

The Impact of Artificial Intelligence on Achieving Sustainable Development in Developing Countries

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Abstract: Artificial intelligence (AI) has become a transformative tool across industries, driving how investments are directed and sustained, particularly in developing nations. This article investigates the role of AI in promoting sustainable investment development in these countries, concentrating on its capacity to address the challenges like resource mobilization and allocation, environmental impact as well as economic inclusiveness. This paper analyzed various cases and theoretical literature to demonstrate how AI could be utilized to advance sustainable development projects in developing countries. The paper concludes, based on the case studies analyzed, that AI-driven platforms and technologies stimulate growth of various sectors, especially agriculture and energy. Thus, developing nations should develop, tailor and implement sustainable policies by leveraging on the unique potential of AI-based technologies.

1 INTRODUCTION

Artificial intelligence (AI) has been touted as a powerful and transformative force to facilitate development, particularly the achievement of sustainable development goals in the context of developing nations. The deployment of AI in diverse areas from agriculture, finance to medicine has the potential of bridging the infrastructural gaps bedeviling growth agendas, optimizing the mobilization and allocation of resources, and fostering inclusive socioeconomic development (Vinuesa et al., 2020). Artificial intelligence's impact on investment is vital, as investments promote economic growth and its sustainability. This research explores how AI contributes to the sustainable investment development, concentrating on its deployment in sectors such as environmental sustainability, socioeconomic development, and economic inclusivity in developing countries.

The advent of AI indicates a transformative prospect for attaining sustainable investment development, especially in developing economies. As these countries strive to balance socioeconomic growth with social equity, environmental sustainability albeit dire obstacles like infrastructural deficits, low resource mobilization, political instability, effects of climate change and so on. AI presents innovative solutions that could improve decision-making, optimize resource generation and allocation, and drive efficiency across various industries. By harnessing AI technologies, developing economies could address pressing development challenges like infrastructural gaps, climate change, poverty alleviation, etc., thereby nurturing an ecosystem that is conducive for sustainable economic growth.

Sustainable investment development involves the flow of financial resources (capital) towards projects and enterprises that can generate environmental, economic, and social benefits. The United Nations

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Sustainable Development Goals (SDGs) provide a framework for understanding and measuring the role of investments in sustainable development policies. Yet, attaining these goals has faced a great deal of challenges in developing economies due to inadequate financial resources, poor governance policies as well as sociopolitical instability (OECD, 2021). Thus, AI has emerged as a driving force for addressing these barriers by enhancing efficiency of resources generation and improving the effectiveness of investments.

Agriculture is one of the major areas where AI can contribute greatly in terms of sustainable investment development in developing nations. By improving precision agriculture with the help of data analytics as well as predictive modeling, AI could help augment yields while reducing the potential risk of environmental degradation. To improve crop rotation and resource allocation, farmers, for instance, could use AI platforms or technologies to assess market trends, weather patterns, and soil health (Liakos et al., 2018). This might create a positive feedback loop for sustainable development by strengthening local economies and enhancing food security.

Furthermore, as poor countries transition from fossil resources to sustainable energy sources, AI systems for renewable energy management are critical. AI applications could help to optimize energy storage programs, improve demand-side management, and strengthen renewable energy integration into national power grids. India, for example, has begun utilizing AI to estimate renewable energy generation, which has considerably improved grid stability and reduced the country's reliance on coal (Choudhary et al., 2021). This development is critical for attracting long-term investment in industries such as infrastructure, renewable technologies, and environmental enhancement.

Likewise, AI can be leveraged in bolstering financial inclusion among underserved groups in developing economies, which also improves access finance and investment opportunities for these groups. According to Dharmaraj and Vijayanand (2018), financial institutions can utilize machine learning algorithms to assess credit risk and provide targeted development products to small and medium-sized firms and smallholder farmers.

This form of democratization of financial services is crucial for promoting innovation and resilience among local entrepreneurs thereby ultimately causing sustainable economic development. Although the potential benefits of AI technologies are substantial it is very important to

investigate thoroughly its accompanying risks and challenges as well. For instance, concerns such as data privacy, algorithms bias, job displacement and so on should be carefully managed and well-tailored to the needs of individual economies to ensure that the deployment of AI platforms aligns with sustainable development principles. Thus, UNCTAD (2021) defined the imperative need for developing country stakeholders and policymakers to give ethical AI practices top priority and create strong regulatory frameworks when using AI technologies to prevent unintended outcomes.

It is evident that AI technologies have a massive and diverse impact on achieving sustainable investment growth in underdeveloped nations. AI's potential to develop areas such as agriculture, finance, healthcare, education, and energy can contribute to sustainable economic growth and social justice. Nevertheless, achieving this potential involves developing and adopting a strategic approach tailored toward responsible AI deployment, capacity building as well as strong governance frameworks. Thus, as government of developing economies navigate the complexities of the current digital age, the integration of AI technologies into their sustainable development efforts will be significant in ensuring a resilient and equitable growth.

The rest of the article is structured as follows: the literature section examines pertinent research on the application of AI technologies in sustainable development; the methodological section offers a number of case studies on the application of AI in diverse fields for sustainable growth; the results and implications section addresses the various advantages, difficulties, and constraints; and the final section ends with policy recommendations and a request for more research.

2 LITERATURE REVIEW

Sustainable investment development underscores balancing socioeconomic and environmental objectives to drive long-term growth. According to Bianchi et al. (2019), the Environmental, Social, and Governance (ESG) framework, as well as other components of sustainable investment development, serve as a guide for investors looking for projects that address societal and environmental concerns while still creating financial rewards. Challenges such as limited capital, poor technological platforms or space, infrastructural gaps, and regulatory frameworks often hamper the strides of achieving sustainable investment development, thus the need to explore

other innovative ways such as AI technologies towards these goals.

The deployment of AI can help in addressing Sustainable Development Goals (SDGs) through direct and indirect mechanisms that could improve productivity, provide predictive analytics, and support decision-making, and ultimately causing and fostering sustainability of economic growth (Zeng et al., 2021). AI technologies such as natural language processing as well as machine learning have been crucial in environmental monitoring, agricultural progress, financial and healthcare services. Developing economies can therefore benefit enormously from AI-driven advancements particularly in resource-scarce environments, where the optimization of outcomes is vital for growth and sustainability.

The predictive analytics capacity of AI-driven technologies can significantly improve resource generation and allocation, especially in agriculture, a major industry in several developing countries. For example, Kamilaris & Prenafeta-Boldú (2018) explained that AI-based models can analyze crop health and predict yields, and this could help in optimizing the use of resources as well as minimize waste. The precision approach in agriculture will not only increase productivity but could also ensure environmental sustainability by reducing the overuse of resources such as fertilizers and water.

Likewise, AI-driven insights can contribute to financial inclusion and access to finance for local businesses by extending financial services to the unserved and underserved populations as well as improve micro-loans, credit scoring and personal finances (Chandran et al., 2021). Using algorithms can be used to analyze creditworthiness based on non-conventional data points as AI has eased access to financial services in rural and remote communities by supporting small businesses and driving sustainable investment in local areas.

AI-based technologies are playing critical role in environmental monitoring, which help developing economies to track their carbon emissions, deforestation risk, and water pollution (Rolnick et al., 2019). Satellite-based AI platforms assist countries in monitoring environmental degradation and devise proactive measures in addressing it. And this serves as a crucial reference point based on which ecologically driven investments can be attracted for green technologies as well as environmental conservation that align with global sustainability agenda. Despite the numerous benefits associated with AI and its potential, Sye et al. (2019) indicates that the implementation of AI-driven technologies

encounters several barriers like data privacy concerns, inadequate infrastructure as well as skills gaps.

Nonetheless, effective integration of AI has the capacity of stimulating efficiency in agriculture, energy management, healthcare as well as other critical sectors such as finance and resource mobilization, thereby increasing the chances of achieving sustainable development.

3 DATA AND METHODOLOGY

This paper adopted secondary data from various platforms for analysis of AI's impact on achieving sustainable development. Data spanning the period of 2013-2024 have been employed as presented in Table 1 below.

Table 1: Breakdown of investments in artificial intelligence.

Year	Public offering	Private investment	Minority's stake	Merger /Acquisition	Total
2013	0.4	5.9	1.4	6.87	14.57
2014	0.72	9.2	0.2	8.92	19.04
2015	0.68	13.43	1.12	10.2	25.43
2016	0.71	18.92	1.27	12.92	33.82
2017	0.75	26.72	1.57	24.68	53.72
2018	13.03	43.1	1.6	21.89	79.62
2019	6.98	58.18	1.68	36.43	103.27
2020	20.06	73.79	88.19	39.83	221.87
2021	37.32	145.4	4.65	173.36	360.73
2022	10.65	113.01	8.2	121.39	253.25
2023	5.37	104.34	9.03	82.26	201
2024	4.64	150.79	4.71	92.19	252.33

Source: Author's own construct using data from Quid discover (2024)

The private sector has been a major source of investments in AI. Private investments have been witnessing year-to-year growth, which can be attributed to the potential benefits businesses and private investors envisage. Mergers and acquisition have also been a major channel of financing AI projects, and this is not a good trend. The data shows a seismic shift in the technological landscape, where the overall funding has soared from \$14.57 billion to \$252.33, representing over 17%, within a period of 12 year. This development is mainly driven by the

explosive rise in the private investment, which underscores a global race for innovation. For developing countries, this tendency presents a critical opportunity to attract capital for homegrown AI solutions that address local challenges. However, the parallel surge in mergers and acquisition points to a consolidation of power and intellectual property within a few global tech giants, which poses enormous risk of increased technological dependency for economies that are unable to cultivate their competitive ecosystems.

The strategic implications of developing economies are profound. To avoid being permanently locked to a passive role as consumers of foreign AI, these countries, despite their limited investment potential, must proactively build domestic capacity. This necessitates urgent investment in human capital through STEM education and targeted AI training to combat brain drain. Furthermore, developing countries must foster vibrant private-sector ecosystems through favorable regulations and incentives, while developing national AI strategies that prioritize regional collaboration and focus on sector of local comparative advantage. The Figure 1 below reveals that AI-driven future is being funded now, and developing economies must act decisively to secure their place within it.

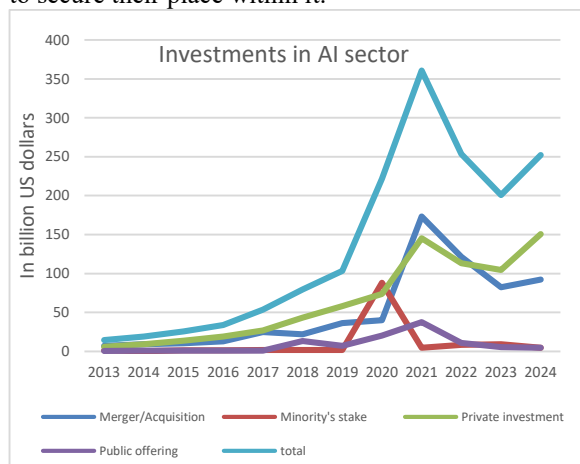


Figure 1: Investments in artificial intelligence sector. Source: Author's own construct.

The figure above illustrates a staggering surge in global AI funding, with the overall investment reaching from modest levels pre-2019 to peak of nearly \$360 billion in 2021, before stabilizing at a substantial value of \$252 billion in 2024. This growth is overwhelmingly driven by private funding, which appears as the largest and most consistent segment, underscoring it as the major engine of AI innovation.

The impact of AI in selected sectors have been analysed in the Figure 2.

The adoption of AI exerts a significant and positive treatment effect across all measured facets of the scientific innovation pipeline. The impact is well and most pronounced in the development of new materials, where the ability of AI-based technologies model and stimulate complex molecular structures has accelerated discovery. This is closely followed by a substantial effect on patent filings, indicating that AI is not only enhancing research and development but also directly leading to a greater output of protectable intellectual property.

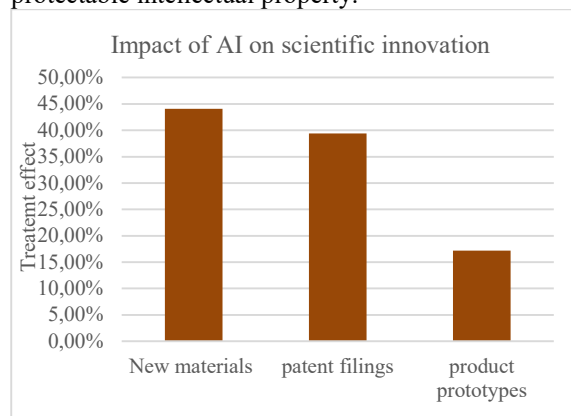


Figure 2: Impact of AI on scientific innovation. Source: Author's own construct.

Furthermore, the notable effect on the creation of product prototypes confirms that AI's impact extends beyond theoretical research into the tangible realization and commercialization of new technologies. Thus, the findings collectively indicate AI's role in socioeconomic development as a powerful multipurpose technology that compresses the innovation lifecycle from the initial discovery to market-ready application.

The paper also analyzed the deployment of AI in agriculture and energy sectors. The deployment of AI in the agriculture and energy sectors in Kenya and India, respectively, has been looked at. We think these cases would serve as critical references for other countries, particularly those developing economies to develop their roadmaps in the use of AI for sustainable development purposes. Having indicated and justified in the previous sections how AI can make sustainable development goals attainable, it imperative to assess successful AI-driven projects and the benefits accrued thereof.

The application of AI in Kenya's agricultural sector

The application of AI-based technology is altering Kenya's agriculture sector, increasing productivity and efficiency while solving important issues that farmers face. Kenya's economy is mostly dependent on agriculture for growth, and the country has made significant headway by integrating AI-driven technologies into farming operations. The agricultural sector of Kenya demonstrates the potential of using AI-based technologies to attain sustainable investment development in developing countries. AI-driven weather prediction models and crop monitoring have helped farmers in Kenya to enhance yield, minimize costs, and promote sustainability. This progress, according to Manyika et al. (2020), has helped in attracting investors interested in funding agricultural innovations that are in line with ESG frameworks. For instance, AI applications that analyze data from sources like satellite photos and Internet of Things (IoT) sensors using machine learning algorithms have made precision farming feasible.

These technologies assist farmers in monitoring crop health, predicting yields as well as detecting diseases at early stages for actions. Morimoto (2020) posited that AI-based platforms such as Agrostar provide farmers with advice tailored to crop management, which enable them to make informed decisions on planting, fertilization as well as pest control.

It is undeniable fact that weather plays a critical role in agriculture, thus the ability to accurately determine weather patterns can go a long way to improve farming such as in the case of Kenya, hence the need for AI as it can enhance the accuracy of weather predictions. This is feasible because machine learning models evaluate and assess historical weather data and current climate conditions to determine localized weather forecasts based on which farmers plan their farming activities. Thus, Ochieng et al. (2021) show that AI-driven tools for weather predictions help improve crop yields by significantly minimizing risks related to unpredictable weather patterns. Additionally, pest and disease management is another area that AI-powered solutions can be particularly useful. Farmers can detect affected crops with help of mobile applications by capturing the images, and this enables them to receive instant diagnoses and recommended treatments. Patel et al. (2020) reveal that AI is used by Plant Village Nuru app to equip farmers in identifying pests and diseases, which facilitate timely interventions to save substantial portions of their harvests.

An improvement in crop yields would amount to nothing if farmers in developing countries do not get

markets for their produce since it may lead to post-harvest losses due to lack of storage facilities and/or create extra costs. Hence, the need to deploy AI in creating markets, which facilitates better market access for farmers in Kenya. AI-driven platforms such as Twiga Foods use AI algorithms to determine market trends and consumer demand thereby providing farmers with insightful information on when to sell their produce at optimal prices. This helps in maximizing profits and minimizing post-harvest losses that exacerbate the plights of smallholder farmers, whose source of livelihood is farming (Fitzgerald, 2019).

Therefore, the application of AI-driven technology in agriculture has the potential to completely change Kenyan farmers' farming methods, enabling them to boost sustainability, productivity, and living standards. By using AI-based technology for crop management, weather forecasting, pest and disease control, and market access, Kenyan farmers can withstand and surpass traditional obstacles and improve their standard of living.

Thus, sustained investment in AI and its deployment of related technologies is pivotal for the future of agricultural development in Kenya and other developing countries.

3.1 AI implementation in India for managing renewable energy

By optimizing energy generation and consumption, artificial intelligence (AI) solutions in renewable energy management demonstrate how technology promotes sustainable investment.

AI-powered tools like machine learning models can predict energy needs and regulate supply, which therefore increases efficiency in solar and wind energy projects. Fujii et al. (2021) demonstrate that innovation attract green investors, who are focused on supporting sustainable energy solutions. India's application of AI to renewable energy management is rapidly changing the industry by improving productivity, allocating resources as efficiently as possible, and streamlining decision-making. Given the commitment by India in increasing its renewable energy capacity, AI-based tools play a pivotal role in managing the complications that are related to renewable sources like wind and solar energy. To improve the accuracy of energy generation forecasts, for example, AI systems examine vast datasets including historical energy output, weather patterns, and demand projections.

A study by Choudhary et al. (2021) revealed that the incorporation of AI-driven predictive analytics causes better forecasting accuracy, and this is significant for grid stability and energy distribution. The storage of energy is just as important as its generation, and it is crucial for managing the intermittent nature of renewable energy. Thus, the deployment of AI helps in optimizing the operation of batteries and other storage facilities by determining energy generation and consumption patterns. AI can help predict the best times to store or release energy through the real-time monitoring and analysis, and this maximizes the efficiency of storage systems (Ghosh et al., 2020). Furthermore, companies such as ReNew Power use AI to improve their battery management systems, increasing the use of renewable energy generated during peak production periods. Furthermore, AI is required for the creation of smart grids, which are critical for integrating renewable energy into the country's current power infrastructure. Surprisingly, smart grids use AI-powered technologies to monitor and control energy flow, detect anomalies, and optimize load balance across several energy sources. According to Kumar and Kumar (2022), programs such as Delhi's smart meter project use artificial intelligence to ensure real-time data collection and analysis, which improves energy distribution efficiency and lowers losses due to theft or inefficiencies.

Another way AI would be particularly important is demand response and load forecasting as it helps in analyzing consumption patterns of users and adjust energy supply, accordingly, hence guaranteeing optimal utility while reducing wastage. Thus, by deploying machine learning algorithms, their usage can precisely determine energy demand and adopt strategies to meet this demand with renewable energy sources. This function of AI is mainly significant and relevant for India, where energy demand rises during peak hours (Maheshwari et al., 2021). Likewise, AI facilities help to remotely monitor renewable energy infrastructure and ensure timely interventions (proactive maintenance) and minimize downtime. By employing AI and IoT sensors, specialists can identify eminent issues in solar panels or wind turbines beforehand and this could help avoid complications thereby ensuring sustainable energy generation. Rao et al. (2023) show how Tata power and other energy firms are significantly improving operational efficiency by leveraging AI to implement predictive maintenance strategies for their renewable assets.

India's deployment of AI in renewable energy management offers huge benefits in the optimization

of energy generation, enhancement of grid reliability, and promotion of overall efficiency. Thus, other developing countries can understudy India's successful integration of AI technologies, this would be significant in addressing challenges of stability and sustainability as many countries continue to expand their renewable energy capacity.

3.2 Barriers in the implementation of AI for sustainable investment development

One of the major challenges facing many developing countries is infrastructural gaps coupled with huge budget deficits in providing the necessary infrastructure for a smooth deployment and implementation of AI technologies. Sey et al. (2019) reveal that many developing economies have inadequate technological infrastructure required for the overall AI implementation, data storage and internet connectivity. Thus, limited AI facilities hamper real-time data processing and analysis, which impact the effectiveness of AI deployment in financial inclusion and resource allocation efforts.

Also, the reliance of AI on data raises ethical and legal concerns about data privacy, particularly in developing countries, where there are still limited regulatory frameworks and/or existing gaps in their data regulation policies. Zeng et al. (2021) reveal that despite ethical AI practices promote robust privacy measures, developing economies encounter numerous barriers in enforcing data security, and this discourages foreign investors because of concerns over legal compliance and data protection.

4 CONCLUSIONS

Sustainable investment development in developing countries is very crucial for their economic and social transformation, which would lead to improved living conditions and breach the existing poverty gap in these nations. One of the major ways to expedite sustainable development efforts to leverage digital and technological progress in ensuring inclusive economic growth while promoting environmentally friendly development. AI offers developing economies a unique platform to advance their sustainable investment development strategies by fostering resource management, environmental monitoring as well as financial inclusivity. Despite the existing challenges like inadequate infrastructure as well as privacy concerns, tailored policies and international collaboration could mitigate these

barriers. AI-driven technologies are essential for accomplishing sustainable development goals because they have the ability to boost economic growth in developing countries.

The case studies herein demonstrate the pivotal role of AI in achieving sustainable investment in diverse sectors, especially in the agricultural and energy sectors. Thus, the objective of this paper is achieved as supported by the works of Rao et al. (2023) and Fitzgerald (2019) on the potential role of AI in the energy and agriculture sectors, respectively, which promote the sustainable growth in the respective countries. To harness the benefits of AI for long-term investment development, emerging nations must focus and implement AI-friendly legislation, data protection frameworks, and digital infrastructure development.

Developing nations can collaborate with the global community to secure financial and technical assistance for their AI-powered initiatives aimed at achieving sustainable development. A supportive environment for AI integration and sustainable investment development goals will also be fostered by the creation and execution of educational initiatives to upskill locals in AI-related competencies.

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