

# Maximizing Artificial Intelligence and Innovations toward Achieving the Sustainable Development Goals

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## Abstract

*The Sustainable Development Goals (SDGs) encapsulate global priorities for achieving a better 2030, outlining a plan of action through 17 identified goals to address humanity's critical challenges. This article explores the timely and impactful utilization of AI technologies to drive progress toward the SDGs, examining their potential impact in shaping a sustainable future. The study identifies and suggests specific AI initiatives to expedite progress in meeting SDG goals. The focus is on countering fundamental challenges through AI and related innovations, emphasizing the inter-relationships between SDGs, target areas, and AI innovations. Recommendations highlight AI's role in supporting economic growth, environmental sustainability, social inclusivity, and effective governance. It underscores the importance of ethical and responsible AI development for maximizing benefits and minimizing risks. The integration of AI and SDGs presents an opportunity for a more sustainable and inclusive global future.*

**Keywords:** Sustainable development goals (SDGs), Applications of Artificial Intelligence in SDG, Innovations, Development.

## I. INTRODUCTION

### A. Scientific overview of SDGs.

The Sustainable Development Goals (SDGs) were introduced by the United Nations during a summit held in New York in 2015, subsequently adopted by 193 member countries as part of a 15-year plan for ambitious action. These agendas aim to eradicate poverty and establish lasting economic balance and prosperity by the year 2030. Utilizing the current waves of Artificial Intelligence (AI), countries can work towards achieving the 17 SDGs, tailoring their approaches to address specific needs and leverage national strengths.

This work provides an overview of AI methods as pivotal tools for meaningfully contributing to the SDGs. The ability to think systematically is crucial for understanding and solving problems, handling unexpected challenges, fostering collaboration, and applying skills necessary to shape the future of nations sustainably. Various technologies, including the Internet of Things (IoT), Blockchain technology, 5G technology, knowledge-driven by Big Data, Mobile

computing, sensor networks, brain science, and AI, have emerged to contribute to innovations that can accelerate progress towards these ambitious goals.

The contributions of this work focus on the application of a constellation of AI technologies across various real-world subsectors, such as Agriculture, Security, healthcare, e-commerce, ecology, etc. Additionally, the study highlights challenges and outlines prospective research directions for academia and industry professionals to adopt for informed technical decision-making.

Addressing massive economic, social, and environmental challenges requires urgent global attention. The SDGs provide a pathway to guide the world towards sustainability (Hajikhani and Suominen, 2022). The general concept of science, technology, and innovation (STI) holds centrality, representing a major focus for long-term competitive benefits within nations that hinge on productive economies (Kahn, 2018; Iqbal, 2021). Innovations resulting from research and



development, as emphasized by Fukuda (2020), Goos et al. (2015), and Kahn (2018), serve as vehicles for job creation, industrial performance, and increasing a nation's GDP.

While some authors argue that the impact of innovation should extend beyond GDP, encompassing critical applications such as addressing climate concerns (Hayden, 2021), it remains clear that the SDG framework calls for a broader consumption of scientific technologies to convey optimum significance beyond present benefits. The post-2015 SDGs agenda demands that member countries enhance research, upgrade technological capabilities, encourage innovation, and increase public and private investment (Giovannini et al., 2015).

The United Nations has established a universal initiative with 17 goals, 27 indicators, and 169 targets, defining both local and global positions. Science,

technology, and innovation (STI), as referred to in the UN and OECD, are recognized as the main driving force for increased productivity, sustainable economic transformation, and prosperity (Daejeon Declaration, 2015). STI is deemed a fundamental tool to implement together with the SDG Goals, enhancing the efficiency of the economy and satisfying human desires.

Hajikhani and Suominen (2022) suggest the need to empower people to drive their future (Giovannini et al., 2015) through relevant mapping of STI for understanding the dynamics behind the performance, growth, and competitiveness of nations. They further state that the work of the United Nations on the creation of SDGs has been central, offering one of the first holistic taxonomies of grand challenges. With the advent of the SDG framework, and a shift in thinking, the innovation system has had to undergo transformative changes (Schot & Steinmueller, 2018).



Figure 1. The 17 SDG of the UN.

#### B. Artificial Intelligence and Machine learning contribution to SDG

Artificial Intelligence (AI) encompasses a form of intelligence that mirrors human cognitive abilities, enabling the completion of diverse tasks across various environments, thereby closely resembling human intelligence. Serving as an overarching term, AI refers to computer programs capable of human-like thinking and actions, often exhibiting characteristics such as self-improvement, inferential learning, and the execution of basic human tasks. Within the broader field of AI, Machine Learning (ML) and Deep Learning (DL) constitute distinct sub-fields, with DL representing a

specialized form of ML that employs sophisticated methods for addressing intricate problems. It is essential to distinguish between machine learning and artificial intelligence, as machine learning operates probabilistically with explicable outputs, contrasting with the deterministic nature of deep learning. Studies project a substantial economic impact of AI, estimating a potential contribution of approximately 14 trillion Euros to the global economy by 2030, accompanied by a twofold increase in economic growth rates by 2035. The process of self-learning through the acquisition of updated data has facilitated the integration of machine learning algorithms into corporate landscapes.

The rapid proliferation of AI applications necessitates standardized regulation, and certification procedures to ensure effective implementation (Walshe et al., 2020). Key drivers of AI integration include the surge in Big Data availability, reduced cloud computing costs, and unrestricted access to computing power. Noteworthy global players in the AI landscape encompass corporations such as DeepMind, Google's AI research, Facebook, Samsung, General Motors, IBM, Microsoft, Thomson Reuters, Thales, and Uber.

### C. Impact of Machine learning on SDGs

Machine Learning (ML) represents a specialized domain within Artificial Intelligence (AI), instrumental in the practical computation of tasks mirroring human cognitive functions. The relationship between AI and Machine Learning is delineated in Figure 2. Prudent selection of an appropriate algorithm tailored to a specific application necessitates careful consideration, as distinct learning algorithms are designed for disparate

In supervised learning, a machine is trained using a labeled dataset containing input features and corresponding output labels. Through the identification of patterns in the input data, the machine learns to make predictions by mapping the patterns to the correct output. Semi-supervised learning, on the other hand, involves training an algorithm on an unlabeled dataset without any prior knowledge or guidance from a human. Its objective is to uncover hidden patterns or structure within the data. Unsupervised learning, as a learning method, focuses on training a machine on an unlabeled dataset and tasking it with discovering patterns or relationships within the data. By grouping or clustering similar data points together, the machine gains an understanding of the data. Reinforcement learning operates by enabling the machine to learn through trial-and-error, interacting with an environment and receiving feedback in the form of

objectives, as highlighted by Sarker (2019, pp. 1–28). The efficacy of a model is contingent upon the inherent characteristics of the data and its relevance to a designated Sustainable Development Goals (SDG) domain. The interrelation among AI, Machine Learning (ML), and Deep Learning (DL) is elucidated in Figure 2.

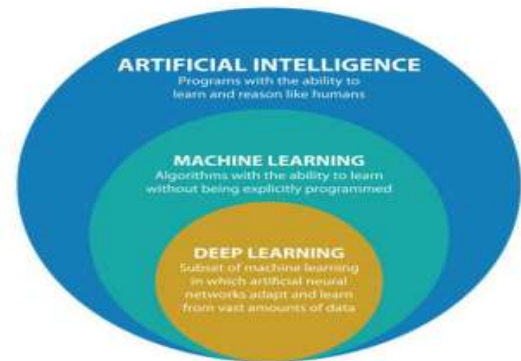


Figure 2: Relationship between AI, ML and DL

rewards or penalties. The machine adjusts its behavior based on this feedback in order to maximize the rewards obtained. Lastly, self-supervised learning is a type of machine learning where a model learns to comprehend and represent data without explicit labeling. Instead, the model is trained to predict certain aspects of the data, such as missing parts in images, words in sentences, or subsequent frames in video sequences. This learning method allows for pretraining on large amounts of unlabeled data, which can subsequently be fine-tuned on a smaller labeled dataset for specific tasks. Self-supervised learning has the advantage of utilizing abundant unlabeled data and can lead to improved performance in generalization on downstream tasks, as the model acquires a more robust and versatile representation of the data. It has been successfully applied in various domains, including computer vision, natural language processing, and speech recognition. This is illustrated in Figure 3.

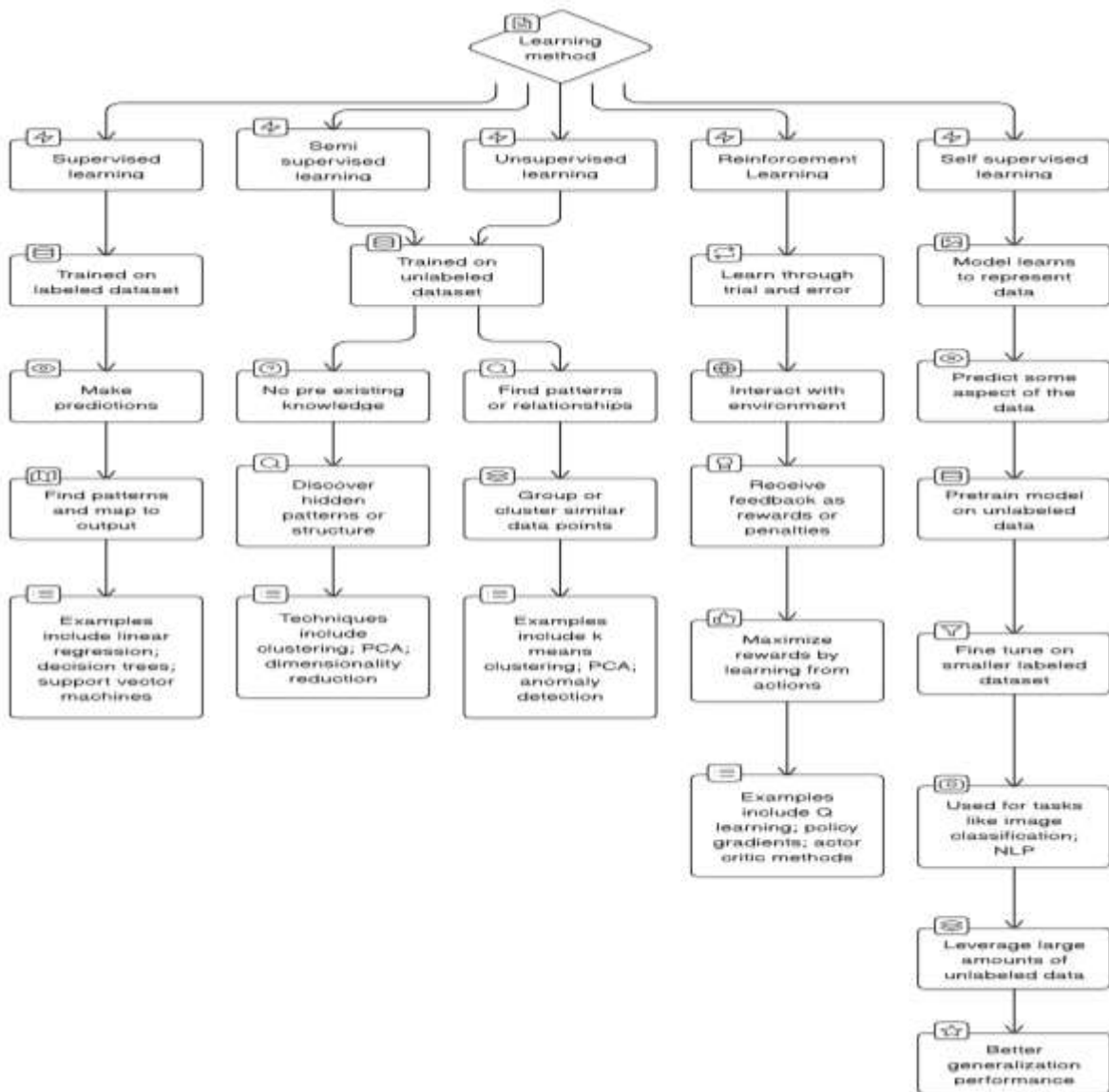


Figure 3: Types of AI Learning

Machine learning (ML) has emerged as a significant tool applicable to various domains, including healthcare, education, agriculture, environment, and business. Its potential to contribute to the attainment of the Sustainable Development Goals (SDGs) is noteworthy. ML, along with other artificial intelligence (AI) innovations, facilitates the generation of actionable insights and informs decision-making processes tailored to the specific requirements of individual countries. Deep learning (DL), a subset of ML based on artificial neural networks, offers particular efficacy in analyzing intricate data and extracting meaningful patterns. DL has proven successful in diverse fields, such as healthcare, where it enhances disease diagnosis,

including cancer detection. By leveraging DL algorithms, medical practitioners can improve the accuracy and efficiency of disease identification, thereby leading to enhanced patient outcomes. Machine learning, more broadly, enables systems to learn from data, discern patterns, and make informed decisions through statistical methodologies. Its capacity to analyze vast volumes of data renders it invaluable in addressing various SDG targets and indicators. For instance, ML can contribute to sustainable agriculture by optimizing crop yields, reducing resource consumption, and enhancing pest management strategies. In the realm of environmental sustainability, ML can support endeavors related to climate change monitoring and mitigation, wildlife conservation, and natural resource management. To



ensure the success and sustainability of the SDGs, the integration of machine learning with a sustainability approach assumes paramount importance. By incorporating ML techniques into decision-making processes, policymakers and stakeholders can make well-informed choices that align with the objectives of sustainable development. Such integration holds the promise of yielding desirable outcomes and contributing to a greener future.

Furthermore, the adoption of innovative policies is imperative to underscore the role of cutting-edge technologies, including ML, in promoting efficiency, ethics, and sustainability in the pursuit of global goals. Policymakers ought to accord priority to the establishment of an enabling environment that supports the ethical deployment and responsible usage of ML technologies. This necessitates addressing concerns encompassing data privacy, algorithmic bias, and equitable access to the benefits derived from ML-driven solutions.

In conclusion, the realization of a future characterized by peace, respect, and opportunity necessitates the centrality of technology and innovation, including machine learning, in the achievement of the 17 Sustainable Development Goals by the target year of 2030. By harnessing the potency of ML and integrating it with sustainability principles, significant strides can be made towards fostering a more sustainable and inclusive world.

#### *D. Application of Big Data for SDG*

Data is ever-growing and it is estimated that the global data traffic may hit about 163 zettabytes which is a trillion gigabytes by 2025. The effectiveness of any machine learning algorithm largely depends on the nature and characteristics of the data used. This also entails the quality and quantity of the data. The effectiveness of any ML or DL model hugely lies in its data and the right choice of Algorithm for the real-world problem. Big data is time-consuming and tedious to process by human standards, hence, data

has to be clean, usable, and machine-readable. Machine learning algorithms are maximally efficient as long as the provided data are well-processed and sufficient. Data characteristics that enhance data quality must consider the adequacy of its volume, variety, velocity, redundancy, and accuracy. Also, Data quality such as dynamicity, granularity, Semantic and Data Usage for Completeness, and Noiseless data.

## II. RECOMMENDATIONS FOR AI INCLUSION IN RELATED SDGs ENGAGEMENTS

AI can be used to promote access to innovation and boost productivity. Stakeholders must work together to ensure that AI applications are developed by teams with diverse demographics, gender, ethnic, and socio-economic backgrounds. (Gouvea, 2017), carried out research that shows that the success of environmental sustainability for instance was impacted by ICT and human development when relating the 3 factors. (Holden, Linnerud and Banister, 2017), envisioned a prioritized SDG model based on the true realities of the country. (Costanza et al., 2016), attributed sustainable well-being by measuring progress directed to the goal and most significantly evaluating each contribution based on the overall progress. That will help stimulates a better global society. (Dandabathula, et al., 2018), suggested an improved public sector ICT-enabled e-governance landscape to promote accountability and transparency through an open data strategy. (Goswami, 2014), found that the impact of technologies on an economy depends on the critical cooperation between government and industry. (Wu et al., 2018), (Dinana, 2020) discussed the impact of ICT in achieving SDGs and identifies several research gaps ranging from the social, economic, and environmental perspectives of sustainable development. We provide the role of AI and ML in achieving SDG in Table 2.

Table 2: Recommended Summaries of AI and Digitalized Solutions for SDGs Based on Current Technologies and Challenges

SDG Goals	Summary Of The Current Challenges Impeding The Attainment Of The SDG Goals	Recommendations For Achieving The SDG Goal through harnessing AI
<b>GOAL 1: ERADICATION OF POVERTY</b> <ul style="list-style-type: none"> <li>• Eradicate extreme poverty</li> </ul>	- According to the World Bank, the global poverty rate fell to 9.2% in 2017. However, progress in eradicating poverty has been uneven across regions. With the worse cases in the sub-Saharan	- AI contributes to identifying areas with high poverty rates and analyzing socioeconomic data to discern patterns and trends, including the

<ul style="list-style-type: none"> <li>• Reduce persisten poverty in all its form</li> <li>• Ensure equal rights to economic resources and basic services</li> </ul>	<p>Africa and South Asia</p> <ul style="list-style-type: none"> <li>- The COVID-19 pandemic has had a significant impact on poverty rates worldwide</li> </ul>	<p>factors contributing to poverty. It aids in recognizing vulnerable populations and facilitating resource allocation to counteract poverty.</p> <ul style="list-style-type: none"> <li>- AI plays a role in enhancing the formal economy by enabling mobile banking applications to provide convenient access to loans and credit services.</li> <li>- AI promotes strong data governance, offering clear projections and plans for poverty alleviation programs, emphasizing the digitalization of government services.</li> <li>- Implementation of a real-time AI-based poverty tracking system for households, coupled with machine learning models for classified predictive analysis.</li> <li>- The utilization of big data for the comprehensive evaluation of poverty alleviation achievements by officials.</li> </ul>
<p><b>GOAL 2: ZERO HUNGER</b></p> <ul style="list-style-type: none"> <li>• Increase Agricultural productivity</li> <li>• Ensure Sustainable food production or achieve food security and eliminating hunger. Improve nutrition, and promote sustainable Agriculture through innovations, climate, and continuous markets</li> </ul>	<ul style="list-style-type: none"> <li>- The number of undernourished people in the world has been increasing since 2014, due to factors such as conflict, economic downturns, and climate change.</li> <li>- There has been progress in reducing hunger globally, but about 9% of the world's population still suffer from chronic undernourishment. Climate change and conflict are major impediment to achieving this goal</li> </ul>	<p>AI contributes to optimizing food production, monitoring distribution, and identifying food waste, aiming to predict and prevent shortages and enhance agricultural practices to combat hunger through:</p> <ul style="list-style-type: none"> <li>- Adoption of smart and precision agriculture.</li> <li>- Remote and automated monitoring of soil yield conditions, farmhouses, and farms using IoT sensors.</li> <li>- Utilizing satellite-integrated real-time weather information for weather prediction.</li> <li>- Implementation of traceability and tracking systems.</li> <li>- Adoption of automated irrigation farming.</li> <li>- Employing efficient crop management techniques for sustainable agriculture.</li> <li>- Integration of machine learning or neural network-based monitoring using UAVs, hyperspectral, and aerial photography to optimize food retention and supply.</li> <li>- Reducing waste through visual product quality inspections.</li> <li>- Development and implementation of</li> </ul>

		<p>AI-based drones, robots, and embedded systems with IoT sensors for predicting malnourished crops, diseases, and natural disasters, utilizing sensors like multispectral to detect nutritional content in crops/plants.</p> <ul style="list-style-type: none"> <li>- Creating high-spec applications for detecting rising food prices at both micro and macro levels.</li> </ul>
<p><b>GOAL 3: GOOD HEALTH AND WELL-BEING</b></p> <ul style="list-style-type: none"> <li>• Achieve universal and affordable healthcare coverage: by radically improving access to healthcare</li> <li>• Reduce maternal mortality and deaths of children</li> <li>• Reduce death from endemic diseases</li> <li>• Decrease deaths and injuries from accidents</li> <li>• Training of health workforce</li> </ul>	<ul style="list-style-type: none"> <li>- There have been significant gains in reducing child and maternal mortality rates, but progress has been slow in reducing the burden of non-communicable diseases and addressing mental health issues across some regions, increasing access to healthcare, and reducing the burden of infectious diseases such as diabetes and heart disease are on the rise.</li> </ul>	<ul style="list-style-type: none"> <li>- AI plays a crucial role in early disease diagnosis, treatment, predicting outbreaks, and enhancing health monitoring and management.</li> <li>- Adoption of AI includes remote telemedicine healthcare services, precision medicine, and cost reduction.</li> <li>- Monitoring and diagnosing critical endemic diseases with timely ailment forecasts.</li> <li>- Proper adoption of AI in medical imaging, diagnosis, discovering new medicines, AI-assisted surgery, and gene editing.</li> <li>- Virtual reality (VR) can be employed with deep learning-based AI clinical bots for error-free surgeries in healthcare units.</li> <li>- AI-based learning facilitates practical virtual or online health education programs, covering family planning, female and child hygiene, and pregnancy procedures, aiming to reduce mortality rates and provide healthcare professionals with specialized task guidance.</li> <li>- AI-based initiatives focus on protecting air, water, soil from pollution and contamination, raising awareness of their damaging effects.</li> <li>- Addressing the impediment to a robust workforce through regular income, achievable through apps.</li> </ul>
<p><b>GOAL 4: QUALITY EDUCATION</b></p> <ul style="list-style-type: none"> <li>• Ensure more accessible, affordable, and qualitative education for all.</li> <li>• Ensure equal access to</li> </ul>	<ul style="list-style-type: none"> <li>- The global literacy rate has increased, However, access to quality education remains a challenge for many countries, particularly girls, undrerserved and marginalized groups. The COVID-19 pandemic has further exacerbated this issue.</li> </ul>	<ul style="list-style-type: none"> <li>- AI facilitates personalized learning experiences, identifies gaps in education systems, and enhances access to education resources.</li> <li>- It contributes to improving the quality and accessibility of education through online learning,</li> </ul>

<p>vocational training and skills programs.</p> <ul style="list-style-type: none"> <li>• Increase training of skilled teachers</li> </ul>		<p>fostering personalized education, and encouraging research efforts.</p> <ul style="list-style-type: none"> <li>- Various tools, including videoconferencing, enable reaching a large audience for meetings, conferences, seminars, workshops, consultations, discussions, and learning. Additionally, advanced data analytics, Massive Open Online Courses (MOOC), open community platforms, blogs, augmented reality, and various multimedia formats are applied for innovative educational methods.</li> </ul>
<p><b>GOAL 5: GENDER EQUALITY</b></p> <ul style="list-style-type: none"> <li>• Eliminate every form of gender-based violence, especially against women and minors.</li> <li>• Ensure women's participation and equal opportunities in critical leadership positions.</li> <li>• Focus on technology in solving gender issues, trafficking, and extreme forms of domestic violence, and harassment.</li> </ul>	<ul style="list-style-type: none"> <li>- While there have been some improvements in gender equality, significant disparities persist, particularly in areas such as political participation, economic empowerment, and access to education and healthcare.</li> <li>- Also, gender-based violence and discrimination remain pervasive issues</li> </ul>	<ul style="list-style-type: none"> <li>- AI can potentially raise awareness of existing gender and social biases, discrimination, and violence, aiming to integrate balanced perspectives into AI systems. Gender bias, present in recruitment tools, face recognition systems, and search engines, should not contribute to discrimination.</li> <li>- AI facilitates the balanced utilization of knowledge and skills programs.</li> <li>- It enhances women's access to information and services, including microfinance and banking services.</li> <li>- AI can be applied to counter universal problems such as trafficking and sexual harassment.</li> <li>- AI learning systems are valuable for gender education.</li> </ul>
<p><b>GOAL 6: CLEAN WATER AND SANITATION</b></p> <ul style="list-style-type: none"> <li>• Increased access to safe drinking water</li> <li>• Improve the quality of water</li> <li>• Protect and restore water-related ecosystems and management of water resources</li> </ul>	<ul style="list-style-type: none"> <li>- Significant progress has been made in improving access to clean water and sanitation, but around 2.2 billion people still lack access to safe drinking water.</li> <li>- Climate change and population growth are putting additional pressure on water resources</li> </ul>	<ul style="list-style-type: none"> <li>- AI assists in monitoring water quality, predicting scarcity, and identifying sanitation needs for improvements, including smart water management, safety, and reduced water wastage.</li> <li>- Data collected from satellite images, digital climatic conditions equipment, and various AI-based systems, IoT, or sensors can predict water scarcity.</li> <li>- AI predictions provide real-time insights into crop growth, determining optimal times for watering and fertilizer use.</li> <li>- AI aids in water conservation, identifying leakages and pipe bursts, with technology like smart water metering for consumption tracking and coordinated operations.</li> </ul>



<p><b>GOAL 7: AFFORDABLE AND CLEAN ENERGY</b></p> <ul style="list-style-type: none"> <li>• Increase production of renewable energy and global supplies</li> <li>• Improve accessibility to a global rate of energy efficiency.</li> <li>• Install and expand modern infrastructure and AI facilities for the production of sustainable energy.</li> </ul>	<ul style="list-style-type: none"> <li>- The share of renewable energy in the global energy mix has increased, but progress has been uneven across regions and the world is not on track to meet the targets of SDG 7</li> <li>- many regions still lack access to reliable, affordable, and clean energy sources despite the efforts by different government</li> </ul>	<ul style="list-style-type: none"> <li>- AI optimizes energy distribution, reduces waste, and promotes renewable energy adoption.</li> <li>- AI and IoT detect, optimize, and monitor natural resources in real-time.</li> <li>- AI enhances operational efficiency through real-time analysis of key performance indicators for machines.</li> <li>- Smart metering services and energy management tools improve efficiency for smart devices, solar farms, windmills, smart grids, etc., reducing carbon footprints and fuel consumption.</li> <li>- DL and SLAM technology accelerate production and assembly for autonomous vehicles, reducing accidents and transport costs.</li> <li>- AI-powered predictive analytics using DL monitors machine wear and tear, reducing system failures.</li> <li>- Real-time access to consumer market data and finances.</li> <li>- AI reduces greenhouse gas emissions and enhances intelligent manufacturing processes.</li> <li>- Real-time image detection, drone surveillance, and automated social network monitoring.</li> <li>- Augmented reality and virtual business meetings.</li> </ul>
<p><b>GOAL 8: DECENT WORK AND ECONOMIC GROWTH</b></p> <ul style="list-style-type: none"> <li>• Balance GDP and economic growth.</li> <li>• productive employees and decent work</li> <li>• Youth empowerment lessens youth unemployment.</li> <li>• Reinforce the capacity of financial institutions and easy access to banking services.</li> </ul>	<ul style="list-style-type: none"> <li>- Global economic growth has slowed down, and the COVID-19 pandemic has had a significant impact on employment and livelihoods.</li> <li>- many people still work in low-paying or precarious jobs. Economic growth has also been uneven, with many countries facing economic challenges</li> </ul>	<ul style="list-style-type: none"> <li>- AI matches job seekers with suitable opportunities, enhances workplace productivity, and offers data-driven insights for economic policy-making.</li> <li>- Cloud-based platforms, telecommuting, augmented reality, virtual business meetings, and knowledge sharing contribute to significant economic growth.</li> <li>- Digital solutions transform production and consumption patterns.</li> <li>- AI expands access to financial services for underbanked and unbanked populations, aligning with SDG 8.</li> </ul>
<p><b>GOAL 9: INDUSTRY, INNOVATION, AND INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>• Accessible internet</li> </ul>	<ul style="list-style-type: none"> <li>- Investment in infrastructure and innovation has increased, but more needs to be done to ensure that it is sustainable and accessible to all.</li> </ul>	<p>AI can be used to optimize innovative and smarter infrastructural planning and management, improve supply chain logistics and support innovation in various industries through:</p>

<ul style="list-style-type: none"> <li>• Quality and reliable infrastructure</li> <li>• Sustainable and functional industrialization</li> <li>• Encourage scientific research in collaboration with the industries</li> </ul>	<ul style="list-style-type: none"> <li>- many developing countries still lack the infrastructure necessary for economic growth</li> </ul>	<ul style="list-style-type: none"> <li>- Smart production in industrial (IoT), fault tolerance detection, 3D printing, Cyber-physical systems, Big data and Data analytics, cloud computing, drones &amp; robotics, embedded system technology</li> <li>- Intelligent logistics are applicable in critical sectors such as oil and gas drilling and exploration, disaster prediction, and prevention.</li> <li>- IoT-connected vehicles and optimized route management</li> <li>- smart products and machines</li> <li>- Augmented reality and wearable technologies</li> <li>- Unmanned Aerial Vehicles (UAV).</li> <li>- Digital warehousing.</li> <li>- ML real-time navigation, decision-making for anomaly detection, and classification.</li> <li>- AI Food quality inspection.</li> <li>- Machine learning for Drug discovery, Drug trial, and monitoring</li> <li>- Automated dialogue systems and help assistance.</li> </ul>
<b>GOAL 10: REDUCED INEQUALITIES</b> <ul style="list-style-type: none"> <li>• Enhance sustainable income growth</li> <li>• Encourage, entrepreneurship, social investments, and economic growth.</li> <li>• Political inclusion through different government initiatives.</li> <li>• Reduce transaction costs and ease of doing business</li> </ul>	<ul style="list-style-type: none"> <li>- While some progress has been made in reducing income inequality, inequalities based on gender, age, race, ethnicity, and disability remain significant challenges</li> <li>- many marginalized groups still face discrimination and exclusion. Economic inequality remains a major issue.</li> </ul>	<p>AI can help identify and address inequalities in access to resources and opportunities, monitor progress toward reducing inequalities, and discrimination in hiring or healthcare, and promote diversity and inclusion through:</p> <ul style="list-style-type: none"> <li>- Utilization of knowledge for all gender</li> <li>- Reduce inequality in every workplace</li> <li>- Encourage social, economic, political, and regional equality irrespective of gender, age, disability status, race, ethnicity, religion, or economic status. This will ensure equal opportunities and eliminate discrimination.</li> <li>- AI can also be used to monitor and prevent hate speech and extremist content online.</li> </ul>
<b>GOAL 11: SUSTAINABLE CITIES AND COMMUNITIES.</b> <ul style="list-style-type: none"> <li>• Safe, affordable, accessible, and sustainable transport systems.</li> <li>• Improve the environmental impact of cities through its air</li> </ul>	<ul style="list-style-type: none"> <li>- Urbanization continues to increase, and there are significant challenges in ensuring that cities are sustainable, resilient, and inclusive.</li> <li>- Rapid urbanization is posing new challenges for sustainable development</li> </ul>	<ul style="list-style-type: none"> <li>- AI aids in urban planning, optimizing transportation and energy systems, and monitoring the environmental and social impacts of urban development.</li> <li>- AI-centric smart cities, governance, environment, and transportation systems contribute to efficient urban management, reducing traffic congestion and</li> </ul>

<p>quality and waste management.</p> <ul style="list-style-type: none"> <li>• Increase the number of cities with policies toward, resource efficiency, mitigation, and adaptation to climatic Change and disaster management</li> </ul>		<p>optimizing transport routes.</p> <ul style="list-style-type: none"> <li>- Smart buildings adhere to distance regulations and feature remotely controlled appliances.</li> <li>- Remote monitoring ensures a safe environment, overseeing household activities.</li> <li>- IoT-based healthcare apps and telehealth monitoring through smart devices enhance the quality of care and consultations.</li> </ul>
<p><b>GOAL 12: RESPONSIBLE CONSUMPTION AND PRODUCTION</b></p> <ul style="list-style-type: none"> <li>• Resourceful use of resources.</li> <li>• Reduce global food waste</li> <li>• Reduce generated waste</li> <li>• Ensure awareness of sustainable development and lifestyles</li> </ul>	<ul style="list-style-type: none"> <li>- Progress has been made in promoting sustainable consumption and production patterns, but more needs to be done to reduce waste and promote circular economies</li> <li>- consumption patterns are still unsustainable. Efforts to promote sustainable production and consumption are necessary.</li> </ul>	<ul style="list-style-type: none"> <li>- AI can help identify and reduce waste in production processes to optimize supply chains and reduce overproduction, promote sustainable production and consumption patterns, and assist in environmental impact assessments.</li> <li>- Big Data analytics Artificial intelligence can impact production and consumption to increase efficiency and sustainability.</li> <li>- AI can be used for personalized recommendations to predict demand and adjust production accordingly.</li> <li>- Power consumption and requirements prediction, dynamic per unit cost maintenance, hardware lifespan analysis</li> </ul>
<p><b>GOAL 13:CLIMATE ACTION</b></p> <ul style="list-style-type: none"> <li>• Strengthen resilience to climatic hazards and natural disasters.</li> <li>• Improve education on Climate issues</li> </ul>	<ul style="list-style-type: none"> <li>- global emissions continue to rise, and climate change remains one of the biggest threats to sustainable development.</li> <li>- While there have been some positive developments, such as the adoption of the Paris Agreement, the world is not on track to limit global warming to 1.5°C.</li> </ul>	<ul style="list-style-type: none"> <li>- AI stands as a crucial tool for climate modeling, predicting environmental changes, and managing resources like greenhouse gas emissions. It plays a pivotal role in developing and executing strategies for climate change mitigation and adaptation.</li> <li>- Utilizing AI alongside remote sensing technologies enables the detection of carbon footprints and gas emissions, paving the way for targeted reduction actions.</li> <li>- In enhancing production efficiency and curbing emissions, AI emerges as a key player, offering solutions for greener and sustainable practices.</li> <li>- AI's contribution extends to safeguarding biodiversity, employing real-time data analytics from UAVs and robot monitors for remote monitoring.</li> <li>- Machine learning, a subset of AI, proves invaluable in analyzing climate data, unraveling trends, and</li> </ul>

		fostering informed decision-making in climate-related matters
<b>GOAL 14: LIFE BELOW WATER</b> <ul style="list-style-type: none"> <li>• Drastically reduce pollution from marine ecosystems due to extended land-based activities</li> <li>• Address the negative impacts of ocean acidification</li> <li>• Provide access to healthy fishing markets</li> </ul>	<ul style="list-style-type: none"> <li>- The state of the world's oceans and marine life continues to deteriorate, with issues such as overfishing, pollution, and ocean acidification.</li> <li>- many marine species are still threatened with extinction. Climate change and overfishing are also major threats</li> </ul>	<ul style="list-style-type: none"> <li>- AI contributes to marine ecosystem protection by actively monitoring water quality and marine life. For instance, AI-driven smart sensors can detect and alert authorities to potential pollution events.</li> <li>- In the fight against illegal fishing, AI technologies, such as automated image recognition, help identify and track unauthorized activities. This ensures sustainable fishing practices and marine resource preservation.</li> <li>- Smart conservation efforts leverage AI for sub-marine and coastal mapping. Examples include underwater drones and real-time satellite imaging, aiding in the assessment and protection of diverse marine environments.</li> <li>- AI's role extends to predicting the movement of pollutants, addressing plastic pollution. Machine learning algorithms can analyze data to anticipate the flow of debris, allowing for targeted cleanup and prevention measures.</li> <li>- Weather monitoring through AI-driven forecasting enhances preparedness for environmental changes. AI models, integrated with satellite data, enable accurate predictions, crucial for safeguarding marine ecosystems from climate-related impacts.</li> </ul>
<b>GOAL 15: LIFE ON LAND</b> <ul style="list-style-type: none"> <li>• Conservation of freshwater ecosystem</li> <li>• Fight desertification and land degradation</li> <li>• management of all types of forests</li> </ul>	<ul style="list-style-type: none"> <li>- Goal 15, "Life on Land" faces challenges such as biodiversity loss, deforestation, and land degradation due to factors like climate change and human activities. Illegal wildlife trade, invasive species, and insufficient conservation efforts further threaten terrestrial ecosystems. Addressing these issues requires robust conservation measures, sustainable land use, and global cooperation.</li> </ul>	<ul style="list-style-type: none"> <li>- AI plays a crucial role in wildlife conservation by monitoring and safeguarding various species. Technologies like UAVs, IoTs, and Big Data aid in effective wildlife tracking and protection efforts.</li> <li>- Sustainable land use and resource management benefit from AI-driven monitoring of soil, plants, and animals. This ensures responsible practices for preserving biodiversity and supporting ecosystems.</li> <li>- AI contributes to the protection of natural reserves, such as oil, by</li> </ul>

		<p>enhancing surveillance capabilities. Automated systems can detect and prevent unauthorized access, minimizing the environmental impact.</p> <ul style="list-style-type: none"> <li>- Combatting illegal deforestation and poaching is made more effective with AI. Advanced algorithms can analyze data to identify suspicious activities, enabling timely intervention to protect forests and wildlife.</li> <li>- AI's predictive capabilities extend to wildfire prevention. By analyzing various factors, such as weather conditions and historical data, AI models can forecast potential wildfire outbreaks, facilitating proactive firefighting coordination.</li> </ul>
<p><b>GOAL 16: PEACE, JUSTICE, AND STRONG INSTITUTIONS.</b></p> <ul style="list-style-type: none"> <li>• Reduce violence and death risk of death through various vices such as terrorism and insecurity.</li> <li>• Develop accountable and trustworthy institutions.</li> <li>• Ensure policy adherence</li> <li>• Ensure public participation in the government decision-making process.</li> <li>• Provide legal identity and databank for all, including birth and death registration.</li> </ul>	<ul style="list-style-type: none"> <li>- Conflict, violence, and human rights abuses or violation continue to be major challenges, and progress in strengthening institutions.</li> <li>- Promoting the rule of law has been uneven.</li> <li>- corruption and pervasive issues.</li> </ul>	<ul style="list-style-type: none"> <li>- Embrace open data policies to empower citizens and foster transparency in government institutions. Utilize Big Data analytics to process and analyze vast datasets for informed decision-making.</li> <li>- Implement technologies such as open government datasets, public apps, and e-identity to enhance citizen participation and engagement in governance processes.</li> <li>- Utilize AI for crime forecasting and prevention to ensure a safer and more secure society through advanced technologies.</li> <li>- Leverage neural networks to analyze legal data, predicting legal outcomes for improved efficiency in the legal system.</li> </ul>
<p><b>GOAL 17: PARTNERSHIPS FOR THE GOALS</b></p> <ul style="list-style-type: none"> <li>- This goal covers a multi-stakeholder partnership, and Advanced modeling of development that can be shared widely and rapidly.</li> </ul>	<ul style="list-style-type: none"> <li>- While progress has been made in promoting international cooperation and partnerships, more needs to be done to ensure that they are effective and inclusive.</li> <li>- Mobilization of resources and coordination efforts across sectors and countries needs to be encouraged.</li> </ul>	<ul style="list-style-type: none"> <li>- AI can facilitate organizational collaboration and knowledge-sharing between various stakeholders, facilitate data-driven decision-making, and promote innovative partnerships through:</li> <li>- Facilitating knowledge sharing through various means to boost collaboration, especially for Science, technology, and innovation (STI).</li> <li>- Supporting innovation and technological transfer, capacity building as well as the use of digital solutions at the core of the</li> </ul>



		<p>overarching implementation means.</p> <ul style="list-style-type: none"><li>- Deliberate investment in AI research and development in collaboration with academia, industry, NGOs, and international allies. To foster technological breakthroughs in AI in meeting the SDG goals.</li><li>- Modelling behavioral prototypes for a better global market.</li></ul>
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III. CHALLENGES AND RESEARCH DIRECTIONS

The successful implementation of Artificial Intelligence (AI) for achieving the Sustainable Development Goals (SDGs) relies heavily on the availability of accurate and relevant data. Data collection and processing are crucial, especially in domains like smart cities, healthcare, and finance, where errors can have significant consequences. It is essential to ensure that the collected data is not irrelevant, of poor quality, or insufficient, as these attributes can compromise the accuracy and effectiveness of AI models. Therefore, thorough investigation and preprocessing of data are necessary to address issues such as ambiguity, missing values, outliers, and meaningless outcomes. This involves sourcing the right quantity of data and employing standardized methods like text mining or data mining, as well as specialized libraries like NLTK, for natural language processing (NLP) tasks in AI. Additionally, effectively handling diverse learning algorithms is vital for building intelligent applications aligned with the SDGs. The challenges associated with AI implementation for the SDGs include ethical concerns, bias, data privacy and security, lack of transparency, limited access and affordability, and the digital divide. To overcome these challenges, solutions involve developing ethical frameworks, diversifying training data, strengthening data protection laws, promoting explainable AI models, investing in capacity building, establishing robust policies and regulations, and fostering public-private partnerships (Floridi, 2020; Buolamwini & Gebru, 2018; Cavoukian & Jonas, 2019; Guidotti et al., 2018; UNCTAD, 2020; ITU, 2019). The challenges associated with implementing AI in the context of SDGs revolve around data quality, ethical considerations, access and affordability, transparent AI models, data protection laws, and fostering collaborations. Ensuring accurate and relevant data for AI models, navigating ethical concerns and biases, addressing barriers in access and affordability, developing ethical frameworks for AI models, strengthening data protection laws, and fostering public-private partnerships are critical aspects. Expected solutions involve implementing measures to enhance data quality, developing robust ethical

frameworks, ensuring widespread access to AI benefits, promoting transparency in AI models, fortifying data protection laws, and encouraging collaborative efforts between public and private sectors. These solutions aim to establish a foundation for responsible and inclusive AI deployment, aligning with sustainable development goals.

IV. CONCLUSION

In summary, the effective management of global challenges remains an ongoing imperative. AI, with its potential to contribute across various domains, presents innovative solutions and opportunities for optimizing resource utilization. The digitalization of the economy emerges as a crucial driver of economic development and promises improvements in people's quality of life. Achieving global improvement demands decisive actions, including the strategic implementation of technologies, formulation of policies, and a commitment to a sustainable approach in AI applications. Increased awareness among stakeholders, policymakers, and civil society about AI's potential for SDG achievement is vital, as is ensuring universal accessibility to AI tools and applications. Ethical considerations, addressing biases, and prioritizing inclusivity are fundamental for fully harnessing the potential of AI and digital technologies across diverse aspects of sustainable development. The contributions of AI and digital technologies in domains such as poverty eradication, quality education, healthcare, sustainable cities, climate action, and partnerships underscore their transformative impact. To unlock their full potential, strategic integration and investment in infrastructure, capacity building, and regulatory frameworks are essential. Through these concerted efforts, AI and digital technologies can accelerate progress towards sustainable development, fostering a more inclusive and equitable future.

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