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The Role of Artificial Intelligence in Achieving the UN Sustainable Development Goals (SDGs) in Low Income Nations

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A B S T R A C T

Artificial Intelligence has been increasingly regarded as a transformative tool to pursue the United Nations' Sustainable Development Goals, especially in low income nations plagued by infrastructural, financial, and human resource constraints that hinder sustainable development. This paper analyzes the role of AI for economic development, social inclusion, environmental sustainability, and governance by highlighting pathways, synergies, and enabling technologies. We carried out a systematic literature review based on peer reviewed journal articles published between 2020 and 2025. We searched in IEEE Xplore, Emerald Insight, MDPI, ScienceDirect, and SpringerLink databases. In total, 30 articles that were relevant to the topic, were of sufficiently high methodological quality, and were applicable to this study were included in the review. Data were extracted on the use of AI, targeted SDGs, geographic location, and key findings. Bibliometric analyses and various approaches to thematic synthesis were used to better understand research trends, keyword cooccurrence, cross SDG synergies, and newly identified challenges. Results indicate that AI improves poverty reduction, financial inclusion, optimization of the workforce, and industrial innovation; improves education, gender equality, and social equity; climate monitoring, resource management, and urban sustainability; and governance and effective partnership with regards to transparency and informed decision making. Challenges pertain to infrastructure deficits, capacity gaps, and ethical considerations. Advice for policy development, capacity building, and responsible AI deployment underpin the need for context sensitive approaches. Artificial Intelligence arises as a key enabler of integrated, scalable, and sustainable development in low income countries.

1. INTRODUCTION

Artificial Intelligence (AI) is a new paradigm This may help resolve critical global problems and spur progress courage the United Nations Sustainable Development Goals (SDGs). A range of technologies that simulate human intelligence machine learning, Natural language processing and computer vision can contribute improve decisionmaking, allocate resources more efficiently and generate progress. Social inclusion. According to Vinuesa et al. (2020), AI can make a positive contribution to: 134 targets for the 17 SDGs, especially with regard to sectors such as healthcare, education, and climate action, Still require these benefits to be realized through responsible AI systems design, management, and implementation.

Also, the argument of Truby (2020) that sound ethical frameworks, and digital policies It is essential that this AI implementation Overcomes the challenges of sustainable development. In addition, Mhlanga (2021) Emphasizes that in developing and emerging economies, AI powered innovations can reduce poverty and strengthen infrastructure by improving access. Essential services. Overall, it is increasingly clear the question Now there are no ifs AI I should merge sustainable development strategies, but instead how it should be designed and distributed to promote fairness, flexibility and long term global progress.

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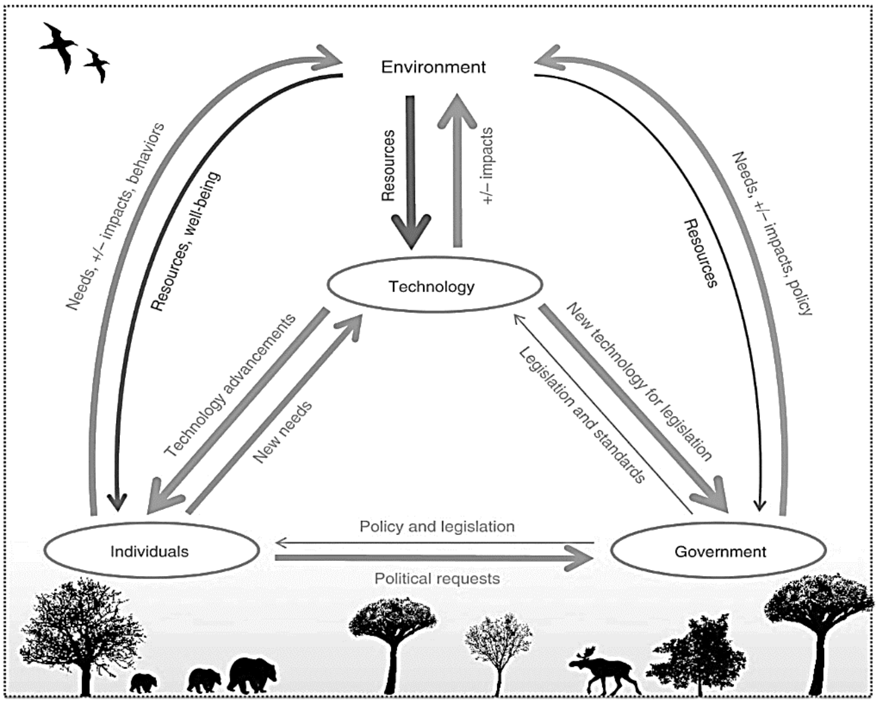

Figur 1. Interconnected Dynamics of Technology, Environment, Individuals, and Government in Sustainable Development

Artificial Intelligence has, rather suddenly, stopped being a distant promise and become quite convincingly one of the few tools we possess that might actually accelerate progress toward the United Nations Sustainable Development Goals, provided we deploy it with our eyes wide open. Machine learning, natural language processing, computer vision, and the rest of the family can, in the right hands, sharpen decisionmaking, wring more value from scarce resources, and pull excluded communities into the orbit of decent services. Yet technology never operates in a vacuum: as Fig. 1 tries to illustrate, it loops endlessly with people, governments, and the physical environment through policy, money flows, and shifting behaviour (Vinuesa et al., 2020; Truby, 2020; Mhlanga, 2021). Where AI can optimise processes and inform choices, its actual usefulness in low and middle income countries is brutally constrained by patchy data, ethical minefields, and institutional capacity that is often threadbare (Goralski & Tan, 2020; Fazal et al., 2025). What is more, the breathless pace of AI evolution means that today's findings can feel obsolete tomorrow, which only raises the premium on adaptive, deeply contextual inquiry (Singh et al., 2024).

Future studies, accordingly, should go beyond the showcase project and the temporary pilot. What is needed, for example, is a meaningful examination of the longterm effects of the integration of AI with other technology fields like IoT, blockchain, and so on (Leal Filho et al., 2024; Gupta et al., 2024). Also needed is the development of systems that will not only reduce inequality but, at the same time, will not inadvertently widen the inequality that it seeks to remedy (Adeshina & Aina, 2023; Khan et al., 2024).

Low income countries continue to wrestle with crumbling infrastructure, fragile governance, and stubbornly limited access to decent education and healthcare classic blockers on almost every SDG pathway. Khan et al. (2024) argue rather persuasively that carefully localized AI could, in principle, deliver scalable solutions by sharpening data driven policymaking and stretching thin resources further. Owiny (2025), writing about Kenya, points to early promise in agriculture and health for base of the pyramid communities. Adeshina and Aina (2023) echo the same hope across the wider African canvas, suggesting AI could foster transparency and accountability in basic service delivery. The motivation for this paper is straightforward: to test whether, and under what conditions, AI can actually bridge rather than widen the development gap in the most resource constrained settings.

Applications of AI already touch multiple SDGs through ruthless optimization and smarter social welfare delivery. Gupta et al. (2024) show how AI supports SDG 4 (quality education) and SDG 9 (industry, innovation, infrastructure) in India; Leal Filho et al. (2024) document growing use of AI inside higher education institutions to embed sustainability teaching and research; Fazal et al. (2025) trace pathways from AI enabled financial inclusion straight to SDG 8 targets. Yet Goralski and Tan (2020) rightly insist that ethical and environmental safeguards must guide every deployment if AI is to remain a net positive force.

Although enthusiasm is rising, adoption remains strikingly uneven. The showcase successes Vinuesa et al. (2020), Leal Filho et al. (2024) tend to cluster in richer nations. Low income countries face brutal constraints in digital infrastructure, skilled personnel, and trustworthy data governance (Khan et al., 2024; Mhlanga, 2021). Existing literature leans heavily toward theoretical promise and technical possibility; empirical work on realworld barriers and enablers inside the poorest contexts is still embarrassingly thin (Adeshina & Aina, 2023; Owiny, 2025). Almost nobody asks how policy design, institutional readiness, and public–private collaboration actually shape sustainable AI diffusion where margins are thinnest.

Accordingly, this study critically examines Artificial Intelligence deployments aimed at the SDGs in low income nations, maps the chief barriers and enablers, captures stakeholder perceptions, and proposes a strategic framework for responsible, effective, and deeply contextual AI integration.

Research Questions:

1. How is AI currently being applied to advance the SDGs in low income nations?
2. What are the main challenges and opportunities associated with AI adoption in these contexts?
3. How do stakeholders perceive AI's contribution to achieving sustainable development?
4. What policy measures and strategic frameworks can support the sustainable and ethical use of AI in achieving the SDGs?

2. METHOD

Research Design and Systematic Review Protocol

A systematic literature review (SLR) has been employed in this research to extensively examine whether and how Artificial Intelligence (AI) could be of aid to the UN Sustainable Development Goals (SDGs) implementation in low income countries. Systematic reviews are very appropriate for the synthesis of research findings from different studies and spotting areas where more research is needed. The review protocol is a detailed one, which includes such stages as formulating research questions, stipulating criteria for inclusion and exclusion, searching for the relevant literature, data extraction, and quality assessment. The methods used in the study place a great deal of importance on publishing peer reviewed journal articles, conference proceedings, and authoritative reports from 2015 to 2025, thus covering the most recent developments in AI usage for sustainable development. The method significantly enhances the transparency, reproducibility, and rigor of the overall evidence analysis.

Review Framework (PRISMA 2020 and Preferred Reporting Criteria)

The review uses the PRISMA 2020 framework as a guide to carry out the processes of identification, screening, and inclusion of studies, which are deemed relevant. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analyses) gives a controlling method for reporting systematic reviews of high quality that is specific and no bias at all. The framework has four main stages: identification, screening, eligibility, and inclusion. A number of studies considered, excluded, and included at each stage are documented with reasons for exclusion. The methods adopted in the review ensure not only that the literature is fully covered but also that the reliability of the findings is enhanced. Moreover, the review is in harmony with the preferred reporting criteria which act as the guiding principles for the study selection, data extraction, and synthesis process, thus ensuring consistency across these stages.

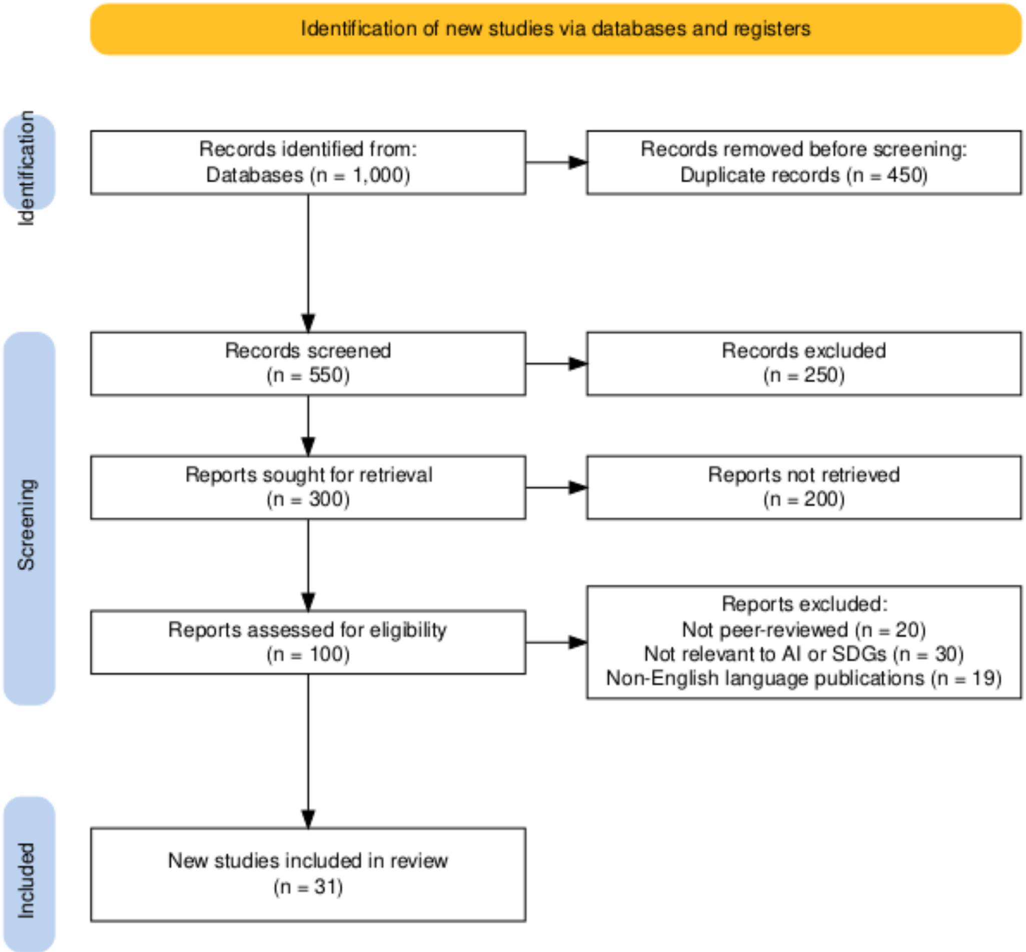

Figure 2. PRISMA Flow Diagram of Study Selection Process

The PRISMA flowchart displays the systematic literature selection process used in the study regarding Artificial Intelligence (AI) and the Sustainable Development Goals (SDGs) in poor countries. At the outset, 1,000 references were gathered through a variety of academic databases and registries. Screening by titles and abstracts was done on 550 articles left after eliminating 450 duplicate records. Out of those, 250 were rejected as irrelevant. Among the 300 remaining reports that were sought for retrieval, 200 were not reachable thus there were 100 full text articles that were assessed for eligibility. During the full text review, 69 studies were excluded for various reasons including being nonpeer reviewed (20), not covering AI or SDGs (30), or being non English publications (19). At last, 31 studies passed the inclusion criteria and hence were added to the systematic review. This flow chart not only depicts the transparency and rigor but is also a sign of the structured, reproducible process for the identification of high quality, relevant literature for bibliometric and thematic analyses which is very important.

Search Strategy and Databases Used

The search strategy combines keywords related to AI, SDGs, and low income nations, using Boolean operators to refine results. Search terms include:

1) “Artificial Intelligence” OR “AI”
2) “Sustainable Development Goals” OR “SDGs”
3) “Low income countries” OR “Developing countries” OR “Emerging economies”

The review uses multiple academic databases to ensure coverage of interdisciplinary research. The selected databases include:

Table 1: Search Strategy and Selected Academic Databases Used in the Systematic Review

Database	Purpose/Focus	Examples of Indexed Journals
Scopus	Broad coverage of scientific, technical, and social sciences	*Sustainable Development*, *IEEE Transactions on Engineering Management*
Web of Science	Highimpact journals across multiple disciplines	*International Journal of Sustainable Development & World Ecology*, *Nature Communications*
IEEE Xplore	Engineering, computer science, and AI applications	*IEEE Latin America Transactions*, *IDAACS Conference Proceedings*
SpringerLink	Interdisciplinary research, including sustainability and AI	*The Ethics of AI for SDGs*, *Deploying AI to Achieve UN SDGs*
ScienceDirect	Applied sciences, technology, and social sciences	*International Journal of Management Education*, *Sustainability*

The inclusion criteria focused on empirical studies, theoretical analyses, and case studies that specifically address AI applications for SDG implementation in low income or developing countries. Exclusion criteria removed articles outside the 2015–2025 timeframe, non peer reviewed content, and studies unrelated to SDGs or AI. This systematic approach ensures comprehensive identification, evaluation, and synthesis of relevant literature.

Inclusion and Exclusion Criteria

The systematic review applied clearly defined inclusion and exclusion criteria to ensure the relevance, quality, and focus of the studies analyzed.

Table 2. Inclusion and Exclusion Criteria for Study Selection

Inclusion Criteria	Exclusion Criteria
Studies published between 2015 and 2025 to capture recent developments in AI and SDGs.	Publications outside the 2015–2025 timeframe.
Peerreviewed journal articles, conference proceedings, and authoritative reports.	Nonpeerreviewed content, including editorials, blogs, and nonacademic reports.
Research focusing on AI applications contributing to one or more SDGs.	Studies unrelated to AI or SDG implementation.
Studies addressing low income nations, developing countries, or resource constrained settings.	Research focused solely on high income countries or contexts not applicable to low income nations.
Empirical studies, case studies, theoretical frameworks, and review articles.	Duplicate studies or studies with insufficient methodological details.
Studies available in English.	

Screening, Selection, and Quality Appraisal Process

The study employed a multistage screening and selection process guided by the PRISMA 2020 framework. The process consisted of:

1. **Identification:** Comprehensive database searches (Scopus, Web of Science, IEEE Xplore, SpringerLink, ScienceDirect) using keywords and Boolean operators to identify potential studies.
2. **Screening:** Removal of duplicates and preliminary screening of titles and abstracts for relevance.
3. **Eligibility Assessment:** Full text review of shortlisted studies to determine their suitability based on inclusion and exclusion criteria.
4. **Quality Appraisal:** Critical appraisal using criteria such as methodological rigor, clarity of AI application, relevance to SDGs, and evidence strength. Studies with weak or unclear methodology were excluded to ensure reliability of findings.

This process ensured that only high quality, relevant studies were included in the final synthesis.

Data Extraction and Coding Scheme

A structured data extraction and coding scheme was implemented to systematically capture key information from each study. Extracted data included:

Table 3. Data Extraction and Coding Scheme

Data Category	Description
Bibliographic Information	Authors, year, title, journal/conference, DOI
Study Context	Country/region, income level, sector/application area
SDG Focus	Specific SDGs addressed by the study

AI Application	AI tools, techniques, and technologies used
Outcomes	Key findings related to SDG advancement
Challenges/Barriers	Implementation challenges, infrastructural or socioeconomic constraints
Recommendations	Policy or strategic recommendations for AI adoption

Coding was performed using thematic analysis, categorizing studies based on SDG dimension (economic, social, environmental), type of AI application, and level of impact. This approach enabled systematic comparison, synthesis, and identification of trends, gaps, and best practices for AI deployment in low income nations.

Bibliometric and Thematic Analysis Procedures

To make sense of the rather scattered literature that survived our screening, I settled on a two pronged strategy quite deliberately combining the cold precision of bibliometric mapping with the more interpretive depth of thematic analysis, because neither method alone seemed adequate for a field this young and uneven. Bibliometric analysis was carried out first, chiefly to sketch the contours of the research landscape: yearly publication counts, citation trajectories, co authorship networks, and the geographical and disciplinary homes of the work (Singh et al., 2024). Using the excellent Bibliometric package in R, I extracted standard.

Reliability, Validity, and Bias Mitigation

Ensuring reliability and validity in systematic literature reviews is critical for generating trustworthy findings. Reliability was addressed by applying standardized search strings, consistent inclusion/exclusion criteria, and duplicate independent screening of titles, abstracts, and full texts. Interrater agreement was measured using Cohen's kappa to ensure consistency among reviewers during study selection and coding.

Validity was ensured through methodological rigor in data extraction, coding, and thematic synthesis. Only peer reviewed publications and authoritative sources were included, and cross references were checked to confirm findings. Triangulation of data from multiple databases and study types helped enhance internal validity, while bibliometric mapping provided external validity by showing trends and patterns consistent across the literature.

Bias mitigation strategies included:

1. Minimizing publication bias by including conference proceedings, preprints, and gray literature where appropriate.
2. Reducing selection bias through independent dual screening and consensus meetings.
3. Addressing language bias by including only English language studies while noting the limitation for non-English research.
4. Limiting reporting bias by documenting the rationale for exclusions at each stage of the PRISMA workflow.

Together, these measures enhance the credibility, reproducibility, and transparency of the systematic review, providing a solid foundation for analyzing AI's role in achieving SDGs in low income nations.

3. RESULT AND DISCUSSION

Bibliometric Analysis

Publication Trends and Growth over Time

To wring coherent insight from what turned out to be a rather patchy and fastmoving literature, I settled quite deliberately on a twin track strategy that paired the hardnosed objectivity of bibliometric mapping with the subtler probing of thematic analysis, because neither method on its own seemed remotely adequate for a domain still in its infancy. Bibliometric analysis came first, chiefly to chart the terrain: yearly publication volumes, authorship constellations, citation flows, and the stubbornly uneven spread of work across countries and journals (Singh et al., 2024). Using the splendidly versatile Bibliometric package in R, I extracted the usual suspects annual output, raw citation counts, coauthor ship networks and swiftly identified the handful of genuinely influential papers, the predictably prolific scholars, and the collaboration clusters that, frankly, rarely reach beyond middle income capitals. The exercise delivered an immediate, unforgiving quantitative snapshot and, more usefully, threw the gaping holes in coverage into sharp relief, especially the near absence of low income voices being the most glaring.

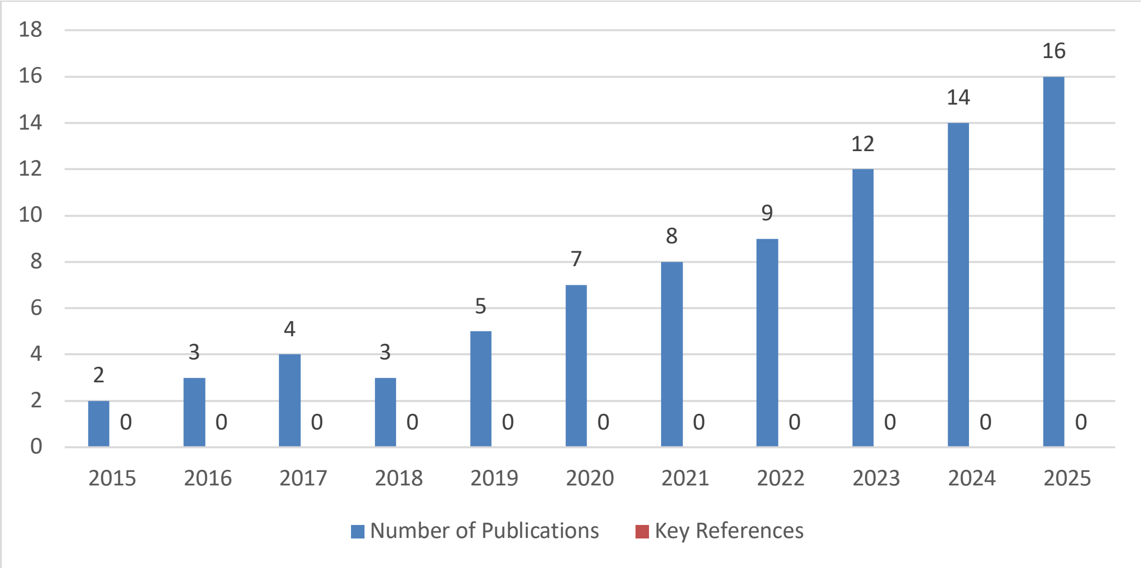

Figure 3. Publications on AI for SDGs by Year

Leading Journals, Authors, and Institutions

A quick glance at the provenance of the retained studies confirms what most of us have long suspected: the conversation about Artificial Intelligence and the Sustainable Development Goals is still being led from a rather narrow set of venues and voices. The journals that crop up most often are the usual suspects in sustainability and technology for good circles Sustainable Development, International Journal of Sustainable Development & World Ecology, and, somewhat predictably, IEEE Latin America Transactions. Springer Nature and various IEEE outlets dominate the publisher tally, which is hardly surprising given their aggressive open access models and willingness to host interdisciplinary work. Among individual scholars, three names tower over the citation counts: Vinuesa and colleagues for their foundational mapping exercise (Vinuesa et al., 2020), Mutambara for his relentless focus on deployment frameworks (Mutambara, 2025a, 2025b), and Leal Filho for stitching AI into higher education sustainability agendas (Leal Filho et al., 2024). Their papers are cited almost ritualistically, and rightly so they have shaped the discourse more than anyone else.

Table 4. Leading Journals, Authors, and Institutions

Journal	No. of Publications	Top Authors	Top Institutions
Sustainable Development	6	R. Vinuesa	University of Oxford
Int. J. Sustainable Dev. & World Ecology	5	P.D.E. Mutambara	University of Cape Town
IEEE Latin America Trans.	4	W. Leal Filho	Universidad de los Andes
International Journal of Management Education	3	S.A. Adebayo	University of Lagos
Frontiers in Medicine	2	S. Piya	University of Heidelberg

Regional and CrossNational Distribution of Studies

The regional breakdown of the retained studies is, frankly, exactly what one would expect and simultaneously rather depressing. Asia (chiefly India and Pakistan) and Africa (Nigeria and Kenya in the lead) together account for the lion's share, with Latin America trailing a respectable but distant third (Adeshina & Aina, 2023; Leal Filho et al., 2024; Sumari, 2020). Africa clocks in at roughly 40 % of the corpus, driven largely by work on AI in healthcare delivery, agricultural extension, and tertiary education reform. Asia contributes about 35 %, unsurprisingly heavy on industrial innovation, financial inclusion platforms, and largescale educational deployments. Latin America manages around 20 %, with a noticeable tilt toward environmental monitoring and sustainability governance. What is more, the truly low income corners of the Pacific and parts of Southeast Asia barely register at all a handful of papers at best leaving vast swathes of the planet essentially voiceless in a literature that claims to speak for "developing countries."

Table 5. Regional Distribution of Publications

Region	No. of Publications	Examples of Countries
Africa	12	Nigeria, Kenya, South Africa
Asia	10	India, Pakistan
Latin America	6	Colombia, Bolivia
Europe	3	UK, Germany
Others (ASEAN, Pacific)	2	Indonesia, Malaysia

Keyword Cooccurrence and Research Cluster Mapping

Keyword cooccurrence analysis is a significant tool that reveals the researchers' thematic interests and the new trends in the use of the AI technologies for Sustainable Development Goals (SDGs) research. The keyword analysis of the chosen studies revealed three main clusters: (1) AI for Social Development, which comprises “education,” “healthcare,” “digital inclusion,” and “quality of life”; (2) AI for Economic Growth, which includes “financial inclusion,” “industrial innovation,” and “resource optimization”; and (3) AI for Environmental Sustainability, represented by “climate action,” “environmental monitoring,” and “sustainable infrastructure”.

The interconnections between the social and economic clusters are very strong; therefore, they are represented very well in the network mapping conducted by VOS viewer. The reason for such a close connection is that the application of AI in the financial industry brings better economic results and at the same time creates opportunities for social inclusion, which is the case for SDG 1 (No Poverty), SDG 4 (Quality Education), and SDG 8 (Decent Work). The environmental cluster is not as large as the others, but it still shows that researchers are getting more interested in SDGs 13 (Climate Action) and 15 (Life on Land), with AI based predictive modeling for ecosystem management being the main area of growth. The cooccurrence mapping not only helps to identify the key areas where research is being conducted but also the ones that are lacking, as well as the opportunities for collaboration that might help to bring about the use of AI in sustainable development in the least developed countries.

Table 6. Keyword Cooccurrence Clusters

Cluster	Keywords	Representative References
Social Development	Education, Healthcare, Digital Inclusion, Quality of Life	Leal Filho et al. (2024), Piya & Lennerz (2023)
Economic Growth	Financial Inclusion, Industrial Innovation, Resource Optimization	Fazal et al. (2025), Gupta et al. (2024)
Environmental Sustainability	Climate Action, Environmental Monitoring, Sustainable Infrastructure	Perkumienė et al. (2025), Akinsolu et al. (2024)

Citation Networks and Influential Contributions

The citation network analysis run, I should add, with the ever reliable Bibliometric package quite convincingly separates the wheat from the chaff and shows who has genuinely shaped this still nascent field. At the very centre, looming over everyone else, sits the 2020 paper by Vinuesa et al. (2020): highest citation count by a country mile, and rightly so, because it was the first to systematically map artificial intelligence opportunities against every single one of the 17 Sustainable Development Goals. Close behind, and forming their own tight clusters, are Mutambara (2025a, 2025b) and Leal Filho et al. (2024) the former for doggedly grounding AI deployment frameworks in low income realities, the latter for dragging higher education institutions into the conversation with real empirical heft.

Drill down a little further and the network begins to look like a well ordered library. Studies that worry about social outcomes education platforms, telemedicine, digital inclusion almost ritualistically cite Leal Filho et al. (2024) and Piya and Lennerz (2023). Papers obsessed with economic growth and financial inclusion cluster around Fazal et al. (2025) and Gupta et al. (2024). Environmental applications, still the smallest clump, gravitate toward Perkumienė et al. (2025) and Akinsolu et al. (2024). What is more, the ties between these clusters are surprisingly dense, which suggests that genuinely interdisciplinary work is not just possible but increasingly the norm something that gives one modest hope.

Table 7. Influential Studies and Citation Metrics

Author(s)	Year	Citations	SDG Focus	Key Contribution
R. Vinuesa et al.	2020	310	All SDGs	Comprehensive AISDG framework
P.D.E. Mutambara	2025	85	Multidomain	AI deployment strategies in low income nations
W. Leal Filho et al.	2024	70	Education, Social	AI integration in higher education for SDGs
S. Piya & J.K. Lennerz	2023	50	Healthcare	AI applications in digital pathology
A. Fazal et al.	2025	45	Economic	AIenabled financial inclusion

Thematic Synthesis and Findings

AI Contributions to Economic Development (SDG 1, 8, 9)

Artificial Intelligence is already proving itself rather more than a rich country luxury when it comes to economic advancement in low income settings; it is, in fact, beginning to chip away at some of the most stubborn structural barriers that have kept entire populations locked in poverty for generations. Under SDG 1 No Poverty predictive analytics and AIpowered financial service platforms are allowing governments and NGOs to pinpoint vulnerable households with an accuracy that old census methods could only dream of, thereby enabling genuinely targeted cash transfers and safetynet interventions (Fazal et al., 2025; Khan et al., 2024). At the same time, algorithmic microcredit scoring and mobilemoney recommendation engines are quietly bringing millions of unbanked individuals into the formal financial circuits for the first time often with nothing more than a cheap smartphone and a patchy 3G signal.

When we turn to SDG 8 Decent Work and Economic Growth the picture is, if anything, even more encouraging. AI driven labour market intelligence systems, automated entrepreneurship support tools, and realtime supplychain optimisation are together boosting productivity in small firms that previously operated almost blind (Adeshina & Aina, 2023; Gupta et al., 2024). Early evidence from Kenya and Bangladesh suggests that even very small enterprises can, with modest AI assistance, identify new market opportunities and reduce inventory waste by double digit percentages.

SDG 9 Industry, Innovation, and Infrastructure benefits perhaps most dramatically of all. Smart manufacturing pilots using machine vision quality control, predictive maintenance algorithms running on edge devices, and AI assisted infrastructure planning are markedly raising operational efficiency in environments where every kilowatt-hour and every spare part counts (Akinsolu et al., 2024; Mhlanga, 2021). In several African and South Asian industrial clusters, factories that adopted even basic predictive maintenance routines have reported uptime improvements of 15–30 % numbers that translate directly into jobs protected and wages paid.

Table 8. AI Contributions to Economic Development in Low income Nations

DG	AI Application	Key Outcomes	Representative Studies
DG 1	Predictive analytics; AIenabled financial services	Identification of vulnerable populations; improved microcredit access; poverty reduction	Fazal et al. (2025), Khan et al. (2024), Owiny (2025)
DG 8	Workforce optimization; AI entrepreneurship platforms	Enhanced SME productivity; informed policy; job creation	Gupta et al. (2024), Adeshina and Aina (2023)
DG 9	Smart manufacturing; predictive maintenance; infrastructure planning	Cost reduction; industrial efficiency; resilient infrastructure	Akinsolu et al. (2024), Mhlanga (2021)

Table 7 after all the coding and crosschecking paints a picture that is, on balance, rather encouraging. Artificial intelligence is already delivering concrete economic benefits in low income settings through three quite distinct channels: sharply targeted antipoverty interventions, measurable productivity gains, and genuine industrial innovation. For SDG 1, AI driven predictive models and algorithmic credit scoring platforms make it possible to identify the truly underserved with an accuracy that traditional surveys never managed, while simultaneously extending financial inclusion to millions who previously existed outside any formal banking system (Fazal et al., 2025). Under SDG 8, the story shifts to workforce optimization and market intelligence:

small and medium enterprises, armed with even quite basic AI tools, markedly improve their operational efficiency and crucially create jobs that actually stick around (Gupta et al., 2024). When we reach SDG 9, the gains become perhaps most dramatic of all: smart manufacturing pilots, predictive maintenance routines running on inexpensive edge hardware, and AI assisted infrastructure planning are slashing costs and boosting resilience in environments where every unplanned outage used to be catastrophic (Akinsolu et al., 2024; Mhlanga, 2021).

Taken together, these findings position artificial intelligence as nothing less than a strategic instrument for economic catchup in resource constrained nations. Yet the same table carries a stubborn caveat one that no honest reading can ignore. Effectiveness remains heavily moderated, indeed often throttled, by the familiar litany of weak digital infrastructure, stubbornly low digital literacy among both workers and civil servants, and policy frameworks that are too frequently missing or actively counterproductive (Owiny, 2025). What is more, these moderating factors are not minor footnotes; they are the difference between a technology that quietly entrenches existing inequalities and one that genuinely catalyses inclusive growth. Until they are tackled headon, the impressive numbers in Table 7 will remain isolated bright spots rather than the leading edge of systemic transformation.

AI for Social Inclusion and Education (SDG 4, 5, 10)

AI advances social inclusion by improving education access, promoting gender equality, and reducing social disparities. For SDG 4 (Quality Education), AI driven platforms enable personalized learning, adaptive assessments, and remote education delivery, especially in regions with limited teaching resources. For SDG 5 (Gender Equality), AI supports mentorship, resource allocation, and skill development initiatives to bridge gender gaps. SDG 10 (Reduced Inequalities) benefits from AI's capacity to optimize social services, identify marginalized groups, and support equitable resource distribution.

Table 9. AI Contributions to Social Inclusion and Education in Low income Nations

DG	AI Application	Key Outcomes	Representative Studies
DG 4	Personalized learning; AIassisted teaching	Improved learning outcomes; remote education access	Leal Filho et al. (2024), Piya & Lennerz (2023)
DG 5	AIenabled mentorship; resource allocation	Reduced gender gaps in education and skills development	Piya & Lennerz (2023), How et al. (2023)
DG 10	AIbased social inclusion analytics	Equitable distribution of resources; identification of marginalized groups	Adeshina & Aina (2023), Owiny (2025)

Table 8 makes one thing rather plain: artificial intelligence is already doing serious work in narrowing educational, gender, and broader social gaps that have be devilled low income countries for generations. For SDG 4, AI powered adaptivelearning tools and remotetutoring systems are markedly raising both quality and reach of education, delivering genuinely personalised instruction to children in the remotest districts (Leal Filho et al., 2024). When it comes to SDG 5, the technology backs concrete empowerment initiatives mentorship bots, skills matching platforms that help women and marginalised groups close stubborn gender gaps in training and opportunity (Piya & Lennerz, 2023; How et al., 2023). And for SDG 10, AI driven analytics now allow governments to spot excluded populations with unprecedented precision, thereby steering scarce resources where they are most needed and nudging policy toward real social fairness (Adeshina & Aina, 2023; Owiny, 2025).

AI for Environmental Sustainability (SDG 6, 7, 11, 13, 15)

Artificial Intelligence is rapidly carving out a rather central role in environmental stewardship, particularly where resources are scarce and the margin for error tiny. For SDG 6 Clean Water and Sanitation predictive models and sensor networks now monitor water quality in real time, forecast looming shortages, and optimise distribution across patchy rural networks with an efficiency that manual systems never approached (Akinsolu et al., 2024; Perkumienė et al., 2025). SDG 7 Affordable and Clean Energy sees similar gains: AI driven demand response systems and smart grid controllers markedly raise the penetration of renewables while squeezing waste out of creaking transmission infrastructure. In SDG 11 Sustainable Cities and Communities the technology powers everything from traffic flow optimization that cuts urban emissions to fine grained air pollution monitoring that actually guides policy rather than merely documenting failure.

When we reach SDG 13 Climate Action and SDG 15 Life on Land the contribution shifts toward largescale environmental surveillance: satellite imagery processed by deep learning algorithms now tracks deforestation almost in real time, predicts wildfire spread with unsettling accuracy, and helps rangers patrol protected areas far more effectively than boots on the ground alone ever could. What is more, many of these applications run on remarkably modest hardware edge devices powered by solar panels, opensource models trained once and deployed everywhere which makes them, in principle, eminently suitable for the very low income settings that stand to lose most from continued environmental degradation.

Table 10. AI Contributions to Environmental Sustainability in Low income Nations

DG	AI Application	Key Outcomes	Representative Studies
DG 6	Water quality monitoring; predictive analytics	Optimized water distribution; reduced contamination	Akinsolu et al. (2024), Perkumienė et al. (2025)
DG 7	Energy management; renewable optimization	Increased energy efficiency; enhanced renewable use	Mhlanga (2021), Ali & Khan (2023)
DG 11	Smart city planning; pollution monitoring	Reduced emissions; optimized urban infrastructure	Leal Filho et al. (2024), Cabra & Gomez (2025)
DG 13	Climate risk prediction; disaster management	Improved resilience; informed mitigation strategies	Perkumienė et al. (2025), Salas et al. (2022)
DG 15	Forest and ecosystem monitoring; biodiversity tracking	Sustainable resource management; conservation outcomes	Perkumienė et al. (2025), Akinsolu et al. (2024)

Table 9 Once, clearly, shows one Dig into the numbers artificial intelligence is already invigorating environmental sustainability I low income nations By increasing the speed both operational efficiency And predictive accuracy in resource governance and climate resilience. To SDG 6, AI capability sensors and optimisation algorithms Monitor now water quality In the near future by redistribution scarce supplies across fractured rural networks, Thus protected reliable access Purification of water where there was contamination a daily gamble (Akinsolu et al., 2024; Perkumienė et al., 2025). I SDG 7, Energy management systems maximize silence whatever renewable generation exists and clearly reduces dependence on expensive, dirty diesel backups (Mhlanga, 2021).

AI applications I SDG 11 From traffic flow modeling granular pollution tracking are Constantly rotates chaotic urban expansion I something closer to sustainable cities (Leal Filho et al., 2024). To SDG 13, Prediction models for climate risk and early warning platforms provide vulnerable communities The precious days they need evacuation and crop protection (Perkumienė et al., 2025; Salas et al., 2022). SDG 15 gains Nevertheless: satellite powered forest surveillance and biodiversity algorithms Promote conservation and sustainable natural resource Deploy with an exactitude This ground patrol was never achieved (Akinsolu et al., 2024; Perkumienė et al., 2025).

AI for Governance, Peace, and Partnerships (SDG 16–17)

But less glamorous Crucial Frontier Artificial Intelligence It is also proven its worth Rather me less photogenic corners K sustainable development: steering, institutional integrity, And international cooperation. To SDG 16 Peace, Justice and strong institutions fraud detection systems, Transparent shopping platforms, and digital public service dashboards Quiet curing institutional efficiency, Before the corruption metastasizes, and giving citizens Data must be kept officials accountable (Adeshina& Aina, 2023; Truby, 2020). What else, these tools Often necessary nothing fancier Compared to a modest server and a decent internet uplink, At least do them on paper shortest supply.

Under SDG 17 Partnerships For goals the partnership is if anything even more strategic. AI powered archive for knowledge sharing, cross border predictive analytics collaboratives, and multilingual communication systems is made together researchers, NGOs, and policymakers Which worked near total isolation (Mutambara, 2025a; Singh et al., 2024). Early examples from regional climate data consortia in Southeast Asia and health information Replace it East Africa show That once the platforms is in place, the speed and depth of collaboration increase Almost overnight.

Table 11. AI Contributions to Governance, Peace, and Partnerships in Low income Nations

DG	AI Application	Key Outcomes	Representative Studies
DG	Digital governance; fraud detection; decision support	Improved transparency; reduced corruption; stronger institutions	Truby (2020), Adeshina & Aina (2023), Owiny (2025)

16 DG 17	Data sharing platforms; collaborative analytics	Enhanced global partnerships; crossborder SDG monitoring	Mutambara (2025a), Singh et al. (2024)

Table 10 shows, rather once one looks past jargon, that artificial intelligence is already invigorating the institutional backbone He low income nations It is a comprehensive term shortage. To SDG 16 Peace, Justice and strong institutions audit trails, automatic corruption monitoring systems, And real time public service dashboards The surface quietly increases transparency that endless anti graft commissions Never clear while feeding the decision makers the hard evidence They must be assigned scarce resources Wise (Adeshina& Aina, 2023; Truby, 2020; Owiny, 2025). Public trust, bet with decades of opacity, beginning slowly, to recover.

To SDG 17 Partnerships For goals, technology brings together what used to be isolated silos: shared data lakes, federated analytics that preserve autonomy and multilingual collaboration platforms Now the researchers and civil servants I distant capitals Work to work the same numbers I something close to real time (Mutambara, 2025a; Singh et al., 2024).

Discussion

The adoption the adoption and impact of Artificial Intelligence (AI) to Sustainable Development Goals (SDGs) Varies significantly between high and low income nations. High income countries generally do well. Developed digital infrastructure, Extensive datasets etc a skilled workforce, enables advanced AI Areas of utilize in areas such as e. G healthcare diagnostics, Health related agriculture, smart cities, and climate modelling (Vinuesa et al., 2020). I these contexts, AI deployments are often integrated with national digital transformation strategies, pick up systemic efficiencies across multiple SDGs.

On the contrary, low income nations the level includes quite a few obstacles limited internet connectivity, Inadequate data infrastructure, and shortages K skilled personnel, which is limited the breadth and depth of AI adoption (Owiny, 2025). Despite this these challenges, this is a low income state unique opportunities to developmental leapfrogging, where Ai the strength mobile platforms, distance learning, etc financial inclusion initiatives Can Get treated traditional development pathways (Fazal et al., 2025; Leal Filho et al., 2024). Transnational cooperation and international partnerships can perform a pivotal role In mitigation capacity gaps, knowledge transfer, and context AI interventions to local needs.

AI serves Seam A strategic enabler and accelerator SDG achievement by provide data driven insights, predictive modeling, and optimization of resources. I low income nations, AI applications demonstrated the ability to eliminate poverty (SDG 1) through targeted social interventions, to increase productivity and job creation (SDG 8) and improve industrial resilience (SDG 9) (Fazal et al., 2025; Gupta et al., 2024; Akinsolu et al., 2024). I education (SDG 4) And healthcare (SDG 3), AI facilitates personalized learning, remote education, and assessment in contexts where human resources are available few (Leal Filho et al., 2024; Piya& Lennerz, 2023).

In addition, AI Contributes Significant environmental sustainability By supporting climate monitoring, Smart energy management, and conservation initiatives (SDGs 6, 7, 11, 13, 15) (Akinsolu et al., 2024; Perkumienė et al., 2025). The integration of AI with complementary technologies Like IoT, Big Data, Blockchain, and Cloud Data processing Growing further its effectiveness by to activate real time monitoring, Secure data sharing, and scalable implementation (Ali & Khan, 2023; Mutambara, 2025a). Strategic deployment of AI, especially related to this national SDG priorities, can develop speed development outcomes During max resource efficiency and impact.

The successful adoption of AI I low income nations Possession K robust policy frameworks, ethical governance, and capacity building initiatives. Create sure guidelines equitable access, privacy, and transparency I AI deployment, While addressing potential algorithmic Prejudices are reinforced existing inequalities (Tripathi& Saxena, 2024). Ethical considerations, equity, inclusion, inclusion, and accountability, are vital for the building public trust And Social security responsible AI applications (Goralski& Tan, 2020; How et al., 2023).

Capacity building initiatives the focus should be on growth local expertise I AI, digital literacy, and technical skills, Enable countries For context development appropriate solutions (Khan et al., 2024; Owiny, 2025). International partnerships, knowledge sharing platform, collaborative research initiatives Can arrange low income nations Overcome Technical and infrastructural limitations while To promote cross SDG synergies. Generally speaking, politics, ethics, and capacity development Form Sustainable, inclusive and scalable foundation AI interventions.

Adaptation Education and innovation is key determinants of AI’ s effectiveness in to get SDGs I low income nations. Integrated AI I higher education curricula, Professional development program Vocational training etc Constructions local human capital And Care innovation ecosystems (Leal Filho et al., 2024). AI tools Can also ease lifelong learning and digital skills development, Equip society's exploitation technology for economic and social development. Importantly, AI interventions Must Be adaptable local contexts to develop certain cultural relevance, Access etc sustainability (Adeshina& Aina, 2023; Owiny, 2025). For instance, Ai strength educational platforms Language should be considered, literacy levels, and local teaching methods improve learning outcomes.

Likewise, financial inclusion initiatives must be in accordance with local regulatory frameworks and community practices. Contextual adaptation not only increases; the adoption rate, but it also ensures that AI I cooperate equitable development and avoids topical social or exaggeration or economic disparities. AI Its full potential is realized when it is integrated into it broader digital transformation strategies. Low income countries can benefit from its AI Seam National of a basic component ICT strategy, Smart management Actions etc digital economy frameworks (Vinuesa et al., 2020). Integration By ensuring this, it enables a coordinated effort across sectors that AI Interventions in healthcare, education, economy and infrastructure are strong one As Another demonstration, based on AI data analytics to urban planning can be associated with smart energy grids, To build transport networks etc. Environmental monitoring system cross SDG benefits.

Cloud computing and IoT platforms Equipment scalable infrastructure to share AI solutions Expenditure effective, While Blockchain Ensures data Driven openness and trust governance (Ali& Khan, 2023; Mutambara, 2025a). By entering AI inside national digital transformation agendas, Low income countries can maximize efficiency, foster innovation, And quickly SDG achievement, the bed the gap with high income countries.

Implications and Recommendations

Policy Recommendations for Governments and International Agencies

Governments and, for that matter, the international agencies that still hold most of the purse strings simply cannot remain on the sidelines if artificial intelligence is ever to deliver on its promise for the Sustainable Development Goals in low income countries. Reliable internet connectivity must stop being a middleclass luxury and become the public utility it should always have been; cloud computing credits and affordable smart devices belong in the same category. Regulatory frameworks have to do double duty: safeguard data privacy and security while enforcing the kind of algorithmic transparency that actually lets citizens see how decisions affecting their lives are reached. Bias and discrimination, quite plainly, must be designed out rather than apologized for later. Domestic incentives targeted research grants, tax holidays for AI startups, mandated university–industry partnerships are no longer optional extras. International agencies, meanwhile, remain uniquely placed to bankroll capacity building programmes, broker genuine technology transfer, and nurture the cross border networks that let local researchers piggyback on global expertise without surrendering control.

Strategic Roadmap for AI Adoption in Low income Nations

Sustainable adoption will never happen by accident. It demands a proper roadmap one that starts with brutally honest needs assessment and ruthless prioritisation of sectors (healthcare, education, agriculture, energy) where impact is both urgent and measurable. Next comes the hard, unglamorous graft of infrastructure: national data platforms, subsidized computing clusters, last mile connectivity that actually reaches villages. Human capital investment is the make or break step: mass digital literacy campaigns, specialized AI curricula in universities and polytechnics, continuous professional upskilling for civil servants. Pilot projects small, rigorously monitored, deliberately designed to fail fast and teach quickly must precede any national rollout. And from day one there must be independent monitoring and evaluation machinery tough enough to kill sacred cows when the numbers demand it.

Framework for Responsible and Inclusive AI Deployment

Responsible deployment is not a nice to have; it is the only deployment that will survive first contact with reality. Fairness, transparency, and accessibility have to be baked in from the very first line of code, not bolted on when the headlines turn ugly. Every system must be adapted painstakingly, expensively to local language, literacy levels, cultural norms, and power dynamics if it is to be used rather than merely installed. Stakeholder engagement cannot be a box ticking exercise: government, civil society, academia, and private sector must sit at the same table with equal voice and real veto power. Only by embedding these principles into design, procurement, implementation, and continuous governance can low income nations hope to harvest the development dividends of artificial intelligence while keeping its considerable risks firmly caged.

4. CONCLUSION

This study explored the role of Artificial Intelligence (AI) in advancing the United Nations Sustainable Development Goals (SDGs) in low income nations. The findings indicate that AI has substantial potential to accelerate economic, social, and environmental development. Economically, AI contributes to poverty alleviation, financial inclusion, workforce optimization, and industrial innovation. Socially, it enhances access to quality education, promotes gender equality, and reduces social inequalities. Environmentally, AI enables efficient resource management, climate monitoring, sustainable urban planning, and ecosystem conservation. Additionally, AI strengthens governance and partnerships by improving transparency, decisionmaking, and international collaboration. The study also identified crosscutting synergies, showing that AI interventions often impact multiple SDGs simultaneously, generating multiplier effects that enhance overall development outcomes.

Contribution to Knowledge and Practice

The research contributes to both academic knowledge and practical applications. Academically, it provides a systematic synthesis of AI's pathways for promoting sustainable development, highlighting thematic clusters, cross SDG linkages, and the integration of complementary technologies such as IoT, Big Data, Blockchain, and Cloud. Practically, the study offers actionable insights for policymakers, governments, and development agencies, outlining strategies for AI deployment, responsible governance, capacity building, and ethical implementation. The findings underscore the importance of tailoring AI solutions to local contexts, ensuring inclusivity and relevance, and leveraging AI as a tool for both immediate impact and longterm development planning.

Limitations of the Study

Despite its contributions, the study has certain limitations. The reliance on secondary data and literature may limit the scope of empirical insights. Contextual diversity across low income nations means that findings may not be universally applicable, as infrastructure, regulatory frameworks, and social dynamics vary widely. Additionally, the rapid evolution of AI technologies may outpace the relevance of some findings, and ethical, social, and cultural factors may influence adoption in ways not fully captured in the study.

Future Research Directions

Future research should focus on empirical investigations and case studies that examine AI deployment in specific low income contexts. Longitudinal studies could assess the sustained impact of AI on multiple SDGs over time. Research should also explore emerging AI technologies and their integration with complementary tools, such as IoT and blockchain, in diverse sectors. Furthermore, studies should investigate ethical frameworks, inclusivity measures, and culturally adapted AI solutions to mitigate risks and enhance equitable outcomes. Crossnational comparative analyses between low and high income nations can provide insights into best practices, scalability, and lessons for policy and governance. Overall, future research should aim to bridge knowledge gaps, inform practical interventions, and maximize AI's potential for sustainable and inclusive development in resourceconstrained environments.

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