THE ROLE OF ARTIFICIAL INTELLIGENCE IN CLIMATE CHANGE MITIGATION AND SUSTAINABLE DEVELOPMENT: A POLICY-ORIENTED ANALYSIS

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Abstract. Artificial intelligence (AI) is increasingly recognized as a valuable tool for addressing climate change and supporting sustainable development. This study examines the opportunities and challenges of AI applications in climate change mitigation, focusing on energy efficiency, environmental monitoring, and sustainable resource management. The findings highlight that while AI offers significant potential benefits, effective policies and responsible implementation are essential for achieving sustainable outcomes.

Keywords: artificial intelligence, climate change mitigation, sustainable development, environmental monitoring, energy efficiency.

Introduction

Climate change has become one of the most pressing global challenges of the twenty-first century, affecting environmental sustainability, economic development, and human well-being. Rising greenhouse gas emissions, increasing temperatures, and extreme weather events have intensified the need for innovative and effective climate solutions. According to the IPCC (2023), climate change continues to pose significant environmental and socio-economic risks worldwide.

In recent years, artificial intelligence (AI) has emerged as a promising technology for addressing climate-related challenges. AI applications are increasingly used in areas such as energy management, environmental monitoring, climate forecasting, and sustainable resource utilization. These technologies can improve efficiency, support data-driven decision-making, and contribute to climate change mitigation efforts. Similar observations are reported by GPAI (2021), highlighting the growing role of AI in supporting climate action and environmental sustainability.

Although numerous studies have explored the relationship between artificial intelligence and sustainability, limited attention has been given to balancing the opportunities and challenges of AI in climate change mitigation from a policy perspective. This study seeks to address this gap by examining both the benefits and risks associated with AI-driven climate solutions.

Despite the growing potential of AI, concerns remain regarding its implementation, including energy consumption, data governance, and unequal

access to advanced technologies. Therefore, understanding both the opportunities and challenges of AI is essential for developing effective policies that support sustainable development.

The purpose of this study is to analyze the role of artificial intelligence in climate change mitigation and sustainable development, with particular attention to its potential benefits, challenges, and policy implications.

METHODOLOGY

This study employs a qualitative research approach to examine the role of artificial intelligence in climate change mitigation and sustainable development. The analysis is based on secondary data obtained from international reports, academic literature, and policy documents related to AI and climate action.

Particular attention is given to AI applications in energy efficiency, environmental monitoring, climate forecasting, and sustainable resource management. The study evaluates both the opportunities and challenges associated with the use of AI in addressing climate-related issues.

A descriptive and comparative analysis method is applied to assess the potential contributions of AI technologies to sustainable development and to identify key policy considerations for their effective implementation.

RESULTS AND DISCUSSION

The analysis indicates that artificial intelligence has significant potential to support climate change mitigation and sustainable development. AI technologies can process large volumes of environmental data, improve decision-making processes, and enhance the efficiency of climate-related initiatives. However, the implementation of AI also presents several technical, economic, and ethical challenges. These findings are consistent with Rolnick et al. (2022), who emphasized the potential of machine learning technologies in addressing climate-related challenges.

Opportunities and Challenges of AI in Climate Change Mitigation

Table 1.

No.	AI Application Area	Potential Benefits	Key Challenges
1	Energy management	Improved energy efficiency and reduced emissions	High implementation costs
2	Climate forecasting	More accurate prediction of climate events	Data quality limitations

3	Environmental monitoring	Real-time detection of environmental changes	Limited access to advanced technologies
4	Sustainable agriculture	Optimized resource use and increased productivity	Digital infrastructure gaps
5	Smart transportation	Reduced fuel consumption and traffic emissions	Cybersecurity and data privacy concerns

Source: Author's compilation based on GPAI (2021), Rolnick et al. (2022), and Vinuesa et al. (2020)

The findings suggest that AI can contribute significantly to energy efficiency and emission reduction. AI-powered systems can optimize energy consumption, support renewable energy integration, and improve the performance of smart grids. These applications can help reduce greenhouse gas emissions while increasing operational efficiency.

Another important area is climate forecasting and environmental monitoring. AI technologies can analyze large datasets from satellites, sensors, and weather stations to improve the accuracy of climate predictions and support early warning systems. This enables governments and organizations to respond more effectively to environmental risks and natural disasters.

Despite these opportunities, several challenges remain. The development and deployment of AI systems often require substantial computational resources and financial investment. In addition, concerns related to data governance, cybersecurity, and unequal access to digital technologies may limit the benefits of AI, particularly in developing countries.

Overall, the results indicate that AI should be considered as a supporting tool for climate action rather than a standalone solution. Effective policies, responsible governance, and international cooperation are essential to maximize the benefits of AI while minimizing potential risks.

CONCLUSION

This study examined the role of artificial intelligence in climate change mitigation and sustainable development. The findings indicate that AI can support climate action through improved energy management, environmental monitoring, climate forecasting, and sustainable resource utilization. These applications have the potential to enhance efficiency and contribute to reducing environmental impacts.

At the same time, the study highlights several challenges associated with AI adoption, including high implementation costs, data governance issues, cybersecurity risks, and unequal access to digital technologies. Therefore, the successful use of AI for climate action requires appropriate policy frameworks, responsible governance, and international cooperation. By addressing these challenges, AI can become an important tool for achieving long-term sustainable development goals. This conclusion is also supported by Vinuesa et al. (2020), who identified AI as an important contributor to achieving sustainable development goals.

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