

# ARTIFICIAL INTELLIGENCE (AI) AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGs): STEERING SUSTAINABLE INNOVATION TOWARD A RESILIENT AND EQUITABLE FUTURE

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## Abstract

Among the most encouraging technological advancements, Artificial Intelligence (AI) holds an opportunity to achieve a number of Sustainable Development Goals (SDGs). It also offers a number of ethical and practical challenges that need to be carefully contemplated, particularly for marginalized and impoverished communities. Outlining AI's revolutionary potential alongside emphasising crucial stages for its morally sound inclusion into sustainable development efforts is the goal of this investigation. In order to provide an overview of existing knowledge and concepts that will direct the investigation, the article makes use of secondary data collected from past and current research. Competent AI management, nevertheless, necessitates significant effort to ensure that AI systems are free of bias, equitable, and transparent, and collaboration between security and AI specialists is vital. The research has highlighted a number of theoretical and practical implications for privacy integration and AI development. When AI is used efficiently for sustainable innovation, it has the ability to substantially tackle pressing worldwide issues including inequality, resource depletion, and climate change. An equilibrium between privacy concerns and AI innovation may be accomplished by the application of Privacy Enhancing Technologies (PETs).

**Keywords:** Sustainable Development Goals, Artificial intelligence, digital technologies, deep learning, sustainable innovation, environment sustainability, social sustainability, economic sustainability, etc.

## 1. INTRODUCTION

With the goal of achieving a more sustainable, inclusive, and affluent world by 2030, the United Nations unveiled the Sustainable Development Goals (SDGs) in 2015 as a global framework for dealing with serious problems including "poverty, inequality, climate change, and peace". The SDGs, comprising 17 interrelated goals, underline the importance of pursuing an equitable approach to "environmental, social, and economic sustainability". This integrated approach emphasizes the notion that breakthroughs in a particular field can have an impact on others, demanding for comprehensive yet adaptable remedies. Governments, corporations, civic society, and individuals need to collaborate together to achieve these goals, which rely primarily on "collaboration, innovation, and technology". The focus on innovation and infrastructure, considered to be essential components of sustainable economic growth, is an essential component of the SDGs. Priorities including public transport, renewable energy, and the advancement of information and communication technology (ICT) have become in significance as urbanization gathers up speed since more than half of the world's population is now concentrated in cities. Furthermore, to being vital to economic growth, infrastructure investments additionally prove necessary for ensuring environmental sustainability and social justice. Artificial Intelligence (AI) is one of the most promising technology developments that has the potential to accomplish several SDGs. AI optimizes resources, boosts productivity, while making accurate projections conceivable in an array of industries, including "energy, healthcare, education, infrastructure, and agriculture".

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Even with AI's revolutionary potential, however, are still hurdles in its implementation. The ethical use of AI is severely constrained by concerns including "algorithmic bias, the digital divide, data privacy issues, and the requirement for openness concerning AI systems". To ensure equitable AI advantages, especially among developing nations, it is imperative to close the gap in digital access, solve these problems.

These significant enquiries are the focus of the present investigation:

1. What role may AI technologies serve in helping different sectors realise the SDGs?
2. What obstacles remain in the means of deploying AI for sustainable development, specifically in underdeveloped locations?
3. How can sectoral collaborations and international partnerships enhance the moral and accountable application of AI to optimize its impact on the SDGs?

Even while the application of AI for various SDGs has advanced significantly, comprehensive research examining the unique opportunities and challenges of implementing AI for sustainability and innovation throughout a spectrum of industries is inadequate. The present investigation primarily concentrates on specific uses of AI, ignoring more general, systemic issues including the "digital divide, moral dilemmas, and the necessity of global partnership". Furthermore, there is an acute shortage of understanding of the way AI may be deployed ethically in developing nations to make certain that everyone can benefit from new technologies.

The study's goals are to:

- Examine how AI can contribute to accomplishing the SDGs in different sectors, including infrastructure, healthcare, education, and agriculture.
- Determine the main obstacles to implementing AI for sustainable development, having an emphasis on concerns pertaining to transparency, ethics, and the digital divide.
- Look into the importance that cross-sector alliances and global partnerships are to ensuring the moral, equitable, and effective deployment of AI technologies.
- Provide policy suggestions concerning issues, encourage responsible AI innovation, and guarantee AI's beneficial contribution to worldwide sustainability goals.

By confronting these issues, this investigation aims to clarify AI's revolutionary potential while emphasizing critical steps for its ethically responsible integration into efforts for sustainable development.

## 2. METHOD

This study uses secondary data gathered from earlier research and ongoing studies with the objective of giving an overview of established information and ideas to direct the analysis.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Integrating artificial intelligence and digital technologies

Due to a general lack of knowledge about the characteristics and potential advantages of developing technologies, specifically artificial intelligence (AI), its development and application occasionally arouse anxiety and aversion. Certain communities are particularly hostile towards AI since they are afraid of the unforeseen changes it could potentially bring about in day-to-day existence. Yet artificial intelligence (AI) serves as essential for automating, streamlining, and enhancing traceability in a range of human endeavours, including those which are required to meet the Sustainable Development Goals (SDGs). AI is officially defined as "software systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information derived from data to ultimately decide the best course(s) of action to achieve a given goal" (European Commission, 2019). AI systems might alter their behaviour in accordance with input from their surroundings through the application of mathematical models or symbolic rules.

AI's synergistic interaction with other digital technologies enables to further realize its immense potential. For example, according to Tan and Wang (2010), the Internet of Things (IoT) comprises networked devices that capture and transfer data, enhancing AI's data-driven decision-making. Computer vision and virtual reality are two instances of 3D technologies which allow for precise information depiction for computational treatment (Boer et al., 1997; Gebler et al., 2014). For the purpose of to safeguard data exchanges for AI applications, blockchain technology assures data immutability and integrity (2030 Agenda for Sustainable Development). The potential of AI to connect millions of gadgets with rapid connectivity and low latency—both essential to real-time AI applications—is enhanced with the infrastructure used for 5G (Hui et al., 2020). According to Barocas and Selbst (2016) and Kshetri (2014), big data technologies oversee vast amounts of quickly evolving data, boosting AI's analytical powers. AI's capacity to optimize resource management can be enhanced by digital twins, that utilise real-time digital models to simulate

physical items (Whyte et al., 2019). Based on Anastasi et al. (2013), smart territories transcend beyond metropolitan regions and include rural ones, permitting AI-driven data management for sustainable development. Last but certainly not least, advanced technologies like driverless cars and quantum computing possess revolutionary prospects that will strengthen AI's influence on accomplishing SDGs. AI has been pitched as an essential component of sustainability when utilised alongside different technological advances in order to generate potent solutions for tackling global issues.

### 3.2 Artificial Intelligence's role in advancing Sustainable Development Goals (SDGs)

Deep Learning (DL) and Artificial Intelligence (AI) are two formidable technologies that have tremendous potential to help accomplish the Sustainable Development Goals (SDGs). Rapid improvements in such technologies are currently having a big impact on a variety of industries, including healthcare, finance, education, and agriculture (Aggarwal et al., 2022; Mhlanga, 2021). The necessity of using these technologies ethically and cautiously is demonstrated by an extensive examination of the 2030 Agenda for Sustainable Development, which concluded that whilst AI might help accomplish 128 targets across all SDGs, it might also impede 58 targets (Vinuesa et al., 2020). For AI systems to keep trying to be ethically and morally responsible in accomplishing the SDGs, transparency and interpretability in AI models are essential (Vinuesa and Sirmacek, 2021). Standardized frameworks for AI-supported Digital Twins (DT) federations have been recommended as potential future research, and AI and technologies such as 3D concrete printing (3DCP) and AI-supported DT have been playing crucial roles for advancing pertinent SDGs in the framework of sustainable infrastructure (Giret et al., 2023; Alami et al., 2023).

Specific SDGs are additionally aggressively addressed by AI. AI enhances financial inclusion for SDG 1 (No Poverty) by improving risk assessment and microfinance accessibility. Applications of artificial intelligence in healthcare (SDG 3) including telemedicine and predictive diagnostics enhance accessing to healthcare, especially in communities with limited resources. While AI in the workforce helps foster job creation and economic resilience (SDG 8), AI-driven personalized learning platforms contribute to better education (SDG 4). Furthermore, through supplying knowledge regarding energy management, environmental preservation, and climate monitoring, AI is supporting climate action (SDG 13), boosting sustainability and social well-being.

Case studies including smart water management, AI in agriculture, and AI in sanitation have examined how AI might speed up the achievement of the SDGs (Goralski & Tan, 2020). These studies highlight how AI may increase productivity, protect resources, and promote international collaborations for sustainability. While acknowledging AI's beneficial effects on the SDGs, Truby (2020) emphasises the necessity of regulation to guarantee accountability, transparency, and conformity to the SDGs. Zwitter & Herman (2018) and Nguyen (2016) concentrate on how blockchain technology might help achieve a number of SDG targets, especially in the areas of financial services and anti-corruption. Vinuesa et al. (2020) provide supplementary proof of AI's positive impacts, showing that when used appropriately, it can support 79% of SDG targets. AI is an essential tool for promoting global sustainability initiatives since, with appropriate regulations, it can improve public health, increase opportunities for learning, and encourage environmental sustainability.

### 3.3 Deployment challenges

To guarantee the positive impacts that it has, the application of AI for sustainable development requires overcoming a number of significant hurdles. Effective mechanisms are required for overseeing AI's role in accomplishing the SDGs while promoting cooperation among multiple stakeholders, rendering governance and collaboration a crucial problem. Furthermore, the influence of big tech firms and private investments raises concerns regarding accessibility, ethics, and the fair sharing of AI's advantages. AI's societal impacts on communities must additionally be taken into account, especially in the light of potential displacement and inequality. Protecting privacy, equity, and inclusion in AI applications requires attention at the individual level. Furthermore, the labour market is experiencing problems owing to the expansion of AI, demanding policies that minimise job displacement and encourage skill development for emerging professions. Last but not least, significant assessment procedures must be implemented to track and assess AI's long-term consequences and make sure it efficiently advances sustainable development aspirations without incurring unforeseen repercussions. Wu et al. (2018) emphasize customized approaches for e-learning content adaptability while emphasizing the economic, social, and environmental limitations of implementing AI to fulfil SDGs. They conclude that AI significantly contributes to global sustainability and propose comprehensive frameworks that demonstrate the links amongst data sources, IoT, and AI to support a variety of SDG viewpoints. According to Vinuesa et al. (2020), who evaluate AI's effect on the SDGs, it can help 79% of targets whereas impeding 35%, with 14% influenced both favourably and unfavourably. In spite of highlighting the capacity of AI to combat disinformation and diminish sociopolitical polarization, they emphasize the significance of suitable regulation to

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minimize hazards. The six main barriers to implementing AI for SDGs are governance, private investments, community effect, individual rights, jobs, and impact evaluation, according to Mazzi, Taddeo, and Floridi (2023). In order to make sure AI enhances sustainability while reducing risks, they stress the significance of moral, inclusive policy, cooperation, and ongoing assessment.

### **3.4 International Collaboration and Cross-Sectoral Partnerships for Responsible AI**

It demands a lot of work and resources to establish responsible, human-centered artificial intelligence (AI), and strong international collaboration is required. There is still an absence of comprehensive technological cooperation which allows nations to take advantage of one another's resources and competitive advantages as they try to capitalize on the opportunities and solve challenges brought about by AI. Numerous AI governance assignments are popping up globally as a consequence of the increased awareness of the potential advantages and issues associated with AI. Both opportunities and difficulties are created by these activities, which frequently include diverse groups of nations and stakeholders that sometimes overlap or diverge. AI governance needs to encourage open involvement and wide interaction at the governance and expert levels for the purpose to tackle these global concerns.

The Global Partnership on Artificial Intelligence (GPAI), which unites OECD member nations and other nations who are involved to advance a common goal, is an excellent instance of promoting international collaboration. The objective of this integrated cooperation is to put into effect the OECD Recommendation on AI, a recommendation for human-centric, safe, secure, and trustworthy AI. The goal of this project is to utilize synergies between the work plans of both organizations, expedite procedures, cut costs and redundancy, and promote an improved and cooperative global AI ecosystem by combining the initiatives of GPAI and OECD countries.

For a long time, partnerships have been vital for solving global issues, particularly when it pertains to the Sustainable Development Goals (SDGs) of the UN. Addressing problems including poverty, inequality, climate change, and high-quality education necessitates these collaborations (Leal Filho et al., 2022b). In an increasingly interconnected world, global partnerships have encouraged scientific achievements and collaborative effort by pulling together academia, industry, and civil society (Castillo-Villar, 2020; Oliveira-Duarte et al., 2021). But they're persisting issues with ensuring that these collaborations are accessible and accountable, specifically when it pertains to AI innovation (Samuel & Clarke, 2022).

AI crosses national borders as a byproduct of digital technologies and the internet. Its research and development frequently use open-source software, sharing data, and distributed computing, with different groups spread across different locations. Researchers from China to Australia and India have all been able to make contributions to global AI innovation owing to this open and cooperative approach (Stanford HAI Index Report, 2019). Government policies which promote collaboration across borders are consequently crucial to effective AI development, emphasising the vital part that international cooperation serves towards enhancing AI. These worldwide partnerships have placed a major priority on ethical AI. Many nations and organizations have developed and endorsed transnational AI ethical standards that represent common democratic principles including human dignity, autonomy, and privacy. In this regard, after numerous discussions, ministers from 37 member nations have endorsed the OECD Principles on AI, which set forth important ethical principles. However, there may be difficulties in transforming those concepts into national laws, which could result in differences that impede the development and widespread adoption of AI. By discovering areas that need alignment, such as AI risk assessment, the establishment of international standards, and compliance evaluation for AI products, international cooperation in regulation of artificial intelligence can help mitigate these concerns.

For AI to be created and utilized responsibly, cross-sectoral alliances and global collaboration are crucial. AI could promote sustainable development and the well-being of the globe by harmonizing moral standards and legal frameworks, fostering cross-border cooperation, and ensuring inclusive participation.

### **3.5 Inclusive, responsible AI innovation to bridge the digital divide**

Artificial intelligence (AI) technologies possess an opportunity to revolutionize the digital gap through their swift growth and application, but they additionally pose practical and ethical issues requiring careful thought, particularly for underprivileged and disadvantaged populations. When creating and implementing AI solutions, practitioners must put ethics, openness, and accountability first. This is especially pertinent in areas like Asia, Africa, and Latin America where data privacy regulations are still being developed. In order to avoid the further escalation of present inequities and to make sure that people are aware about how their data is collected, analysed, and utilized, governments and AI practitioners need to collaborate together to improve people's capacity to comprehend the data value chain.

The potential for gender inequality to be reinforced is one of the primary risks linked to AI development. AI systems frequently employ data that has been carefully chosen by human engineers, which may inadvertently reflect the

prejudices of the people who designed the systems. AI applications have a tendency to exacerbate already-existing gender and social injustices if these biases are not thoroughly investigated, especially in nations with fewer resources. In order to conquer these obstacles, a conscious emphasis on inclusivity is essential, as is making sure that varied data is used when constructing AI models and that AI systems are developed with intentional checks to prevent the perpetuation of prejudices. Accessible for underserved populations must be given top priority in the worldwide push for ethical AI, and solutions that address the digital requirements of the most marginalized groups need to be advocated.

Bridging the digital gap also requires access to AI training and education. Only those who are able to afford pricey programs or dwell in areas with better infrastructure have the opportunity to receive high-quality AI education in a number of developing nations. This ultimately results in a lack of various viewpoints in AI development and exacerbates inequality in society by creating an AI skill gap. This needs to be tackled through incorporating AI education into school curricula as well as developing scalable, reasonably priced online training resources, such as Massive Open Online Courses (MOOCs). Possibilities for AI training, especially for under-represented groups, can be further enhanced via collaborations among governments, the commercial sector, and educational institutions. Additionally, in settings with limited resources, AI holds enormous potential for enhancing vital services including healthcare, education, and agriculture. AI solutions must be designed to work in locations with poor infrastructure, processing capacity, and connectivity to the internet in order to realize their full potential. To guarantee that AI technologies can be utilised in a way that is affordable to everyone, regardless of geographic location or socioeconomic standing, governments, corporations, and international organizations must work together to make investments in the required digital infrastructure.

Overcoming the AI digital divide requires international cooperation and the exchange of AI research. To create open-source tools, promote information sharing, and establish frameworks for responsible AI development, international collaboration is necessary. These partnerships may ensure that AI technologies are developed with a global viewpoint, taking into consideration the specific needs of many communities. In order to ensure that the advantages of AI are shared evenly and equitably, policies which encourage responsible AI development, and the democratization of AI capabilities will be crucial.

Finally, taking into account the demands, values, and cultural sensitivities of different groups is crucial for promoting inclusion in AI design. Incorporating different points of view into AI development could assist in reduce prejudices and ensure AI applications are fair, objective, and advantageous to all groups. International AI governance frameworks intended to promote the ethical application of AI while facilitating the incorporation of moral principles that take into consideration the diversity of nations around the globe. By embracing these tactics, the AI community may help to closing the digital divide, promoting more inclusive societies, and guaranteeing that AI is a beneficial force that enhances people's lives and promotes communities everywhere.

### **3.6 Managing AI for Sustainable Innovation**

Artificial intelligence (AI) has tremendous potential to spur sustainable innovation in an array of sectors, but managing it effectively calls for a responsible, strategic strategy that supports social, economic, and environmental objectives. In order to minimise biases and guarantee inclusion in AI development, Tavanti (2023) highlights the necessity of putting ethical frameworks into effect that place a high value on openness, accountability, and justice. Furthermore, ensuring accuracy, security, and privacy in AI systems requires strong data management. In order to advance social justice and lessen inequality, AI must be accessible to everyone, particularly underprivileged groups, with an emphasis on inclusive innovation. Government, business, academia, and civil society must work collaboratively to develop AI solutions that are both creative and socially conscious. Tavanti goes on to highlight the significance of ongoing impact evaluations to guarantee AI advancements support sustainability objectives. To foster systemic change, organizations need to take on a long-term vision that is in accordance with international sustainability initiatives, such the Sustainable Development Goals (SDGs) of the UN. According to Tavanti, sustainable innovation is the generation of new goods, services, technologies, or business models that have a beneficial impact on the economy, society, and environment. It emphasises on tackling challenges like depletion of resources, disparities, and climate change while making certain the demands of future generations are satisfied. With this all-encompassing strategy, firms can responsibly utilize AI's disruptive promise and help create a more just, inclusive, and ecologically sustainable existence.

## **4. IMPLICATIONS**

A variety of theoretical and practical consequences for AI development and privacy integration have been highlighted in the paper. Theoretically, it highlights the significance of a conceptual change in which issues of privacy are

incorporated into AI systems from the outset, encouraging moral AI that places a priority on accountability, transparency, and fairness. As a way to ensure that important principles like fairness and openness are taken seriously consistently, it must be done to close gaps among the privacy policy and AI communities. In practice, privacy frameworks must be deliberately integrated by AI developers and deployers, making compliance to national and international laws an essential element of the AI development process.

To address uncertainties, lower legal risks, and guarantee that AI systems are free from bias, equitable, and transparent, cooperation between privacy and artificial intelligence experts is crucial. Along with putting accountability systems into effect to keep an eye on AI's ethical ramifications, organizations must also embrace tools like model cards for openness and explainability. International regulatory collaboration needs to happen on a global scale, and the implementation of Privacy Enhancing Technologies (PETs) might help in establishing a balance between privacy concerns and AI innovation. By following these guidelines, firms may create AI systems that respect moral principles and advance sustainable global growth, guaranteeing that innovation is both environmentally friendly and beneficial.

## **5. CONCLUSION AND RESEARCH OPPORTUNITIES**

The potential for artificial intelligence to address urgent global issues including resource depletion, inequality, and climate change is enormous when AI is handled effectively for sustainable innovation. Organizations may use AI to generate significant environmental, social, and financial benefits by integrating ethical frameworks, effective information stewardship, inclusion, and sustainability goals into AI systems. Research in the future ought to focus on developing context-specific ethical frameworks, defining quantifiable sustainability metrics for AI applications, bolstering data governance in developing nations, and developing models of cross-sector collaboration that promote inclusive AI innovation. To make certain AI is a responsible force for a sustainable, fair future, ongoing investigations are also required for monitoring its impact across critical sectors including healthcare, agriculture, and energy.

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