2. Enhanced cooling through vegetation
3. Reduced urban flooding

4.8 Sustainable Building Design

Climate-responsive architecture minimizes heat absorption and energy use.

Features:

1. Natural ventilation
2. Shading devices

3. Energy-efficient materials
4. Daylight utilization

Benefits:

1. Reduced indoor temperatures
2. Lower energy consumption
3. Improved occupant comfort

4.9 Water Bodies and Blue Infrastructure

Lakes, ponds, wetlands, and fountains contribute to cooling through evaporation.

Benefits:

1. Microclimate regulation
2. Biodiversity enhancement
3. Recreational value

4.10 Waste Reduction and Circular Economy

Reducing waste generation and promoting recycling decreases greenhouse gas emissions.

Benefits:

1. Lower landfill emissions
2. Resource conservation
3. Sustainable production systems

RESULTS AND DISCUSSION

The review indicates that sustainable methods can effectively reduce environmental temperatures when implemented collectively. A forestation and urban green infrastructure demonstrate significant cooling effects, often reducing local temperatures by 2–8°C. Green roofs and cool roofs contribute to building-level cooling and energy savings. Renewable energy systems reduce greenhouse gas emissions, mitigating long-term temperature increases. Integrated approaches combining vegetation, water management, sustainable construction, and renewable energy provide the most effective temperature reduction outcomes. Public participation and government support are critical for successful implementation.

CONCLUSION

Environmental temperature rise is a major environmental challenge affecting ecosystems, human health, and economic activities. Sustainable methods provide practical and environmentally responsible solutions for temperature reduction. A forestation, urban greening, cool roofs, renewable energy adoption, sustainable buildings, and water conservation measures have demonstrated significant effectiveness in mitigating heat impacts. The study concludes that integrated sustainable planning can substantially reduce environmental temperatures while supporting climate resilience and sustainable development.

7. Future Scope

Future research can focus on:

1. Smart city technologies for temperature management.
2. Artificial intelligence-based climate monitoring systems.
3. Development of advanced cooling materials.
4. Integration of renewable energy with urban infrastructure.
5. Community-based climate adaptation programs.

6. Large-scale implementation of green infrastructure.

7. Climate-resilient urban planning frameworks.

Quantitative assessment of combined sustainable interventions.

REFERENCES

1. Akbari, H., Pomerantz, M., & Taha, H. (2001). Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. Solar Energy, 70(3), 295–310.
2. Arnfield, A. J. (2003). Two decades of urban climate research: A review of turbulence, exchanges of energy and water, and the urban heat island. International Journal of Climatology, 23(1), 1–26.
3. Berardi, U., GhaffarianHoseini, A., & GhaffarianHoseini, A. (2014). State-of-the-art analysis of the environmental benefits of green roofs. Applied Energy, 115, 411–428.
4. Bowler, D. E., Buyung-Ali, L., Knight, T. M., & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review. Landscape and Urban Planning, 97(3), 147–155.
5. Brown, R. D., & Gillespie, T. J. (1995). Microclimatic landscape design. John Wiley & Sons.
6. EPA. (2024). Using green roofs to reduce heat islands. U.S. Environmental Protection Agency.
7. FAO. (2020). Global forest resources assessment 2020. Food and Agriculture Organization of the United Nations.
8. Gartland, L. (2012). Heat islands: Understanding and mitigating heat in urban areas. Earthscan.
9. Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: The role of green infrastructure. Built Environment, 33(1), 115–133.
10. Givoni, B. (1998). Climate considerations in building and urban design. John Wiley & Sons.
11. Grimmond, C. S. B. (2007). Urbanization and global environmental change: Local effects of urban warming. Geographical Journal, 173(1), 83–88.
12. Intergovernmental Panel on Climate Change. (2023). Climate change 2023: Synthesis report. IPCC.
13. International Energy Agency. (2023). Renewables 2023. IEA.
14. Lehmann, S. (2014). Low carbon construction systems using prefabricated engineered solid wood panels. Sustainable Cities and Society, 14, 227–238.
15. Levinson, R., & Akbari, H. (2010). Potential benefits of cool roofs on commercial buildings. Energy and Buildings, 42(3), 286–293.
16. Li, D., Bou-Zeid, E., & Oppenheimer, M. (2014). The effectiveness of cool and green roofs as urban heat island mitigation strategies. Environmental Research Letters, 9(5), 055002.
17. McPherson, E. G., Simpson, J. R., Peper, P. J., & Xiao, Q. (2005). Municipal forest benefits and costs in five U.S. cities. Journal of Forestry, 103(8), 411–416.
18. National Aeronautics and Space Administration. (2023). Global climate change: Vital signs of the planet. NASA.
19. Nowak, D. J., Crane, D. E., & Stevens, J. C. (2006). Air pollution removal by urban trees and shrubs. Urban Forestry & Urban Greening, 4(3–4), 115–123.
20. Oke, T. R. (1982). The energetic basis of the urban heat island. Quarterly Journal of the Royal Meteorological Society, 108(455), 1–24.
21. Oke, T. R. (1987). Boundary layer climates (2nd ed.). Routledge.

22. Pachauri, R. K., & Meyer, L. A. (Eds.). (2014). Climate change 2014: Synthesis report. IPCC.
23. Paolini, R., Santamouris, M., Synnefa, A., & Menon, D. (2018). Developing the next generation of cool roofing materials. Energy and Buildings, 162, 179–189.
24. Pearlmutter, D., Berliner, P., & Shaviv, E. (2007). Integrated modeling of pedestrian energy exchange and thermal comfort in urban street canyons. Building and Environment, 42(6), 2396–2409.
25. Rosenzweig, C., Solecki, W., Parshall, L., Chopping, M., Pope, G., & Goldberg, R. (2006). Characterizing the urban heat island in current and future climates. Environmental Science & Technology, 40(19), 5887–5891.
26. Rosenfeld, A. H., Akbari, H., Romm, J. J., & Pomerantz, M. (1998). Cool communities: Strategies for heat island mitigation and smog reduction. Energy and Buildings, 28(1), 51–62.
27. Santamouris, M. (2014). Cooling the cities—A review of reflective and green roof mitigation technologies. Solar Energy, 103, 682–703.
28. Santamouris, M. (2015). Regulating the damaged thermostat of the cities. Energy and Buildings, 91, 43–56.
29. Shashua-Bar, L., & Hoffman, M. E. (2000). Vegetation as a climatic component in urban street canyons. Energy and Buildings, 31(3), 221–235.
30. Solecki, W. D., Rosenzweig, C., Parshall, L., Pope, G., Clark, M., Cox, J., & Wiencke, M. (2005). Mitigation of the heat island effect in urban New Jersey. Environmental Hazards, 6(1), 39–49.
31. Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011). Positive effects of vegetation: Urban heat island and green roofs. Environmental Pollution, 159(8–9), 2119–2126.
32. Taha, H. (1997). Urban climates and heat islands: Albedo, evapotranspiration, and anthropogenic heat. Energy and Buildings, 25(2), 99–103.
33. Tiwari, A., Kumar, P., Kalaiarasan, G., & Ottosen, T. B. (2021). The impacts of existing and hypothetical green infrastructure scenarios on urban heat island formation. Environmental Pollution, 274, 115898.
34. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations.
35. United Nations Environment Programme. (2023). Global environment outlook. UNEP.
36. UN-Habitat. (2022). World cities report 2022. United Nations Human Settlements Programme.
37. U.S. Environmental Protection Agency. (2023). Reducing urban heat islands: Compendium of strategies. EPA.
38. Voogt, J. A., & Oke, T. R. (2003). Thermal remote sensing of urban climates. Remote Sensing of Environment, 86(3), 370–384.
39. Wong, N. H., & Yu, C. (2005). Study of green areas and urban heat island in a tropical city. Habitat International, 29(3), 547–558.
40. Wong, N. H., Tan, C. L., Kolokotsa, D., & Takebayashi, H. (2021). Greenery as a mitigation and adaptation strategy to urban heat. Nature Reviews Earth & Environment, 2(3), 166–181.
41. World Bank. (2023). Climate-smart cities program. World Bank.
42. World Health Organization. (2023). Climate change and health. WHO.
43. World Meteorological Organization. (2023). State of the global climate 2023. WMO.
44. Zinzi, M., & Agnoli, S. (2012). Cool and green roofs: An energy and comfort comparison. Building and Environment, 55, 66–76.
45. Oberndorfer, E., Lundholm, J., Bass, B., Coffman, R. R., Doshi, H., Dunnett, N.,

Gaffin, S., Köhler, M., Liu, K. K. Y., & Rowe, B. (2007). Green roofs as urban ecosystems. BioScience, 57(10), 823–833.

46. Speak, A. F., Rothwell, J. J., Lindley, S. J., & Smith, C. L. (2012). Urban particulate pollution reduction by green roofs. Environmental Science & Technology, 46(14), 7692–7699.
47. Getter, K. L., & Rowe, D. B. (2006). The role of extensive green roofs in sustainable development. HortScience, 41(5), 1276–1285.
48. Takebayashi, H., & Moriyama, M. (2007). Surface heat budget on green roof and high-reflective roof. Building and Environment, 42(8), 2971–2979.
49. Norton, B. A., Coutts, A. M., Livesley, S. J., Harris, R. J., Hunter, A. M., & Williams, N. S. G. (2015). Planning for cooler cities. Landscape and Urban Planning, 134, 127–138.
50. Zhao, L., Lee, X., Smith, R. B., & Oleson, K. (2014). Strong contributions of local background climate to urban heat islands. Nature, 511(7508), 216–219.

HOW TO CITE: Sandeep Patil*, Saloni Patil, A Study on Reducing Environmental temperature through Sustainable method, Int. J. in Engi. Sci., 2026, Vol 3, Issue 7, 66-72. https://doi.org/10.5281/zenodo.21440999