
Climate Change and Mitigation Strategies: Addressing Emerging Environmental Challenges

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ABSTRACT

Climate change represents a critical global environmental challenge driven primarily by anthropogenic activities such as fossil fuel combustion, deforestation, industrialization, and unsustainable agricultural practices. This study examines the causes, impacts, and response strategies associated with climate change, with particular emphasis on emerging climatic anomalies in urban contexts. Drawing on existing literature and recent empirical observations, including the Bengaluru hailstorm of 2026, the paper highlights the increasing frequency and intensity of extreme weather events as indicators of climatic instability. The analysis reveals that climate change significantly affects ecosystems, biodiversity, agriculture, water resources, and human health, thereby posing serious threats to sustainable development and food security. Urbanization and the associated heat island effect further intensify environmental stress, especially in rapidly growing regions. The study evaluates mitigation strategies such as the transition to renewable energy, afforestation, energy efficiency, and policy interventions, alongside adaptation measures including resilient infrastructure, climate-smart agriculture, and improved disaster preparedness. Despite the availability of technological and policy solutions, challenges such as economic



dependence on fossil fuels, institutional barriers, and limited public awareness hinder effective implementation. The paper concludes that addressing climate change requires integrated policy frameworks, global cooperation, and long-term commitment to sustainability. The findings underscore the urgency of combining mitigation and adaptation approaches to ensure environmental resilience and sustainable development in the face of escalating climate risks.

Introduction

Climate change is one of the most significant environmental challenges of the modern era. It refers to long-term changes in temperature, precipitation, and atmospheric conditions, primarily caused by human activities such as fossil fuel combustion, deforestation, and industrialization. These activities increase greenhouse gas concentrations, leading to global warming.

Over the past century, global temperatures have risen significantly, causing melting glaciers, rising sea levels, and changing weather patterns. Cities such as Bengaluru, traditionally known for moderate climates, are now experiencing unusual weather phenomena including hailstorms and extreme rainfall. These events highlight the growing instability of climate systems.

Understanding climate change is essential for developing effective mitigation and adaptation strategies. This paper explores the causes, impacts, and solutions to climate change with a focus on sustainable development.

Literature Review

Numerous scientific studies confirm that climate change is largely driven by anthropogenic factors. Reports by the Intergovernmental Panel on Climate Change (IPCC) emphasize the role of greenhouse gases such as carbon dioxide, methane, and nitrous oxide in trapping heat within the Earth's atmosphere. Research also indicates that extreme weather events are increasing in both frequency and intensity. Urbanisation has further intensified climate effects through the urban heat island phenomenon. Previous studies highlight the importance of renewable energy, afforestation, and sustainable practices in reducing emissions. Literature underscores the urgency of global cooperation and policy interventions to mitigate climate change effectively.



Causes of Climate Change

The primary causes of climate change including greenhouse gas emissions, deforestation, industrialization, and agricultural activities. Burning fossil fuels releases large amounts of carbon dioxide into the atmosphere, contributing significantly to global warming. Deforestation reduces the Earth's capacity to absorb carbon dioxide, while industrial activities emit pollutants that further disrupt climate systems. Agricultural practices release methane and nitrous oxide, both potent greenhouse gases. Rapid urbanization also contributes to increased energy consumption and environmental degradation, exacerbating climate change impacts.

Impacts of Climate Change

Climate change has far-reaching impacts on ecosystems, biodiversity, agriculture, water resources, and human health. Extreme weather events such as floods, droughts, cyclones, and hailstorms are becoming more frequent. Biodiversity loss is a major concern as many species struggle to adapt to changing environmental conditions. Agriculture faces reduced crop yields and soil degradation, threatening food security. Water scarcity is increasing in many regions due to altered rainfall patterns. Human health is also affected through heat-related illnesses, respiratory issues, and the spread of infectious diseases.

Case Study: Bengaluru Hailstorm (2026)

The Bengaluru hailstorm of March 2026 serves as a notable example of unusual climatic activity. Large hailstones caused damage to infrastructure, vehicles, and crops, raising concerns about climate variability. Similar events in nearby regions such as Kodagu, Dharwad, and Shivamogga indicate a broader pattern of climatic instability. While a single event cannot be directly attributed to climate change, the increasing frequency of such anomalies suggests a strong link. Urban factors such as reduced green cover and increased heat retention contribute to these extreme events, highlighting the need for sustainable urban planning.

Mitigation Strategies

Mitigation strategies focus on reducing greenhouse gas emissions to limit global warming. Transitioning to renewable energy sources such as solar, wind, and hydroelectric power is essential. Improving energy efficiency in buildings and industries can significantly reduce emissions. Afforestation and reforestation help absorb carbon dioxide and restore ecosystems. Sustainable agricultural practices reduce



environmental impact while ensuring food security. Government policies, including carbon pricing and environmental regulations, play a crucial role in promoting sustainable practices.

Adaptation Strategies

Adaptation strategies aim to help communities cope with the impacts of climate change. These include building resilient infrastructure, improving water management systems, and developing early warning systems for extreme weather events. Climate-resilient crops and sustainable urban planning are essential for reducing vulnerability. Adaptation measures ensure that societies can withstand environmental changes and minimize damage.

Challenges

Addressing climate change involves several challenges, including economic dependence on fossil fuels, political barriers, and lack of technological access in developing regions. Public awareness and behavioral changes are also necessary but can be difficult to achieve. Global cooperation and long-term commitment are essential for overcoming these challenges.

Conclusion

Climate change is a global issue that requires immediate and coordinated action. The increasing occurrence of extreme weather events highlights the urgency of the problem. By implementing mitigation and adaptation strategies, it is possible to reduce environmental impact and ensure a sustainable future. Governments, organizations, and individuals must work together to address this critical challenge.

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