

An Assessment of Artificial Intelligence Development in Nigeria: Challenges and Opportunities

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ABSTRACT

This paper assesses the current state of artificial intelligence development in Nigeria by examining key opportunities, challenges, and areas of application. Artificial Intelligence (AI) has emerged as a transformative technology with the potential to improve productivity, service delivery, and economic growth across various sectors. In Nigeria, the adoption and development of AI are still at an early stage but show promising prospects. The study adopts a qualitative review approach, drawing insights from existing literature, policy documents, and observed trends within the Nigerian technology ecosystem. Findings reveal that while Nigeria faces challenges such as inadequate infrastructure, limited skilled manpower, data scarcity, and weak policy frameworks, there are significant opportunities in sectors such as finance, healthcare, education, agriculture, and governance. The paper concludes by recommending strategic investments in education, infrastructure, policy formulation, and public-private partnerships to accelerate AI development in Nigeria.

Keywords: *Artificial Intelligence, transformative technology, digital transformation*

1. INTRODUCTION

Artificial Intelligence refers to the ability of machines and computer systems to perform tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making. The capabilities of AI, including machine learning, natural language processing, computer vision, and robotics, are being utilized to address intricate challenges, improve efficiency, and provide novel solutions across several domains (Rai, 2020 and Marr, 2021) Developed economies have made significant progress in AI research,

deployment, and commercialization, whereas poorer nations such as Nigeria are now starting to investigate how AI might be used to tackle important socio-economic issues (Chui *et al.*, 2022). Nigeria, a country experiencing fast population growth and economic development, holds great potential in incorporating artificial intelligence (AI) into vital industries, including healthcare, agriculture, education, and finance (Okolie *et al.*, 2021). Artificial intelligence (AI) has the potential to tackle critical issues in the country, such as strengthening healthcare delivery, improving agricultural output, boosting educational performance, and upgrading financial services (Adegboye *et al.*, 2020). However, interest in artificial intelligence has increased in recent times due to the growth of the digital economy, expansion of internet access, and a vibrant technology startup ecosystem. Despite this progress, AI development in Nigeria remains limited when compared to global standards. Understanding the challenges and opportunities associated with AI development is essential for policymakers, researchers, and industry stakeholders. This paper, therefore, assesses the state of AI development in Nigeria, focusing on its challenges and opportunities.

2. Concept of Artificial Intelligence

Artificial intelligence (AI) is a specialised area of computer science concerned with the design of algorithms and systems capable of performing tasks that typically require human intelligence. These tasks include speech recognition, image processing, natural language understanding, data analysis, and autonomous decision-making. It has emerged as a transformative technology globally (Russell and Norvig, 2020). AI applications, including machine learning, natural language processing, and robotics, have the capacity to significantly reshape various sectors by enhancing efficiency, precision, and productivity (Haenlein and Kaplan, 2019). Nigeria, with its rapidly growing population and expanding economy, has substantial potential to integrate AI across key sectors such as healthcare, agriculture, education, and finance (Okolie *et al.*, 2021). The adoption of AI offers solutions to several pressing national challenges, including improved healthcare services, increased agricultural productivity, enhanced educational outcomes, and more efficient financial systems (Adegboye *et al.*, 2020). In the healthcare sector, AI can support accurate disease diagnosis, optimise treatment plans, and predict the spread of infectious diseases (Olaleye *et al.*, 2023). Similarly, AI-powered agricultural systems can analyse data to evaluate soil conditions, predict weather trends, and recommend optimal planting periods, thereby increasing crop yields and minimising losses (Omobayode and Fabiyi, 2022). AI systems rely heavily on data, computing power, and skilled professionals. Their effectiveness depends on the availability of quality datasets, reliable infrastructure, and supportive institutional frameworks.

3. CONTEXTUAL REVIEW

3.1 The role of artificial intelligence (AI) in developing economies

Artificial intelligence (AI) has the potential to act as a driving force for development in emerging economies by fostering economic growth, improving public service delivery, and encouraging innovation. Given the rapid population growth and the need for scalable solutions in developing countries, AI technologies offer significant benefits. This section explores various dimensions of AI adoption in low-income nations, drawing on existing studies to highlight both the potential benefits and the challenges associated with its implementation.

3.2 Innovation and entrepreneurship

Artificial intelligence promotes innovation by providing entrepreneurs and organisations with new tools and technological capabilities. According to Manyika *et al.* (2017), AI can enable the emergence of new business models and market opportunities, particularly within sectors such as finance, e-commerce, and logistics. In developing countries, where access to traditional financial services is often limited, AI-powered financial technology solutions can enhance financial inclusion by offering mobile banking services, microcredit facilities, and personalised financial advisory support. Beyond finance, AI can drive innovation across local industries by supporting the development of products and services tailored to specific market needs. For example, AI applications can be employed to design affordable healthcare diagnostic solutions, improve agricultural technologies, and deliver customised educational content that addresses the unique challenges faced by learners in different regions.

3.3 Economic Growth and Productivity

Chui *et al.* (2018) provide an in-depth analysis of how artificial intelligence (AI) can drive economic growth in developing countries. Proponents argue that AI technologies can significantly enhance productivity by automating routine tasks, streamlining supply chains, and enabling more efficient use of resources. Through AI-based data analytics, organisations are better positioned to predict market trends and consumer behaviour, supporting more informed decision-making and improved competitive advantage. Additionally, AI can improve industrial efficiency through predictive maintenance, which minimises equipment downtime and reduces maintenance costs (Bauer *et al.*, 2019). This capability is particularly relevant for emerging economies such as Nigeria, where industrial sectors often struggle with equipment reliability and maintenance challenges.

Academic institutions and research centres are gradually introducing AI-related courses and research initiatives. Additionally, private sector organisations and multinational

technology companies are beginning to invest in AI-driven solutions tailored to local needs. However, several challenges have constrained the scale of AI deployment remains small, and widespread adoption remains limited.

4. APPLICATION AND OPPORTUNITIES FOR ARTIFICIAL INTELLIGENCE IN NIGERIA

4.1 Financial Services

In the financial industry, artificial intelligence (AI) is transforming operational processes, risk management practices, and customer service delivery, thereby enhancing innovation and efficiency. A major application of AI in finance is fraud detection and prevention, where machine learning models process large volumes of transaction data in real time to identify unusual patterns and potential fraudulent behaviour (Ogundele *et al.*, 2020). Early detection of such activities enables financial institutions to reduce financial losses, safeguard customer funds, and maintain confidence in the financial system. AI-powered chatbots and virtual assistants are reshaping customer engagement within the financial sector. These intelligent systems communicate with users through text or voice platforms, offering personalized financial advice, responding to customer queries, and supporting transaction processes efficiently (Adeleye *et al.*, 2021). By employing natural language processing and machine learning techniques, these tools provide continuous customer support, improve user satisfaction, and lower operational expenses. Furthermore, AI-based predictive analytics enhance risk assessment and management by examining historical records, market dynamics, and macroeconomic factors. The insights generated support informed investment decisions, effective portfolio management, and proactive risk control, ultimately strengthening financial performance and institutional resilience (Adebayo *et al.*, 2020).

4.2 Healthcare Sector

In Nigeria, where access to quality healthcare services remains limited, artificial intelligence (AI) presents innovative solutions with the potential to transform healthcare delivery. One notable application is medical image analysis, where AI systems can examine diagnostic images such as X-rays, MRIs, and CT scans to accurately identify abnormalities and diseases (Smith *et al.*, 2020). This capability supports the early detection of illnesses such as cancer, tuberculosis, and pneumonia, enabling timely treatment and improved patient outcomes. Additionally, AI-enabled telemedicine platforms are increasingly being adopted in Nigeria, particularly in rural and underserved communities with inadequate healthcare infrastructure (James and Oluwatobi, 2019). These platforms facilitate remote consultations between patients and healthcare providers, easing pressure on congested hospitals and clinics. AI-powered chatbots and virtual health assistants further enhance these services by

offering tailored health information, medication reminders, and preliminary health assessments, thereby improving healthcare access and operational efficiency (Adewale *et al.*, 2021).

4.3 Education

Artificial intelligence (AI) holds significant promise for transforming education in Nigeria by responding to varied student learning needs, improving instructional delivery, and enhancing administrative processes. AI-based adaptive learning systems tailor educational experiences to individual learners by considering their abilities, challenges, and preferred learning styles (Ogunlade *et al.*, 2019). By evaluating student performance data, these systems adjust course content and teaching materials to provide personalised support and improve academic outcomes. In addition, AI-powered educational platforms deliver interactive and engaging learning experiences that accommodate different learning preferences (Oloruntoba *et al.*, 2021). Technologies such as virtual reality (VR) and augmented reality (AR) create immersive learning environments that replicate real-life situations and promote experiential learning, particularly in science, technology, engineering, and mathematics (STEM) disciplines. From an administrative perspective, AI enhances efficiency by automating routine tasks such as grading, student registration, and timetable management, enabling educators and administrators to dedicate more time to instruction, mentoring, and student engagement (Adeloye *et al.*, 2018). Furthermore, AI-enabled chatbots and virtual assistants improve communication by providing prompt support to students, parents, and academic staff, thereby strengthening the overall effectiveness of educational institutions.

4.4 Agriculture

Agriculture plays a central role in Nigeria's economy, providing employment for a large segment of the population and supporting national food security. Artificial intelligence (AI) technology presents innovative approaches to improving agricultural output, maximising efficient use of resources, and reducing production risks. A key application of AI in agriculture is precision farming, where advanced algorithms enable farmers to gather and analyse data from sources such as satellite images, drones, and Internet of Things (IoT) sensors to support informed decision-making (Afolabi *et al.*, 2018). These data-driven decisions include determining suitable planting periods, optimising irrigation and fertiliser application, and identifying crop diseases and pest infestations at early stages. As a result, precision farming enhances crop productivity, minimises resource waste, and encourages sustainable farming practices. Furthermore, AI-based agricultural advisory platforms offer customised guidance and actionable insights to farmers' specific needs and local environments (Ajayi *et al.*, 2020). By integrating information on soil conditions, weather

trends, market dynamics, and policy frameworks, these systems strengthen farmers' decision-making capacity, leading to increased productivity.

4.5 Governance and Public Services

AI can enhance public service delivery through data-driven decision-making, traffic management, crime analysis, and digital government services. This can improve transparency, efficiency, and accountability.

5. CHALLENGES OF ARTIFICIAL INTELLIGENCE DEVELOPMENT IN NIGERIA

5.1 Inadequate Infrastructure

Reliable electricity, high-speed internet, and computing infrastructure are essential for AI development. The lack of adequate infrastructure in Nigeria presents a major challenge to the effective implementation of artificial intelligence (AI). Successful deployment of AI systems requires reliable internet connectivity, robust data storage capabilities, and access to modern computing resources. However, many parts of Nigeria continue to experience slow and unstable internet, frequent power outages, and limited access to advanced technology. This digital divide not only hinders the adoption of AI but also exacerbates existing socio-economic inequalities. To fully leverage AI technologies, substantial investments are needed to upgrade the country's digital and physical infrastructure (Oyediran *et al.*, 2021).

5.2 Shortage of Skilled Manpower

A major challenge facing AI adoption in Nigeria is the scarcity of skilled professionals with expertise in AI and related fields such as data science, machine learning, and software engineering. The country experiences a significant shortage of personnel capable of developing, implementing, and maintaining AI systems. Many Nigerian educational institutions have incomplete AI curricula and provide limited opportunities for practical, hands-on training. This skills gap restricts organisations from building and deploying AI solutions internally or hiring qualified experts externally. Addressing this issue requires targeted educational initiatives and professional development programs for developing a competent AI workforce (Adepoju *et al.*, 2022).

5.3 Limited Access to Quality Data

AI systems depend on large, accurate, and well-structured datasets. Reliable access to high-quality data is critical for the development of effective AI systems. In Nigeria, data collection processes are often inconsistent, leading to incomplete, outdated, or biased datasets. High-quality and dependable data is essential for training machine learning models

and ensuring accurate and fair outcomes. The lack of standardised data collection methods and centralised data repositories makes it challenging for organisations to access and utilise the information needed for AI applications. Efforts are therefore required to improve data collection procedures, establish clear data standards, and create accessible data repositories (Nkomo *et al.*, 2022).

5.4 Weak Policy and Regulatory Frameworks

The deployment of AI technologies raises numerous ethical and legal challenges that must be addressed to ensure responsible and fair use. Key concerns include data privacy, algorithmic bias, and the potential for job displacement. Nigeria currently lacks comprehensive legal and ethical frameworks to govern AI research and implementation. Data privacy is particularly critical, as many AI systems rely on large datasets containing sensitive personal information. Ethical AI use also requires addressing algorithmic bias, which can produce unfair outcomes and reinforce existing socio-economic inequalities. Additionally, the automation of certain tasks through AI may lead to significant job losses, particularly in sectors that depend heavily on repetitive labour (Durodolu *et al.*, 2021).

5.5 High Cost of Technology Adoption

The cost of acquiring hardware, software, and cloud computing services remains high for many Nigerian organisations and startups. The development and deployment of AI technologies require considerable financial investment. In Nigeria, AI innovation is constrained by limited funding, posing a major challenge for its growth. Many organisations, particularly startups and small businesses, struggle to secure the necessary resources for AI projects. Government support for AI research and development remains inadequate, highlighting the need for increased investment from both public and private sectors. Access to sufficient funding is essential for establishing the required infrastructure, acquiring advanced technologies, and developing the skilled workforce needed to advance AI initiatives (Akinyemi *et al.*, 2021).

6. IMPLICATIONS FOR NATIONAL DEVELOPMENT

Artificial Intelligence holds significant potential to contribute to Nigeria's economic growth, job creation, and global competitiveness. If effectively harnessed, AI can support innovation, improve service delivery, and enhance productivity across sectors. However, failure to address existing challenges may widen the digital divide and limit Nigeria's ability to compete in the global digital economy.

7. CONCLUSION

Artificial Intelligence development in Nigeria is at a formative stage, characterised by significant challenges and promising opportunities. While infrastructural, skill-related, and policy limitations hinder progress, the potential benefits of AI adoption across key sectors

are substantial. With strategic investments, supportive policies, and capacity building, Nigeria can leverage artificial intelligence to drive sustainable development and economic transformation.

8. RECOMMENDATIONS

To enhance AI development in Nigeria, the following measures are recommended:

1. The government should increase investment in digital infrastructure, including power and internet connectivity.
2. The government should integrate of AI and data science education into academic curricula at all levels.
3. The government should develop national AI policies and ethical frameworks.
4. The government should promote public–private partnerships to support AI research and innovation.
5. The government should strengthen data collection, management, and sharing practices.

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