Bodhi International Journal of
Research in Humanities, Arts and Science

Vol. 10 Special Issue 3 December 2025
E-ISSN: 2456-5571

Artificial Intelligence for Advancing Sustainable Development Goals: Opportunities and Challenges

L. Cresenta Shakila Motha[1] & M. Evangeline Vanmathi[2]
[1&2]Assistant Professors, PG & Research Department of Rehabilitation Science
Holy Cross College (Autonomous), Tiruchirappalli
Affiliated to Bharathidasan University, Tiruchirappalli, Tamil Nadu

Open Access

Manuscript ID:
BIJ-SPL3-Dec25-ECO-039

Subject: Rehabilitation Science

Received : 21.08.2025
Accepted : 31.09.2025
Published : 31.12.2025

DOI: 10.64938/bijsi.v10si3.25.Dec039

Abstract

Artificial intelligence (AI) is reshaping sustainable economic development by offering transformative opportunities while posing significant hurdles in an era of rapid technological advancement. This study explores how AI can drive productivity gains, foster innovation, and support environmental goals, such as optimizing renewable energy systems to cut emissions and enabling precision agriculture for resource efficiency. Drawing on global frameworks like the SDGs, AI emerges as a tool for inclusive growth, potentially adding substantial value to economies through automation and data-driven insights. However, challenges including workforce displacement—impacting up to 40% of jobs in vulnerable markets—widening inequalities between nations, and the high energy demands of AI infrastructure, which could strain global electricity supplies, threaten equitable progress. A mixed-methods approach, incorporating thematic analysis of international reports and quantitative data from sources like UNCTAD and IMF, tests hypotheses on AI's productivity boosts and the need for governance to offset risks. Findings affirm that ethical frameworks and reskilling initiatives are essential to balance benefits, with policy recommendations emphasizing international collaboration, green tech subsidies, and alternative metrics for holistic impact assessment. Ultimately, aligning AI with sustainability requires proactive strategies to ensure resilient, fair economies that benefit all stakeholders amid ongoing evolution.

Keywords: artificial intelligence, sustainable development, economic productivity, job displacement, policy governance

Introduction

The advent of artificial intelligence (AI) marks a transformative era in human history, similar to the industrial revolutions of the past, but with unprecedented speed and scope. Sustainable economic development, defined as growth that meets the needs of the present without compromising the ability of future generations to meet their own, is increasingly intertwined with AI technologies. This integration presents a dual-edged sword: opportunities for enhanced productivity, innovation, and environmental stewardship, alongside challenges such as job displacement, inequality exacerbation, and resource-intensive computational demands. As we navigate the age of AI, understanding these dynamics is crucial for policymakers, businesses, and societies aiming to foster inclusive and resilient economies.

AI's role in economic development can be traced back to its foundational concepts in the mid-20th century, but its exponential growth in recent decades—fueled by advancements in machine learning, big data, and computational power—has accelerated its impact. According to recent analyses, AI could add trillions to the global economy by boosting productivity across sectors. For instance,

generative AI alone has the potential to automate tasks equivalent to 300 million full-time jobs, reshaping labor markets and economic structures. However, this potential is not uniformly distributed; emerging markets may face greater risks due to digital divides, with up to 40% of jobs potentially negatively impacted.

Opportunities abound in leveraging AI for sustainability. AI-driven tools can optimize resource use, predict environmental changes, and facilitate green innovations. For example, AI applications in renewable energy can enhance efficiency, potentially reducing global emissions by 1.8 GtCO2e annually in the power sector. In agriculture, AI enables precision farming, minimizing waste and boosting yields, which is vital for food security in a world facing climate change. Moreover, AI fosters innovation in circular economies, where predictive analytics can extend product lifecycles and reduce waste. The United Nations Development Programme's 2025 Human Development Report emphasizes AI's role in reshaping human possibilities, positioning it as a tool for advancing the Sustainable Development Goals (SDGs).

Yet, challenges loom large. One primary concern is the environmental footprint of AI itself. Training large models requires immense energy, with data centers projected to consume up to 8% of global electricity by 2030. This "energy paradox" highlights how AI's development could undermine sustainability efforts unless mitigated through efficient designs and renewable energy sourcing. Economically, AI may widen inequalities; high-income countries are better positioned to harness AI for growth, while low-income nations risk being left behind, exacerbating global divides. Job displacement is another hurdle, particularly for routine tasks, leading to skill polarization and potential unemployment spikes.

Internationally, frameworks like the OECD's AI Principles and the UN's AI for Good initiative underscore the need for ethical AI deployment to ensure sustainable outcomes. Nationally, countries like Canada are investing in AI ecosystems to drive innovation while addressing sustainability. In developing contexts, AI can bridge gaps in education and healthcare, but requires infrastructure investments to avoid dependency.

The paradox of AI innovation—creating sustainable value while potentially destroying it—demands balanced management. For sustainable economic development, AI must be aligned with SDGs, promoting inclusive growth. This involves rethinking metrics beyond GDP, such as GDP-B that accounts for well-being and environmental health. Education systems must evolve to prepare workforces for AI-augmented roles, emphasizing lifelong learning.

In summary, the age of AI offers a pivotal moment for sustainable economic development. By addressing challenges head-on and capitalizing on opportunities, societies can harness AI to build resilient, equitable economies. This paper explores these aspects through a comprehensive review, objectives, hypotheses, methodology, discussion, recommendations, and conclusion.

International and National Review of Literature

The literature on AI and sustainable economic development is burgeoning, reflecting global concerns over technological disruption and environmental imperatives. Internationally, key studies highlight AI's dual impact. The UNCTAD Technology and Innovation Report 2025 emphasizes inclusive AI for development, noting that AI can accelerate SDG progress but requires equitable access to avoid widening gaps. Similarly, the World Economic Forum's reports underscore AI's potential to reduce emissions across sectors while warning of workforce reductions in automatable tasks.

A Nature article from 2025 discusses AI's role in sustainable development research, enabling rapid analysis of complex data for environmental solutions. McKinsey's 2024 insights outline opportunities like AI-driven economic development in public sectors, balanced against challenges such as ethical implementation. The IMF's 2024 analysis reveals that AI could negatively affect 40% of jobs in emerging markets due to digital divides. OECD

reports on AI and skills future stress reskilling to mitigate labor market disruptions.

Nationally, literature varies by context. In the US, NBER's 2024 summary on transformative AI economics discusses frameworks for economic reshaping, including policy preparations. European studies, like those in Sustainability journals, explore AI's paradoxical effects on value creation and destruction. In Asia, research from China and India focuses on AI for green growth; a 2025 Nature Humanities & Social Sciences article examines AI investments in sustainable development, highlighting efficiency gains.

African perspectives emphasize AI's role in addressing poverty and climate challenges, but note infrastructure barriers. Canadian reports from ISED highlight AI ecosystems fostering job creation and sustainability. Overall, literature converges on the need for balanced AI governance to ensure sustainable economic benefits.

Objectives

1. To analyze the opportunities presented by AI in enhancing productivity and innovation for sustainable economic development.
2. To examine the challenges, including job displacement and environmental impacts, posed by AI adoption.
3. To propose policy frameworks that mitigate risks while maximizing AI's benefits for inclusive growth.

Hypothesis

1. AI integration will significantly boost economic productivity in sectors like agriculture and energy, leading to reduced emissions and enhanced sustainability.
2. Without adequate reskilling programs, AI will exacerbate income inequality and unemployment in developing economies.
3. Ethical AI governance frameworks will positively correlate with balanced sustainable development outcomes.
4. The environmental costs of AI training and deployment can be offset through renewable energy adoption and efficient algorithms.
5. Collaborative international efforts in AI technology transfer will accelerate sustainable economic development in low-income countries.

Methodology

This study employs a mixed-methods approach, combining qualitative literature review with quantitative data analysis from secondary sources. The research is primarily desk-based, drawing on reports from organizations like UNCTAD, OECD, and World Economic Forum published between 2020 and 2025. For international perspectives, we reviewed 50+ global reports and journal articles sourced via academic databases and web searches.

Qualitatively, thematic analysis was conducted using NVivo software to code themes such as "opportunities," "challenges," and "policy recommendations" from literature. This involved identifying patterns in how AI impacts SDGs.

Quantitatively, we analyzed datasets on AI's economic contributions, such as McKinsey's productivity estimates and IMF's job impact projections. Statistical tools like regression analysis were used to test hypotheses, correlating AI adoption rates (from Stanford AI Index 2025) with sustainability metrics like emission reductions.

Data collection was ethical, using publicly available sources. Limitations include reliance on secondary data, potentially biased towards Western perspectives; future studies could incorporate primary surveys from diverse regions.

Discussion

The discussion synthesizes findings on AI's role in sustainable economic development. Opportunities are evident in productivity gains; AI can automate routine tasks, freeing human capital for creative endeavors. In sustainable sectors, AI optimizes supply chains, reducing waste by up to 20% in manufacturing. For instance, AI in smart grids enhances energy efficiency, supporting the transition to renewables.

Challenges include labor disruptions; 40% of employers anticipate workforce reductions due to AI. This could lead to skill polarization, where high-skilled workers benefit while others lag. Environmentally, AI's carbon footprint is significant, with training one model equating to emissions from five cars' lifetimes. Inequality risks are pronounced in emerging markets.

Balancing these requires innovative metrics like GDP-B. Policy interventions, such as technology transfer, can aid global equity. Hypotheses are supported: AI boosts productivity but needs governance to avoid inequality.

Suggestions and Recommendations

1. Invest in reskilling programs to prepare workforces for AI-driven economies, focusing on digital literacy.
2. Develop ethical AI frameworks emphasizing sustainability, including carbon audits for AI projects.
3. Promote international collaboration for technology transfer to bridge digital divides.
4. Encourage AI applications in green tech, subsidizing innovations for emission reductions.
5. Adopt alternative economic metrics to measure AI's holistic impact.
6. Implement robust data privacy and security regulations in AI systems to build public trust and ensure equitable access, preventing misuse that could hinder sustainable development.
7. Foster public-private partnerships to accelerate AI adoption in sustainable practices, such as joint initiatives for climate modeling and resource management.
8. Integrate AI literacy into national education curricula from early stages to cultivate a future-ready workforce capable of leveraging AI for economic and environmental benefits.
9. Support research and development in energy-efficient AI algorithms and hardware to minimize the carbon footprint of AI technologies while maintaining performance.
10. Establish ongoing monitoring and evaluation mechanisms, including AI impact assessments aligned with SDGs, to adapt policies dynamically and address emerging challenges.

Conclusion

In conclusion, AI offers profound opportunities for sustainable economic development but demands careful navigation of challenges. By aligning AI with SDGs through inclusive policies, societies can achieve resilient growth. Future research should focus on real-time impacts to refine strategies. In conclusion, the age of AI presents a pivotal moment for sustainable economic development. By proactively addressing challenges through inclusive policies, ethical governance, and strategic investments, societies can harness AI to create economies that are resilient, equitable, and environmentally sustainable. The alignment of AI with SDGs offers a roadmap for progress, but it requires concerted efforts from all stakeholders to ensure that no one is left behind. As AI continues to evolve, ongoing research and adaptive strategies will be essential to maximize its potential while mitigating its risks, paving the way for a future where technology and sustainability coexist harmoniously.

References

Book References (APA 7th Edition)

1. Ghai, S. K., Rawal, R. B., Dhir, S., Lata Tripathi, S. (2025). *Artificial intelligence techniques for sustainable development*. CRC Press.
2. Kulkov, I. (Ed.). (2024). *Artificial intelligence and machine learning for sustainable development*. CRC Press.
3. Whig, P., Sharma, P., Aneja, N., Elngar, A. A., & Silva, N. (2024). *Artificial intelligence and machine learning for sustainable development*. CRC Press.

Website References

1. https://www.mckinsey.com/industries/public-sector/our-insights/using-ai-in-economic-development-challenges-and-opportunities

2. https://www.weforum.org/stories/2025/04/ai-jobs-international-workers-day/
3. https://unctad.org/system/files/official-document/tir2025_en.pdf
4. https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about
5. https://news.mit.edu/2025/explained-generative-ai-environmental-impact-0117