Journal
Of the
Oriental Institute
M.S. University of Baroda

ISSN: 0030-5324
UGC CARE Group 1

Artificial Intelligence as a Catalyst for Achieving Sustainable Development Goals in India: A Conceptual Review and Policy Perspective

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Abstract

India, as a rapidly developing economy and an active signatory to the United Nations 2030 Agenda for Sustainable Development, faces complex and interrelated challenges including poverty reduction, equitable healthcare access, quality education, environmental sustainability, and inclusive economic growth. Addressing these challenges requires innovative, scalable, and data-driven solutions beyond conventional policy mechanisms. In this context, Artificial Intelligence (AI) has emerged as a strategic technological enabler with significant potential to accelerate India's progress toward the Sustainable Development Goals (SDGs). This paper presents a conceptual and analytical review of AI-driven initiatives within the Indian context, systematically mapping AI applications to selected SDGs and critically examining their socio-economic and policy implications. Drawing on secondary data from government publications, NITI Aayog policy documents, United Nations SDG reports, and peer-reviewed academic literature, the study develops an India-specific AI–SDG mapping framework. The paper identifies key opportunities offered by AI adoption, along with structural constraints, ethical challenges, and governance gaps that may hinder its effective implementation. Furthermore, it proposes a policy-oriented roadmap for the responsible and inclusive deployment of AI aligned with India's sustainable development priorities. By integrating technological innovation with governance and sustainability considerations, the study contributes to the emerging literature on AI for sustainable development and offers practical insights for policymakers, researchers, and development practitioners.

Keywords: Artificial Intelligence, Sustainable Development Goals, India, Responsible AI, Digital Sustainability

1. Introduction

India's development trajectory is deeply intertwined with the objectives of the United Nations Sustainable Development Goals (SDGs), given the country's vast demographic scale, socio-economic heterogeneity, and persistent regional and developmental disparities. With a population exceeding 1.4 billion, India's progress toward sustainable development has significant global implications. The SDGs provide a comprehensive framework addressing critical issues such as poverty alleviation, quality education, healthcare accessibility, environmental sustainability, gender equality, and inclusive economic growth. While India has demonstrated notable advancements in several domains—particularly

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digital inclusion, renewable energy adoption, financial inclusion, and technological innovation—substantial challenges continue to impede holistic and equitable development.

Over the past decade, initiatives such as the Jan Dhan–Aadhaar–Mobile (JAM) trinity, the rapid expansion of digital payment platforms, and large-scale investments in renewable energy have strengthened India's institutional and infrastructural foundations. India has emerged as one of the world's leading producers of solar energy and has made commendable progress in expanding access to banking and digital services, particularly among previously underserved populations. Despite these achievements, systemic challenges persist in critical areas such as healthcare delivery, educational quality, urban governance, environmental protection, and climate resilience. Inequalities in access to quality public services between urban and rural regions, as well as across socio-economic groups, remain a major concern. These challenges are complex, interlinked, and dynamic, often extending beyond the capacity of traditional policy instruments and administrative mechanisms.

Conventional development approaches, which rely heavily on manual processes, fragmented data systems, and reactive decision-making, often struggle to address the scale and complexity of contemporary development challenges. Issues such as disease surveillance, learning outcome disparities, agricultural inefficiencies, urban congestion, pollution, and disaster risk management require predictive, adaptive, and data-driven solutions. In this context, emerging digital technologies—and Artificial Intelligence (AI) in particular—offer transformative potential to enhance governance effectiveness, optimize resource allocation, and improve service delivery outcomes. AI enables the processing and analysis of large volumes of structured and unstructured data, supports real-time decision-making, and facilitates predictive modeling, thereby offering new possibilities for sustainable development planning and implementation.

Artificial Intelligence, encompassing technologies such as machine learning, big data analytics, computer vision, and natural language processing, has rapidly evolved as a foundational technology shaping the Fourth Industrial Revolution. In the Indian context, AI has the potential to bridge critical development gaps by enabling precision, scalability, and efficiency across sectors. For instance, AI-driven diagnostic tools can improve early disease detection and healthcare accessibility in remote regions; adaptive learning platforms can personalize education and address learning gaps; precision agriculture technologies can optimize resource use and enhance farmer incomes; and smart city applications can improve urban mobility, energy efficiency, and waste management. These applications directly correspond to several SDGs, including SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Recognizing the strategic importance of AI, the Government of India has undertaken multiple policy initiatives to integrate digital technologies with national development priorities. The Digital India programme aims to transform India into a digitally empowered society and knowledge economy by expanding digital infrastructure, promoting digital literacy, and enabling technology-driven governance. Complementing this vision, the

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National Strategy for Artificial Intelligence, released by NITI Aayog under the theme "AI for All," emphasizes the use of AI for social empowerment, inclusive growth, and sustainable development. The strategy identifies priority sectors such as healthcare, agriculture, education, smart cities, and smart mobility, aligning AI adoption with SDG-linked outcomes.

More recently, the IndiaAI Mission has been launched to strengthen India's AI ecosystem by focusing on research and development, skill creation, data infrastructure, and responsible AI governance. The mission seeks to position India as a global leader in AI innovation while ensuring that AI technologies are deployed in a manner that is ethical, inclusive, and socially beneficial. Similarly, the Smart Cities Mission leverages AI and data analytics to enhance urban governance through intelligent traffic management systems, smart energy grids, real-time pollution monitoring, and predictive maintenance of public infrastructure. Collectively, these initiatives reflect a policy shift toward leveraging AI as a tool for sustainable and inclusive development rather than merely as a driver of economic growth.

However, alongside its transformative potential, the adoption of AI in India raises significant concerns related to governance, ethics, and sustainability. One of the most critical challenges is the digital divide, characterized by unequal access to digital infrastructure, affordability constraints, and varying levels of digital literacy across regions and social groups. Without deliberate policy interventions, AI-driven solutions risk exacerbating existing inequalities rather than alleviating them. Additionally, algorithmic bias arising from non-representative datasets can reinforce social discrimination, particularly in areas such as credit scoring, recruitment, and welfare targeting. Issues of data privacy, surveillance, and cybersecurity further complicate the deployment of AI in public systems, necessitating robust regulatory frameworks and accountability mechanisms.

Environmental sustainability also presents a paradox in the context of AI adoption. While AI can contribute to climate action through energy optimization, climate modeling, and disaster prediction, the growing energy consumption of data centers and high-performance computing systems poses environmental challenges of its own. This underscores the need for promoting "green AI" practices that emphasize energy efficiency and sustainable computing. Moreover, institutional capacity constraints at state and local levels often limit the effective implementation and governance of AI-driven initiatives, highlighting the importance of capacity building and inter-agency coordination.

Against this backdrop, the present paper examines how Artificial Intelligence can act as a catalyst for achieving the Sustainable Development Goals in India while critically assessing the associated risks and governance requirements. By adopting a conceptual and analytical approach, the study seeks to map AI applications to selected SDGs that are particularly relevant to the Indian context and to evaluate their socio-economic and policy implications. The paper emphasizes the importance of responsible AI governance, digital inclusion, and policy coherence in ensuring that AI-driven development is both sustainable and equitable.

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By situating AI within India's broader sustainable development agenda, this study contributes to the growing body of literature on AI for sustainability and development governance. It offers an India-centric perspective that integrates technological innovation with ethical, institutional, and policy considerations, thereby providing valuable insights for policymakers, researchers, and development practitioners. Ultimately, the paper argues that AI, when aligned with inclusive governance frameworks and sustainability objectives, can play a pivotal role in shaping India's development trajectory toward the realization of the Sustainable Development Goals.

2. Review of Literature

1. Global Context: AI as an SDG Multiplier

Research by the UN and major tech consortiums (e.g., Google's *AI in Action* 2025) confirms that AI can positively enable 79% of all SDG targets. Globally, the literature emphasizes that AI's role has evolved from simple automation to predictive governance.

- Synthesis: Scholars argue that AI is no longer just a "tool" but a "catalyst" that addresses the interdependencies between goals—for example, how improving AI in energy (SDG 7) directly accelerates industrial innovation (SDG 9) and climate action (SDG 13).

2. The Indian Landscape: "AI for All" and Digital Public Infrastructure (DPI)

Recent literature (Vasudev, 2025; NITI Aayog, 2025) highlights India's unique path. Unlike Western models, India's AI integration is built upon its Digital Public Infrastructure (Aadhaar, UPI, and Bhashini).

- Key Literature Point: NITI Aayog's *AI for Viksit Bharat* (2025) roadmap identifies India as a global leader in "frugal AI"—using low-compute, high-impact models to serve marginalized populations.
- The "IndiaAI Mission": Research highlights the ₹10,300 crore government investment (2024–2029) as a turning point for domestic AI research and semiconductor independence.

3. Sector-Specific Empirical Evidence in India

A. Agriculture (SDG 2: Zero Hunger)

- Precision Farming: Studies published in *Computers and Electronics in Agriculture* (2025) show that AI-driven neural networks in India now detect crop diseases with 95% accuracy.

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- Resource Efficiency: Reports from the World Economic Forum (2025) indicate that AI-powered irrigation and pest surveillance have reduced input costs by 15-20% for smallholder farmers in states like Telangana and Karnataka.

B. Healthcare (SDG 3: Good Health & Well-being)

- Accessibility: Recent reviews (ResearchGate, 2025) focus on AI-driven diagnostic tools and chatbots that bypass the doctor-to-patient ratio gap.
- Case Studies: Literature cites the use of AI in screening for diabetic retinopathy and tuberculosis in rural India, significantly lowering the "pilot-to-scale" gap that previously hindered public health.

C. Affordable Energy (SDG 7)

- Economic Impact: A 2025 study in the *EPRA International Journal* quantified that AI-driven renewable forecasting reduced grid integration costs in India by 18-25%, contributing a net present value of ₹1.45 lakh crore to the economy.

4. Policy Perspectives and Ethical Governance

The shift in 2026 literature is heavily toward Responsible AI.

- The Bias Gap: Researchers (Andrew, 2025) warn that AI datasets in India often lack linguistic and regional diversity, potentially leading to "digital exclusion" (SDG 10: Reduced Inequalities).
- Regulatory Frameworks: Policy reviews emphasize the transition from "voluntary guidelines" to "risk-based regulation." The 2025 *India Voluntary National Review* highlights the need for Standardized Data Governance to ensure privacy while fostering innovation.

5. Identified Research Gaps

While the literature is rich in sector-specific pilots, there is a lack of:

1. Longitudinal Impact Assessments: Most studies look at 1-2 year windows; there is a need for 5-year outlooks on AI's impact on employment.
2. AI-Energy Paradox: Limited domestic research on the carbon footprint of India's growing data center clusters vs. the carbon saved by AI optimizations.

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3. Objectives of the Study

1. To analyze the role of Artificial Intelligence in advancing Sustainable Development Goals in India
2. To map key AI applications to selected SDGs relevant to the Indian context
3. To identify challenges, ethical issues, and governance gaps in AI adoption
4. To propose policy recommendations for responsible and inclusive AI-driven sustainability

4. Research Methodology

This study employs a qualitative, conceptual research design aimed at synthesizing existing literature and policy frameworks to evaluate the catalytic role of Artificial Intelligence (AI) in achieving Sustainable Development Goals (SDGs) within the Indian context.

4.1 Data Collection Strategy

The study relies exclusively on secondary data published between 2015 (the inception of the SDGs) and 2026. The data were purposively sampled from four primary domains:

- Multilateral Reports: United Nations SDG India Index Reports (2019–2025) and UNDP reports on digital transformation.
- National Policy Documents: Strategic papers from NITI Aayog (e.g., *National Strategy for AI*), MeitY (Ministry of Electronics and Information Technology), and the IndiaAI Mission.
- Government Program Data: Progress reports from flagship initiatives such as *Digital India*, *Ayushman Bharat Digital Mission*, and *PM-Kisan*.
- Academic Literature: Peer-reviewed articles retrieved from Scopus, Web of Science, and Google Scholar using keywords such as "AI-SDG Nexus," "Frugal AI India," and "Digital Public Infrastructure (DPI)."

4.2 Data Analysis: Thematic Content Analysis

The analysis follows a Thematic Synthesis approach, which allows for the integration of findings from diverse sources into a cohesive framework.

1. Open Coding: Initial identification of AI applications (e.g., "AI in soil health," "AI in TB screening").
2. Axial Coding: Grouping these applications into broader SDG categories.
3. Cross-Mapping: Using a Matrix Analysis to link specific Indian AI policies to their corresponding SDG targets.

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4.3 The AI–SDG Mapping Framework

To visualize the "catalyst" effect, the study develops a mapping framework that evaluates AI interventions based on three criteria:

- Reach: Impact on marginalized or rural populations (SDG 1, 10).
- Scalability: Integration with India's Digital Public Infrastructure (UPI, Bhashini).
- Sustainability: Energy efficiency and environmental impact of the deployment (SDG 12, 13).

5. AI–SDG Mapping Framework in India

Table 1: Mapping of AI Applications with Selected SDGs in India

SDG	SDG Focus Area	AI Applications in India	Key Indian Initiatives
SDG 2	Zero Hunger	Precision farming, crop yield prediction	PM-KISAN, AI Sowing App
SDG 3	Good Health	AI diagnostics, telemedicine	eSanjeevani, Ayushman Bharat
SDG 4	Quality Education	Adaptive learning, AI tutors	DIKSHA, SWAYAM
SDG 8	Decent Work	Skill mapping, labour analytics	Skill India Digital
SDG 11	Sustainable Cities	Smart traffic, waste management	Smart Cities Mission
SDG 13	Climate Action	Climate modelling, disaster prediction	IMD AI Models

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6. Sector-wise Analysis

6.1 Healthcare (SDG 3)

AI-based tools are improving early diagnosis of diseases such as tuberculosis, cancer, and diabetic retinopathy, especially in rural India. Telemedicine platforms supported by AI triaging systems enhance accessibility and reduce healthcare inequities.

6.2 Education (SDG 4)

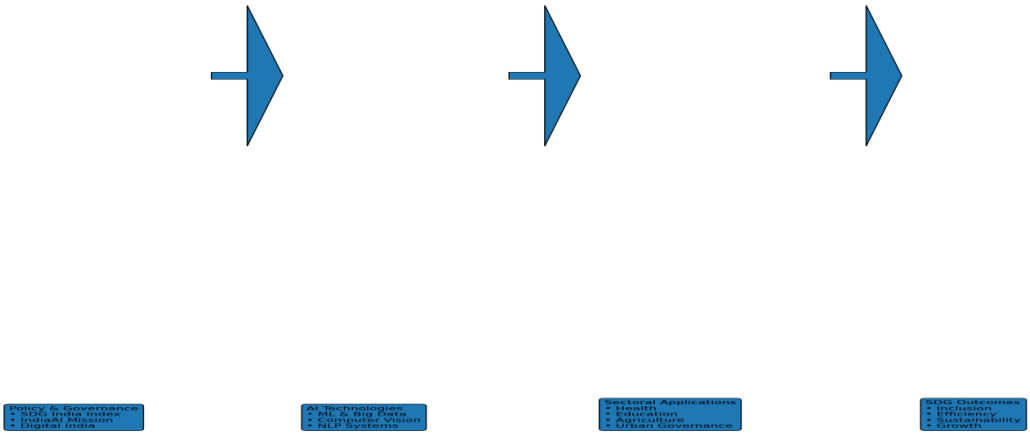
AI-driven platforms like DIKSHA and SWAYAM personalize learning content, track student performance, and support multilingual education, addressing regional and socio-economic disparities.

6.3 Agriculture and Food Security (SDG 2)

AI-enabled precision agriculture optimizes irrigation, fertilizer use, and pest management, contributing to farmer income stability and sustainable resource use.

6.4 Urban Governance and Climate Action (SDGs 11 & 13)

Smart city solutions use AI for traffic optimization, energy efficiency, air quality monitoring, and disaster risk reduction, enhancing urban sustainability and climate resilience.



7. Challenges and Ethical Concerns in India

- Digital divide between urban and rural regions
- Algorithmic bias due to non-representative datasets
- Data privacy and surveillance concerns
- High energy consumption of AI infrastructure
- Limited AI governance capacity at state and local levels

8. Policy Implications and Recommendations

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The synthesis of current policy documents—including the IndiaAI Mission (2024-2029) and the India AI Governance Guidelines (2025-26)—reveals five critical pillars for a sustainable AI-SDG nexus in India.

8.1 Strengthening Responsible AI Frameworks

India's AI governance has transitioned from voluntary guidelines to a "Risk-Based Regulation" model.

- Constitutional Alignment: Policies must ensure that AI algorithms adhere to the principles of *Equality* (Article 14) and *Non-arbitrariness*. This includes mandating "Ethical Impact Assessments" for AI used in welfare distribution (SDG 1 & 10).
- The Seven Sutras: Adoption of the FREE-AI (Framework for Responsible and Ethical Enablement of AI) principles: *Trust, People-First, Innovation over Restraint, Fairness, Accountability, Understandability, and Safety.*

8.2 Promoting Green AI and Energy-Efficient Infrastructure

As data center energy demand in India is projected to reach 1,000 TWh by 2026, "Green AI" is no longer optional.

- Mandatory Audits: Expand the *Energy Conservation Act (2001)* to include AI data centers as "Designated Consumers," requiring mandatory energy and water audits.
- Incentivizing SLMs: Provide tax credits for developers using Small Language Models (SLMs) that require significantly less compute power than frontier LLMs, specifically for local governance and agricultural applications.

8.3 State-Level AI Skilling and Institutional Capacity

To prevent a "Digital Intelligence Divide," the IndiaAI FutureSkills pillar must be decentralized.

- Tier 2 & 3 Focus: Establishing "AI-SDG Innovation Labs" in 174 identified ITIs and polytechnics across states to build a local workforce capable of maintaining SDG-focused AI tools.
- Public Sector Literacy: Mandatory AI-literacy certification for civil servants to ensure "AI-augmented governance" does not compromise citizen rights.

8.4 Public-Private-Academic (PPA) Partnerships

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The study recommends a "Mission Mode" approach for SDG targets that are currently off-track.

- The 7 Chakras of Cooperation: Aligning industry R&D with the seven areas of multilateral cooperation identified for the *India-AI Impact Summit 2026*, specifically focusing on Inclusion for Social Empowerment and Resilience.
- Sovereign Data Sets: Utilizing AIKosh (National Dataset Platform) to provide researchers with high-quality, anonymized Indian data to build "India-specific" solutions for healthcare and climate resilience.

8.5 Citizen-Centric Governance and Transparency

- Digital Product Passports: Implementing AI-driven tracking for e-waste (SDG 12), ensuring that the hardware powering the AI revolution is recycled within India's circular economy.
- Explainability Mandates: High-stakes AI systems (e.g., in healthcare or judicial assistance) must be "Understandable by Design," allowing citizens to contest AI-driven decisions through a dedicated AI Grievance Redressal Cell.

9. Empirical Research Framework

9.1 Research Model and Hypotheses

Based on the literature review and SDG–AI mapping, the study proposes an empirical framework where Artificial Intelligence adoption acts as an independent variable influencing SDG-oriented outcomes, mediated by governance quality and moderated by digital inclusion.

Hypotheses:

- H1: AI adoption has a significant positive impact on SDG achievement in India.
- H2: Responsible AI governance positively mediates the relationship between AI adoption and SDG outcomes.
- H3: Digital inclusion significantly moderates the relationship between AI adoption and sustainable development outcomes.

9.2 Proposed Conceptual Framework (Figure 1)

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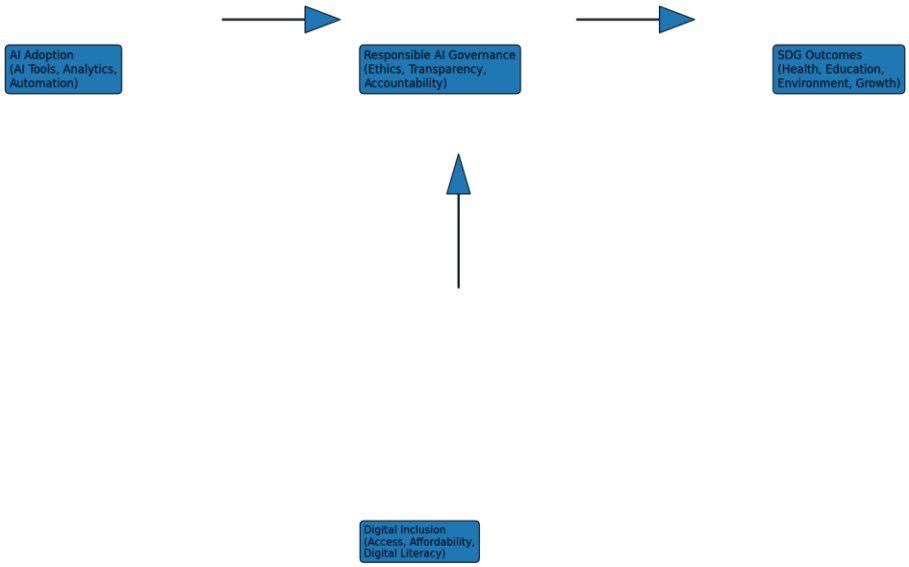

(Figure 1: AI-SDG Empirical Framework showing AI Adoption → Responsible Governance → SDG Outcomes, moderated by Digital Inclusion)

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10. Data Collection and Measurement (For Empirical Extension)

The empirical extension of this study may be conducted using primary data collected from policymakers, academicians, technology professionals, and development practitioners across India.

Sample Size: 300–500 respondents

Data Collection Tool: Structured questionnaire using a 5-point Likert scale

Key Variables:

- AI Adoption (automation, analytics, AI tools)
- SDG Outcomes (health, education, environment, governance)
- Responsible AI Governance (ethics, transparency, accountability)
- Digital Inclusion (access, affordability, digital literacy)

Statistical Tools: SPSS / AMOS / SmartPLS

- Reliability Analysis (Cronbach's Alpha)
- Factor Analysis
- Regression / SEM

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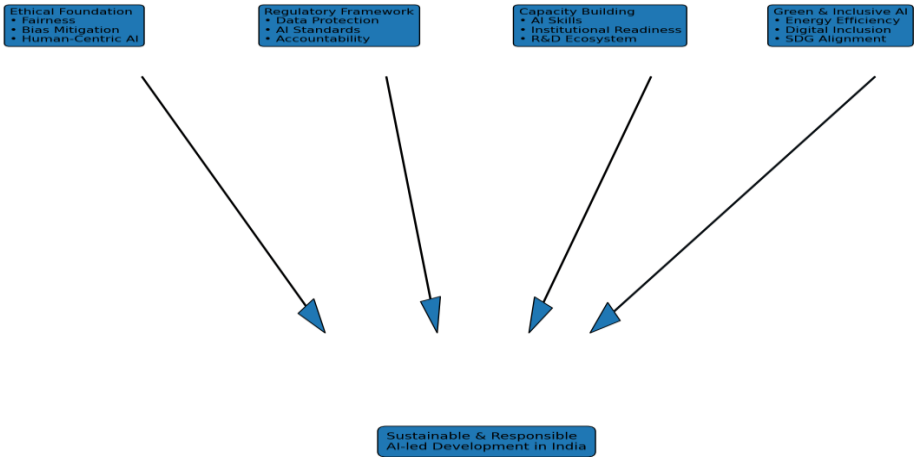
11. Policy Implications and Recommendations



1. Formulate a National Responsible AI Act aligned with SDGs
2. Mandate SDG impact audits for large-scale AI deployments
3. Promote Green AI incentives for energy-efficient computing
4. Decentralize AI governance to state and urban local bodies
5. Integrate AI–SDG metrics into the SDG India Index

12. Conclusion

This study establishes that Artificial Intelligence can act as a powerful catalyst for achieving the Sustainable Development Goals in India when deployed within a robust ethical, inclusive, and policy-driven framework. By integrating AI innovation with responsible governance and digital inclusion, India can leverage technology not merely for economic growth but for holistic and sustainable development. The proposed conceptual and empirical framework contributes to academic literature and offers actionable insights for policymakers and practitioners. Future research may empirically validate the model across sectors and regions.

13. Future Research Directions

Future research should focus on examining the long-term effects of Artificial Intelligence on Sustainable Development Goal indicators through longitudinal studies to establish causal relationships. Comparative state-wise analyses within India can provide insights into regional disparities in AI adoption and SDG performance, enabling more context-specific policy interventions. Further investigation is required to assess the environmental implications of AI, particularly the trade-offs between its sustainability benefits and the energy consumption of AI infrastructure. Additionally, citizen perception studies on AI governance, ethics, data privacy, and trust are essential to ensure socially acceptable, transparent, and human-centric AI implementation.

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