



ICSSR-SRC Sponsored

HARNESSING ARTIFICIAL INTELLIGENCE, INNOVATION AND TECHNOLOGY: A PATHWAY TO ECONOMIC TRANSFORMATION AND SUSTAINABLE DEVELOPMENT IN INDIA

Chief Editor

Dr. R. Gayathri

VOLUME II



ICSSR-SRC Sponsored

HARNESSING ARTIFICIAL INTELLIGENCE, INNOVATION AND TECHNOLOGY: A PATHWAY TO ECONOMIC TRANSFORMATION AND SUSTAINABLE DEVELOPMENT IN INDIA

Volume II

Chief Editor

Dr. R. Gayathri

Seminar Convenor and Associate Professor,
UG Department of Commerce IB,
Nallamuthu Gounder Mahalingam College, Pollachi

Editor

Dr. N. Bhuvanesh Kumar

Assistant Professor and Head,
UG Department of Commerce (IB),

Editorial Board Members

Dr. R. Kalaiselvi

Assistant Professor, UG Department of Commerce (IB)

Dr. P. Karthika

Assistant Professor, UG Department of Commerce (IB)

Harnessing Artificial Intelligence, Innovation and Technology: A Pathway to Economic Transformation and Sustainable Development in India

©

Chief Editor : **Dr. R. Gayathri**

Editor : **Dr. N. Bhuvanesh Kumar**

Editorial Board Members : **Dr. R. Kalaiselvi & Dr. P. Karthika**

First Edition: 2025

ISBN: 978-93-94004-50-4

Price: ₹ 1400/-

Copyright

All rights reserved. No part of this book may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, mechanical, photocopying, recording or otherwise, without prior written permission of the author.

Printed at

SHANLAX PUBLICATIONS

61, 66 T.P.K. Main Road

Vasanthanagar

Madurai – 625003

Tamil Nadu, India

Ph: 0452-4208765,

Mobile: 7639303383

[email: publisher@shanlaxpublications.com](mailto:publisher@shanlaxpublications.com)

[web: www.shanlaxpublications.com](http://www.shanlaxpublications.com)

44	The Role of Artificial Intelligence in Shaping Startup Business Models: Theoretical Perspective Dr. P. Kalaivani	272
45	Artificial Intelligence in Disease Identification and Preventive Public Health Dr. R. Beena	279
46	Automating Adventure: An Investigation into the role of AI in Optimizing Operational Efficiency for Online Travel Agencies Dr. Murugan. S, Mr. Deepadharsan R & Mr. Sarath. GD	288
47	Artificial Intelligence, Workforce Transformation and Digital Skills for Developing the Indian Economy: A Descriptive Study Dr. P. Gurusamy	294
48	Harnessing AI and Iot for Tribal Women Empowerment and Family Well-Being in Rural India Dr. M. Sakthi	301
49	Technology-Driven Empowerment: The Role of AI and Innovation in Strengthening Self Help Groups in India Dr. M. Sakthi & Dr. K. Vanith	306
50	AI as a Strategic Driver of Business Growth and Organizational Performance Ms. M. Haripriya, Ms. M. Satheeswari & Dr. R. Manikandan	312
51	Transforming the Startup Ecosystem with AI Dr. P. Anitha & V. Harini	317
52	Privacy and Data Security Concerns in Artificial Intelligence Adoption Dr. S. Poongodi & S. Abithanjali	321
53	AI for a Greener Tomorrow: Pathways to Sustainable Growth Dr. S. Poongodi	325
54	Artificial Intelligence for Climate Action, Resource Management, and Social Equity Dr. P. Jayanthi	329
55	Artificial Intelligence Impact on Entrepreneurship and Job Creation Dr. M. Meena Krithika, Ms. R. Srivaishna & Ms. M. Srimathi	333
56	Environmental Implications of AI and Pathways to Sustainable Growth Dr. M. Meena Krithika, Ms. K. Sowmya & Ms. M. Sripadmavathi	338
57	Artificial Intelligence in Education: Impact on Students' Academic Development and Future Outlook Dr. S. Kaleeswari & Dr. R. Amsaveni	343
58	Transforming the Startup Ecosystem with AI Dr. P. Gomathi Devi	349
59	Privacy and Data Security Concerns in AI Adoption Dr. M. Meena Krithika	352

AI FOR A GREENER TOMORROW: PATHWAYS TO SUSTAINABLE GROWTH

Dr. S. Poongodi

Assistant Professor, PG Department of Commerce-CA
Nallamuthu Gounder Mahalingam College, Pollachi, Tamil Nadu, India
poongodimuruganatham@gmail.com

Abstract

Artificial intelligence (AI) is widely regarded as one of the most transformative technologies of the 21st century. While its potential to revolutionize industries is undeniable, AI development and deployment also carry environmental costs, particularly in terms of energy use, carbon emissions, and resource consumption. This paper explores the dual role of AI as both a driver of environmental challenges and a powerful enabler of sustainable growth. First, the ecological footprint of AI is examined, focusing on data centers, energy demands, and hardware lifecycles. Second, the paper highlights how AI can serve as a catalyst for sustainability in domains such as climate modeling, renewable energy integration, sustainable agriculture, and circular economies. Finally, pathways to sustainable AI growth are discussed, including green computing, policy frameworks, industry innovation, and ethical considerations. The findings suggest that while AI's current trajectory poses risks, targeted strategies can redirect its growth toward a greener, more sustainable future.

Keywords: Artificial intelligence – Environmental Impact – Pathways - Innovation - Sustainable Growth

Introduction

Artificial intelligence has emerged as a cornerstone of global technological development. From healthcare and logistics to education and manufacturing, AI-driven systems are being integrated into virtually every sector. According to PwC (2018), AI could contribute up to \$15.7 trillion to the global economy by 2030. However, the environmental implications of this growth are increasingly coming under scrutiny. Training advanced AI models requires massive computational power, often consuming more electricity than small towns. Strubell et al. (2019) estimated that training a single large natural language processing model could emit as much carbon dioxide as five average cars over their entire lifespans. Beyond energy, the production of AI-specific hardware contributes to e-waste and strains the supply of rare earth metals. Yet, AI is not only part of the problem; it is also a potential solution. By optimizing energy use, enhancing climate predictions, and enabling sustainable resource management, AI can become a key driver of environmental progress. The central challenge lies in ensuring that AI's ecological costs do not outweigh its sustainability benefits. This paper aims to provide a comprehensive overview of AI's environmental footprint, explore its role in promoting sustainable practices, and propose pathways toward sustainable AI growth.

AI's Environmental Impact

Energy Consumption and Carbon Emissions

The training of large-scale AI models requires extensive computational resources. For example, OpenAI's GPT-3 reportedly required 175 billion parameters, trained over several weeks using thousands of GPUs. Such training processes can consume gigawatt-hours of electricity, producing substantial carbon emissions if powered by non-renewable sources (Strubell et al., 2019).

Data centers, the backbone of AI infrastructure, consume significant amounts of electricity not only for computation but also for cooling. Although hyperscale companies such as Google and Microsoft are moving toward renewable energy, the overall sector remains heavily reliant on carbon-intensive grids (IEA, 2023).

Hardware Production and E-Waste

The hardware demands of AI systems further exacerbate environmental concerns. The production of advanced chips involves mining lithium, cobalt, and other rare earth minerals, which are associated with environmental degradation and exploitative labor practices (Pattnaik et al., 2022). Moreover, as hardware becomes obsolete quickly, electronic waste from AI infrastructure is growing, adding pressure to global recycling systems.

AI as a Driver of Sustainability

Despite these challenges, AI offers unique opportunities to support global sustainability goals:

1. Climate Modeling and Disaster Management:

AI-driven climate models enhance the accuracy of predictions, helping policymakers design more effective adaptation strategies (Rolnick et al., 2019). Early warning systems powered by AI can reduce the human and economic toll of natural disasters.

2. Renewable Energy Optimization:

AI enables smart grids to manage fluctuating renewable energy sources such as wind and solar. By predicting demand and adjusting supply in real time, AI reduces dependence on fossil fuels (IEA, 2023).

3. Sustainable Agriculture:

AI-powered drones and IoT sensors provide farmers with precise data on soil health, weather, and crop conditions. This allows for efficient use of water and fertilizers, reducing environmental impacts while maintaining yields (UNEP, 2023).

4. Circular Economy and Waste Reduction:

Machine learning improves waste sorting and recycling processes. AI also supports product lifecycle management, encouraging reuse and refurbishment (Pattnaik et al., 2022).

5. Transportation and Logistics:

AI optimizes traffic flows in cities, reduces fuel consumption in logistics networks, and supports the development of autonomous electric vehicles.

Pathways to Sustainable AI Growth

To align AI with sustainability, multi-pronged strategies are required:

Green Computing

Advances in model efficiency, such as pruning, quantization, and knowledge distillation, can reduce computational requirements without sacrificing performance (Schwartz et al., 2020). Data centers should increasingly adopt renewable energy sources and energy-efficient cooling technologies.

Policy and Governance

Governments must establish clear frameworks for sustainable AI. This includes carbon accounting for model training, transparency requirements for energy use, and incentives for green AI research. The European Union's proposed AI Act provides an early example of integrating ethics and sustainability into AI governance.

Industry Innovation

Private companies must invest in sustainable AI infrastructure. Initiatives such as hardware recycling, carbon-neutral data centers, and open-source collaborations can reduce AI's ecological footprint while fostering innovation.

Ethics and Global Equity

Green AI initiatives must account for global disparities. Developing countries, often hardest hit by climate change, should have equitable access to AI technologies for sustainability. International collaborations can ensure that green AI benefits are shared widely.

Discussion

The tension between AI's environmental costs and its sustainability potential underscores the complexity of technological progress. Left unchecked, AI could exacerbate energy demands and carbon emissions. However, with deliberate strategies, AI can instead become a cornerstone of sustainable development. Balancing these outcomes requires a systems approach that integrates technological innovation, policy reform, and ethical considerations. Collaboration between governments, industry leaders, and researchers is essential. Furthermore, public awareness and pressure can accelerate the adoption of sustainable practices, ensuring accountability across sectors.

Conclusion

AI represents both a challenge and an opportunity for global sustainability. On one hand, its rapid growth is increasing energy consumption, carbon emissions, and e-waste. On the other, it offers powerful tools to address climate change, optimize resources, and transition toward greener economies. The future of AI depends on choices made today. By investing in green computing, enacting supportive policies, and fostering global cooperation, AI can be redirected toward a greener tomorrow. Rather than a burden, AI has the potential to become a force for sustainable growth—if its development is guided responsibly.

References

1. International Energy Agency. (2023). Data centres and energy use. <https://www.iea.org/reports/data-centres-and-data-transmission-networks>
2. Pattnaik, P., Dutta, S., & Ghosh, S. (2022). Green AI: Reducing the carbon footprint of artificial intelligence. *Journal of Cleaner Production*, 351, 131567. <https://doi.org/10.1016/j.jclepro.2022.131567>
3. PwC. (2018). Sizing the prize: What's the real value of AI for your business and how can you capitalise? PwC Global. <https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf>
4. Rolnick, D., Donti, P. L., Kaack, L. H., Kochanski, K., Lacoste, A., Sankaran, K., Ross, A. S., Milojevic-Dupont, N., Jaques, N., Waldman-Brown, A., Luccioni, A., Maharaj, T., Sherwin, E. D., Mukkavilli, S. K., Kording, K. P., Gomes, C., Ng, A. Y., Hassabis, D., Bengio, Y., ... Chayes, J. (2019). Tackling climate change with machine learning. *arXiv Preprint arXiv:1906.05433*. <https://arxiv.org/abs/1906.05433>
5. Schwartz, R., Dodge, J., Smith, N. A., & Etzioni, O. (2020). Green AI. *Communications of the ACM*, 63(12), 54–63. <https://doi.org/10.1145/3381831>

6. Strubell, E., Ganesh, A., & McCallum, A. (2019). Energy and policy considerations for deep learning in NLP. Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics, 3645–3650. <https://doi.org/10.18653/v1/P19-1355>
7. United Nations Environment Programme. (2023). Artificial intelligence and the sustainable development goals. UNEP. <https://www.unep.org/resources/report/artificial-intelligence-and-sustainable-development-goals>