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INTERPLAY BETWEEN ARTIFICIAL INTELLIGENCE/DATA SCIENCE AND SUSTAINABLE DEVELOPMENT: A STUDY OF EDO STATE, NIGERIA

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Abstract
The integration of artificial intelligence (AI) and data science (DS) is said to be transforming sustainable development by enabling data-driven decision-making, optimizing resource management and enhancing problem-solving efficiency. Therefore, the objectives of this study were to: assess the level of awareness and adoption of AI and DS for sustainable development in Edo State, Nigeria; identify key areas where AI and DS are making significant impacts; and, thirdly, to evaluate the challenges hindering their effective utilization. This paper applied the diffusion of innovation theory to examine how AI and DS are being adopted for sustainable development initiatives. The study employed a mixed-methods approach, combining quantitative and qualitative research methods. Findings indicate that the awareness and adoption level of AI and DS for sustainable development in Edo State, Nigeria is low; also, AI and DS, though not adequately utilized, but are increasingly used in environmental monitoring, smart agriculture, healthcare and urban planning, contributing to enhanced efficiency and sustainability. However, challenges such as limited technical expertise, inadequate infrastructure, and data privacy concerns impede broader adoption. The study concluded that AI and DS have immense potential to drive sustainable development, but require strategic policy frameworks and capacity building. It recommended investment in digital infrastructure, AI education, and cross-sector collaborations to maximize their impact. Policymakers, educators and industry stakeholders must also work together to foster an enabling environment for AI and DS-driven sustainability.

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Introduction

Sustainable development has emerged as a cornerstone of the global policy agenda, driven by the urgent need to harmonize economic growth, social equity and environmental stewardship. The United Nations Sustainable Development Goals (UN SDGs), adopted in 2015, underscore the imperative for innovative, scalable solutions to challenges such as climate change, resource depletion, poverty, and inequality (UNDP, 2021). In this context, artificial intelligence (AI) and data science (DS) have rapidly evolved as transformative tools, offering unprecedented capabilities in predictive analytics, automation, and data-driven decision-making. From optimizing energy consumption to enhancing precision agriculture, AI/DS applications are reshaping industries worldwide, promising efficiency gains and sustainability outcomes (World Economic Forum, 2022). However, the adoption of these technologies remains uneven, particularly in developing regions such as sub-Saharan Africa, where infrastructural deficits, limited technical expertise, and policy gaps persist (World Bank, 2020).

Nigeria, Africa's most populous nation, exemplifies this paradox. While urban centers such as Lagos and Abuja are gradually integrating AI-driven solutions into sectors such as Fintech and Healthcare, rural and semi-urban regions lag significantly. Edo State, located in southern Nigeria, epitomizes this dichotomy. As a hub of agricultural production, contributing over 20% of Nigeria's cassava and rubber output, and a rapidly urbanizing region, Edo State faces mounting sustainability challenges. Climate change-induced disruptions, including erratic rainfall patterns and soil degradation, threaten food security, while population growth (estimated at 3.2% annually) strains urban infrastructure, healthcare, and waste management systems (National Bureau of Statistics, 2022). Systemic issues such as limited access to reliable energy, Internet connectivity, and digital literacy compound these challenges and hinder the adoption of advanced technologies.

Despite these hurdles, AI and DS hold immense potential to address Edo's sustainability gaps. For instance, machine learning algorithms could predict crop yields and optimize irrigation in agriculture, while geospatial analytics might enhance urban planning and disaster resilience (Oyelade, et al., 2021). Agriculture is now turning to AI technologies to help yield healthier crops, control pests, monitor soil and growing conditions, organize data for farmers, help with the workload, and improve a wide range of agriculture-related tasks in the entire food supply chain (Guanah & Obi, 2022).

Similarly, AI-powered diagnostic tools could bridge healthcare access in remote communities. However, the extent to which these technologies are understood, adopted, and scaled in Edo remains understudied. Existing research on AI/DS in Nigeria predominantly focuses on urban tech hubs, overlooking the semi-urban and rural contexts where sustainability challenges are most acute. This gap limits policymakers' ability to design context-specific interventions, risking further marginalization of regions such as Edo in the global digital transformation.

This paper investigated the intersection of AI/DS and sustainable development in Edo State, Nigeria, through the lens of the diffusion of innovation (DOI) theory. By analyzing awareness levels, application areas and adoption barriers, the study contributed actionable insights for leveraging AI/DS to achieve SDGs in resource-constrained settings.

The research is timely, aligning with Nigeria's National Digital Economy Policy (2020–2030), which prioritizes digital literacy and technological innovation as drivers of inclusive growth (Federal Ministry of Communications and Digital Economy, 2020). It also responded to calls for localized, evidence-based strategies to bridge the global AI divide (UNESCO, 2023).

Statement of the Problem

Despite significant global advancements in artificial intelligence (AI) and data science (DS) as catalysts for sustainable development, Edo State, Nigeria, lags critically in harnessing these technologies to address its pressing

socio-economic and environmental challenges. While nations worldwide leverage AI/DS for precision agriculture, smart city planning, and climate resilience (UNDP, 2021; World Economic Forum, 2022), Edo State remains constrained by systemic barriers that stifle innovation. A pervasive lack of awareness of AI/DS capabilities persists across key sectors, including governance, agriculture, and healthcare.

Fragmented infrastructure further compounds these challenges. Chronic power shortages, limited internet penetration (estimated at 42% in urban areas and 18% in rural zones), and inadequate data collection systems undermine the deployment of AI/DS solutions (World Bank, 2020). In agriculture, where Edo contributes 20% of Nigeria's cassava production, the absence of IoT-enabled sensors and predictive analytics leaves farmers vulnerable to climate shocks, such as erratic rainfall patterns and pest outbreaks (Oyelade et al., 2021). Similarly, urban planning authorities struggle to manage rapid population growth (3.2% annually), resulting in unregulated urbanization, traffic congestion and waste management crises; issues that could be mitigated through AI-powered smart city models.

Skill gaps present another critical barrier. Technical expertise in AI/DS is concentrated in urban tech hubs such as Lagos, leaving Edo's workforce underprepared to adopt or maintain advanced systems. A 2023 report by the Edo State Ministry of Education highlighted that fewer than 10% of tertiary institutions in the state offer courses in data science or machine learning, creating a mismatch between emerging technologies and local capacity. This gap is particularly detrimental in healthcare, where AI-driven diagnostic tools could alleviate burdens on understaffed rural clinics, but remain underutilized due to a lack of trained personnel (Adegboye, et al., 2020).

The confluence of these factors, low awareness, infrastructural deficits, skill shortages, and policy inertia, creates a cycle of stagnation. If left unaddressed, Edo State risks entrenching socio-economic inequalities, environmental degradation, and missed opportunities for inclusive growth. This study, thus, underscores the urgency of bridging the AI/DS adoption gap to unlock sustainable development in a region where innovation is not merely aspirational but imperative.

Objectives of the study

The objectives of the study were to:

1. Assess the awareness and adoption level of AI/DS for sustainable development in Edo State
2. Identify key sectors where AI/DS are making an impact
3. Evaluate the challenges impeding effective utilization.

Theoretical Framework

This study was hinged on the diffusion of innovation (DOI). The Theory, pioneered by Rogers (2003), provides a robust framework for understanding how technological advancements permeate social systems over time through communication channels. At its core, DOI posits that the adoption of innovations is not instantaneous, but occurs progressively through five stages: *knowledge* (awareness of the innovation), *persuasion* (forming an attitude toward it), *decision* (adoption or rejection), *implementation* (putting it into practice), and *confirmation* (reinforcement based on outcomes).

These stages are influenced by the perceived attributes of the innovation, including *relative advantage* (its superiority over existing solutions), *compatibility* (alignment with cultural and infrastructural norms), *complexity* (ease of use), *treatability* (opportunity to experiment), and *observability* (visibility of results). When this theory is related to AI and DS adoption for sustainable development in Edo State, the DOI framework elucidates why these technologies remain predominantly in the *early majority* phase of adoption. At this stage, innovations gain traction among pragmatists reliant on evidence of tangible benefits before committing (Rogers, 2003).

For instance, AI-driven environmental monitoring tools in Edo State demonstrate *a relative advantage* by enabling real-time tracking of deforestation, which traditional methods could not achieve efficiently. Similarly, DS applications in healthcare, such as predictive analytics for disease outbreaks, offer *observability* through improved patient outcomes, persuading stakeholders to adopt these tools. However, adoption is stifled by *complexity*, and many end-users, particularly in rural agricultural communities, lack the technical expertise to operate AI systems—and *compatibility* gaps, as the existing infrastructure often cannot support advanced technologies.

The *knowledge* stage is critical in Edo State, where the awareness of AI/DS remains fragmented. While urban policymakers and tech-savvy entrepreneurs may recognize these tools, rural farmers and healthcare workers often lack exposure to their potential. This disparity highlights the role of communication channels: mass media and social networks have been ineffective in disseminating AI/DS knowledge equitably, leaving marginalized groups underserved. Meanwhile, the *persuasion* stage is influenced by socio-economic factors. For example, cost-benefit analyses by smallholder farmers—weighing the expense of AI-enabled irrigation systems against potential yield improvements, determine whether they progress to the *decision* stage.

Edo State's struggle to advance beyond the *early majority* phase also stems from limited *treatability*. Pilot projects, such as smart agriculture initiatives in Benin City, are often isolated or underfunded, restricting opportunities for stakeholders to test technologies before full-scale adoption. Furthermore, *compatibility* challenges arise from Nigeria's erratic power supply and low Internet penetration (World Bank, 2020), which undermine the reliability of data-driven systems. Without addressing these barriers, the *confirmation* stage, where users reinforce their adoption based on positive outcomes, remains elusive for many.

The DOI framework also categorizes adopters into innovators, early adopters, early majority, late majority, and laggards. In Edo State, *innovators* include tech startups and academic institutions experimenting with AI/DS prototypes, while *early adopters* comprise forward-thinking state agencies, such as the Edo State Ministry of Agriculture, which has integrated geospatial analytics into land-use planning. The *early majority*, local NGOs and mid-sized enterprises, are cautiously adopting tools such as AI-powered climate models but require stronger institutional support to scale their efforts.

The DOI is relevant to this study because the study identifies systemic bottlenecks in Edo State's AI/DS adoption journey. For example, the lack of localized training programs exacerbates *complexity*, while insufficient funding for grassroots initiatives limits *treatability*. These insights align with global studies on technology diffusion in developing regions, where infrastructural and cognitive barriers often delay adoption (World Economic Forum, 2022). Ultimately, the DOI lens underscores the need for tailored strategies that address stage-specific challenges, ensuring that AI/DS innovations transition from niche experiments to mainstream drivers of sustainable development.

Bringing AI and Data Science into Sustainable Development

Bringing artificial intelligence (AI) and data science together is a game-changer for tackling tough environmental, economic, and social problems. It's a major boost for sustainable development efforts all around the world (Safikul, 2024). AI acts a bit like the human brain, letting machines and models look at data, figure out what might happen next, and offer useful insights. This is really key for making smart choices (Nidhi, 2022). Data science makes this even better by helping us make decisions based on what the data actually tells us, instead of just going with gut feelings or experience. This combination is changing the way businesses work and make big plans, proving incredibly useful for companies of all sizes (Nidhi, 2022).

How AI and Data Science are used in Sustainable Development

AI and data science are completely changing how we approach global development. They are opening doors to solutions that can grow and last across different areas (James et al., 2024). Take healthcare: AI is making it more accessible, efficient, and leading to better results using things like machine learning and predictive analytics. In education, AI helps make learning more personal, simplifies paperwork, and creates engaging ways to learn, which ultimately gets students more involved and improves their results (Abimbola et al., 2024). It is similar to farming, where AI helps farmers be more precise, monitor crops, and control pests. This leads to much better yields, uses resources more efficiently, and lessens the impact on the environment (George et al., 2024). In addition, AI-powered mapping tools (GIS) make forecasts for development and sustainability checks more accurate, helping us make smarter decisions when planning cities.

When it comes to sustainable energy, AI-powered tools are helping to improve predictions, manage power grids better, and bring in more renewable energy sources (Nedungadi et al., 2024). For instance, AI and big data analysis can reduce energy waste, accurately predict spikes in demand, and better balance the load on power grids. Using AI together with robotic process automation (RPA) helps make decisions based on data, smooth out administrative tasks, and improve how services are delivered in smart cities. AI also helps make tourism more sustainable by predicting how many tourists will come and managing energy use and waste in popular destinations (Cristian et al., 2024). Since AI can sift through huge amounts of data and provide real-time information, it helps those involved in tourism use sustainable methods.

AI and Data Science in Protecting the Environment

AI offers amazing new ways to monitor and protect the environment, really changing how we manage ecosystems (Nneamaka et al., 2024). AI programs can look through photos from camera traps, drone images and GPS data to spot animals and estimate how many there are. This leads to better ways to stop poaching and protect a wider variety of species (Nneamaka et al., 2024). What is more, the AI analysis of images helps check how healthy forests are, spot where forests are being cut down, and find areas that need replanting.

AI can also predict natural disasters, giving us early warnings so we can be better prepared and assess the situation (Nneamaka et al., 2024). In addition, AI makes it possible to monitor things in real time and obtain reports through IoT devices with environmental sensors that send data straight to AI systems for analysis. A good example is Snapshot Safari, which mixes citizen science with machine learning to quickly produce ecological data from camera traps, showing how an efficient, combined data system can revolutionize how we tackle critical environmental issues.

"Smart conservation" brings together wildlife monitoring and AI. It uses AI to automatically identify species from pictures and sounds, which makes checking on habitat health and tracking animal numbers much more effective (Hedge et al., 2024). AI is also used with satellite photos to keep a constant eye on habitats by spotting changes in land use and seeing where habitats are shrinking (Hedge et al., 2024). Using models to predict outcomes helps plan conservation actions ahead of time by forecasting how environmental changes might impact animal populations, while AI systems that give real-time alerts and monitoring make it easier to fight illegal activities such as poaching (Hedge et al., 2024). This whole approach shows the incredible power of AI in protecting the variety of life, solving environmental problems, and helping ecosystems and people live together long-term (Hedge et al., 2024).

Challenges and Things to Consider

Even with all the amazing things that AI and data science can do, using them for sustainable development is not without its hurdles (Kumari et al., 2024). These include questions about ethics, worries about data privacy, and

the gap between those with and without digital access, things we must sort out to make sure everyone benefits fairly and sustainably. There are also concerns about job losses increasing because of AI, which stresses the need to develop AI responsibly (Kumari et al., 2024). Bias in the algorithms and the risk of making existing inequalities worse are other serious ethical points that need careful attention. Furthermore, we absolutely need clear rules that put data privacy and security first, demand openness about how algorithms work, and ensure that everyone can access these tools fairly.

To overcome these obstacles, we need practical plans from policymakers, tech experts, and everyone involved. These plans should focus on fair access, ethical rules, and working together on new ideas (Onoja et al., 2024). It is really important to keep investing in AI for sustainable development, alongside helping people build the skills needed and creating supportive policies to get the most benefit from AI while reducing the potential downsides and inequalities (Kumari et al., 2024). Dealing with issues such as data quality, security, and biases in algorithms is also vital for creating AI solutions that are ethical and can grow. Making sure we can trust AI technologies is necessary for a lasting digital shift, which can be helped by countries working together and creating standards to stop AI problems later on.

Innovative AI and an Economic Strategy for Sustainability

Artificial intelligence (AI) is playing a really important part in helping push forward sustainable ways of doing business in different areas. In farming, AI tools look at soil data, predict how much crop you will get, and spot pest or disease problems early. This helps farmers grow more while using less pesticide and fertilizer. For example, robots using AI can spot and pull out weeds exactly where they are, meaning less need for chemical weed killers and supporting greener farming methods (2030 Builders, 2024).

In the energy world, AI is completely changing local energy systems with new ideas such as virtual power plants. This is where the batteries in homes automatically send power back to the grid when needed. Making things work well like this takes the pressure off the old power plants and saves energy (Mendelsohn, 2024,). "Also, AI programs improve how supply chains work by identifying problems and recommending ways to reduce fuel use, greenhouse gases, and wasted resources.

Companies are using AI to come up with new ideas that use fewer materials, include recycled stuff, and support ways to reuse and recycle more (like in a circular economy). Instead of just tweaking how things are already done, AI gives us the chance to completely rethink products and services to be greener right from the start. For instance, using AI to make decisions in supply chains that focus on sustainability can really reduce carbon footprints. It helps make things run smoother and meets the rules and what customers want regarding being sustainable.

Nevertheless, even though AI offers big advantages, it cannot solve sustainability problems all by itself. Using AI has to be part of a bigger plan that involves creating policies, getting everyone involved, and thinking about the ethical side of things to make sure that new technology leads to results that are fair for everyone and good for the environment. Therefore, combining creative AI uses with smart, overall economic plans looks really promising for helping us reach global sustainability targets.

Roles of AI and Data Science in Global Health and the Green Economy

Artificial intelligence (AI) is becoming a key in shaping economic plans that aim for sustainability. In farming, for example, AI-powered "precision farming" uses data from sensors, drones, and satellites to give farmers up-to-the-minute information about soil health, how crops are doing, and weather forecasts. These tools help farmers use resources such as water and fertilizer more efficiently, which boosts crop yields and supports greener farming methods (Boston Institute of Analytics, 2024). Think about AI-powered drones: they can keep a constant eye on

crops, spotting problems such as pests, diseases, or lack of nutrients early on. This means that farmers can step in quickly and rely less on chemicals (Johnson Street Bridge, 2024).

In the energy business, AI is shaking things up by making operations more efficient and cutting down on environmental harm. A startup in Finland called Capalo AI has created virtual power plants that use AI to predict how much renewable energy will be generated and used. By looking at things like weather forecasts and how much energy people are using, their system makes the battery storage work better. This makes sure there is enough power when the demand is high and helps battery owners make the most money (Business Insider, 2025). In addition, big tech and energy companies have teamed up to form the Open Power AI Consortium. They want to create AI models and data specifically for the power industry, hoping to make the power grid more reliable and manage energy better (Axios, 2025).

AI also plays a big part in pushing forward circular economy ideas—where we reuse and recycle more. It helps with designing products, running operations, and improving the infrastructure. According to the Ellen MacArthur Foundation (2019), AI can really speed up the shift to a circular economy by helping us use resources more efficiently and cutting down on waste. For example, AI programs improve supply chains by finding bottlenecks and suggesting ways to use less fuel, produce fewer greenhouse gases, and conserve resources (Maersk, 2023). In addition, AI-driven systems can improve recycling by sorting materials accurately, which increases recycling rates and helps meet sustainability goals (Algorithma, 2024).

However, we need to be careful when bringing AI into sustainability plans, thinking about the ethical side and potential problems. Making sure data stays private, dealing with the environmental footprint of AI systems themselves, and making sure everyone has fair access to AI technologies are really important things to consider. It is vital for policymakers, business leaders, and communities to work together to create guidelines for using AI responsibly to promote sustainability. By making sure that new technology aligns with ethical standards and environmental goals, AI can truly help build sustainable economic strategies.

Methodology

The study employed both quantitative and qualitative research methods to obtain a clear objective, balanced and reliable result-oriented work. The questionnaire and the questionnaire guide were used as the research instruments for gathering data. Although the research was based on Edo State, the researchers concentrated on Benin City, the capital city of Edo State. This decision is justified because Benin City is cosmopolitan in nature and have both indigenes and non-indigenes of the State residing here. The city is also made up of three local governments.

The population of this study comprises Benin City residents. According to Macrotrends.net (2025), the current metro area population of Benin City in 2025 will be 2,045,000, a 3.65% increase from 2024. The sample size was 385 and this was arrived at using the Australian Bureau of Statistics Sample Size Calculator (2025). The researchers determined the required responding sample size, standard error, relative standard error, and a confidence interval for a proportion estimate using only one of these criteria as an input. The estimated variance proportion was 0.5 (5%), and the confidence interval was 0.05 (5%). From the total population of 2,045,000, a sample size of 385 was arrived at.

The researchers used a purposive sampling technique to select respondents from three populous local governments in Benin City (Ikpoba-Okha, Oredo and Egor). The researchers selected two respondents from each of the three local governments for oral in-depth, totaling six, while 379 copies of the questionnaire were administered to the respondents. Out of these copies, only 360 (94.97%) copies were retrieved and found useful for this research. The data gathered from the field were analyzed using tables and simple percentages, based on the research objectives.

Data Presentation and Analysis

Table 1: Level of awareness and adoption of AI and DS for sustainable development in Edo State, Nigeria

Variables	Frequency	Percentage
Very high	24	6.68

High	45	12.6
Moderate	36	10
Low	194	53.90
Very low	61	16.92
Total	**360**	**100**

Source: Field Survey, 2025

The data in Table 1 imply that the level of awareness and adoption of AI and DS for sustainable development in Edo State, Nigeria, is low.

Table 2: Key areas where AI and DS are making significant impacts on Edo State, Nigeria

Variables	Frequency	Percentage
Education	52	14.44
Health	43	11.94
Agriculture	54	15
Economy	24	6.67
None of the above	187	51.95
Total	**360**	**100**

Source: Field Survey, 2025

Table 2 can be interpreted to mean that a prevalent lack of awareness about AI/DS capabilities persists across key sectors, hence they are not being adequately utilized to make impacts in Edo state, Nigeria; they can be said to be only partially used.

Table 3: Evaluation of the challenges hindering the effective utilization of AI/DS for sustainable development in Edo State

Variables	Frequency	Percentage
Inadequate technical expertise	65	18.05
Limited infrastructure	80	22.22
Unsteady Internet network	55	15.28
Digital literacy	44	12.23
Unreliable electricity supply	52	14.44
Others	64	17.78
Total	**360**	**100**

Source: Field Survey, 2025

From Table 3, it can be deduced that the effective utilization of AI/DS for sustainable development in Edo State will be difficult to achieve, for now, due to the above-listed factors, which serve as obstacles.

Discussion of the Findings

This study revealed that the awareness and adoption level of AI/DS for sustainable development in Edo State, Nigeria was low, indicating that individuals in this specific setting were relatively not well-informed about AI/DS and their applications. This finding is supported by the outcome of the research work carried out by Guanah, Okowa-Nwaebi, and Igwe (2024), which indicate a growing but uneven awareness of AI's potential, with a low level of usage for sustainable development in Nigeria. The study identified key areas where AI can be deployed,

such as security, agriculture, education, and health. It concluded that strategic efforts are needed to raise awareness and foster innovation to realize AI's potential in Nigeria (Guanah, et al., 2024).

The potential of AI in driving sustainable development across Africa cannot be overemphasized, hence Poliwatch Africa`s (2024) policy advocacy document explores AI`s potentials. It emphasizes overcoming barriers and fostering an inclusive AI ecosystem to ensure that AI contributes positively to Africa's sustainable development goals.

In an oral in-depth interview with Augustine Agbongiator of the Ikpoba-Okha Local Government Area, he stated that there is moderate awareness and adoption of AI/DS, concentrated in urban areas, with promising applications in environmental monitoring, smart agriculture, healthcare, and urban planning. Agbongiator asserts that these technologies enhance operational efficiency and sustainability outcomes, aligning with the Sustainable Development Goals (SDGs) such as zero hunger (SDG 2) and climate action (SDG 13).

Furthermore, the diffusion of innovation (DOI) theory underscores that Edo State's AI/DS adoption stalled at the *early majority* stage, where pragmatism and evidence of success dominate decision-making. While innovators and early adopters, such as tech startups and progressive government agencies, have initiated pilot projects, broader implementation is hampered by gaps in compatibility (e.g., unreliable power supply), complexity (e.g., skill shortages), and observability (e.g., insufficient dissemination of success stories). Without targeted interventions, these barriers risk perpetuating a digital divide, where AI/DS benefits remain concentrated in urban centers, worsening rural-urban inequalities.

Without the strategic adoption of AI/DS, Edo State risks falling short of multiple Sustainable Development Goals (SDGs). For example, low agricultural productivity jeopardizes SDG 2 (zero hunger), while haphazard urban expansion threatens SDG 11 (sustainable cities). Moreover, the State's inability to leverage AI for environmental monitoring undermines progress toward SDG 13 (Climate Action), as deforestation and pollution escalate unchecked. Insufficient funding for pilot projects and weak policy frameworks exacerbate these challenges by failing to incentivise private sector investment in AI/DS innovations.

The second finding of this study showed a prevalent lack of awareness about AI/DS capabilities across key sectors, hence they are not being adequately utilized to make impacts in Edo state, Nigeria. The World Bank (2020) affirms that the adoption of these technologies remains uneven, particularly in developing regions such as sub-Saharan Africa, where infrastructural deficits, limited technical expertise, and policy gaps persist.

However, there is partial utilization of AI in the health sector in Edo State (11.94%). This aligns with the findings of Efegbere, Akpojubaro, Erhuvwu, Omaedepo, Anastacia, Hycent, Akhere, Mark and Ebiruke (2024) who conducted a study in Edo State University Teaching Hospital and discussed the integration of AI, concluding that it offers a promising array of benefits for healthcare services. Although this does not cover all areas requested, it highlighted the positive impact of AI in healthcare, which could extend to efficiency and sustainability improvements.

In the education sector, the impact of the utilization of AI/DS is only 14.44%. An experiment in Edo State, Nigeria, carried out by De Simone, Barron, Mosuro, Dikoru and Manlio (2024) leveraged free generative AI tools aiming to enhance educational outcomes, representing a pioneering effort in the region. Although it focused on education, such technological advancements might also contribute indirectly to urban planning through better-educated professionals and improved data analysis capabilities.

Talking about journalism and data analysis, with implications for environmental monitoring, Guanah, Agbanu and Obi (2020) opine that there is evidence showing the growing use of AI in data analysis, automation, and content creation for news reporting in Benin City, Edo State, Nigeria. This indicates that AI-driven data

processing techniques are being adopted, potentially applicable to environmental monitoring by analyzing large datasets efficiently.

Considering businesses, including agriculture, Akounjom et al. (2024) explored the prospects of effectively utilizing Artificial Intelligence in businesses across Nigeria, discussing its roles and challenges. A 2022 survey by the National Bureau of Statistics (2022) revealed that only 35% of Edo's agricultural stakeholders are familiar with AI-driven tools for crop optimization, perpetuating reliance on outdated farming practices that yield subpar outputs and exacerbate food insecurity.

Given that agriculture is a significant sector in many African economies, including Nigeria, the principles discussed here about AI's application in business operations could similarly apply to smart agriculture practices aimed at enhancing productivity and sustainability in a place like Edo State, Nigeria.

While responding to a question during an interview, Andrew Edoadagbon of the Oredo local government attests that AI/DS have some impact in Edo State, but emphasizes the need for state-level AI policies aligned with national frameworks, investments in rural broadband and renewable energy infrastructure, and integration of AI/DS education into academic and vocational training programs. Edoadagbon called for cross-sector collaboration among policymakers, educators, and industry stakeholders to address systemic barriers and scale context-specific innovations.

Lastly, this study found that challenges such as limited technical expertise, inadequate infrastructure, and data privacy concerns impede the broader adoption of AI/DS in Edo State, Nigeria. This finding is in agreement with Ajia`s (2024) assertion that makes a case for AI adoption to tackle challenges in agriculture, but notes that the sector faces numerous challenges including poor infrastructure and limited access to modern technology, reflecting some of the same issues like inadequate infrastructure and technical expertise that you have pointed out in your statement about Edo State.

Abejide and Okonkwo (2023) also identified challenges such as digital literacy, a lack of data infrastructure, and inadequate policies. They also noted the lack of a structured data ecosystem and skills acquisition as challenges to AI adoption in Africa. They discussed similar challenges regarding the adoption of artificial intelligence (AI) in academic libraries, particularly in developing countries, including Nigeria.

During an interview with Esther Ihase of the Egor local government area, she highlighted the fact that AI/DS can be used to track deforestation, for predictive crop analytics in agriculture, for resource optimization in health, and for utilization in traffic management when it comes to urban planning. However, she added that adoption is hindered by limited technical expertise, inadequate infrastructure, unreliable power and Internet, and data privacy concerns.

Conclusion

The findings of this study affirm that AI and DS possess immense potential to drive sustainable development in Edo State, Nigeria, by addressing critical challenges in sectors such as agriculture, healthcare, urban planning, and environmental conservation. Technologies such as predictive analytics, machine learning, and IoT-enabled systems have already demonstrated tangible benefits, including improved crop yields, optimized healthcare resource allocation, and real-time environmental monitoring. However, the transformative promise of AI/DS remains constrained by systemic barriers such as fragmented digital infrastructure, limited technical expertise, and low awareness among key stakeholders.

To unlock the full potential of AI/DS, Edo State must prioritize strategic policy frameworks and capacity-building initiatives. This requires aligning technological adoption with the United Nations Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure) and SDG 4 (Quality Education). By addressing infrastructural deficits, fostering digital literacy and incentivising innovation, Edo State can transition from fragmented experimentation to systemic, scalable AI/DS integration.

Recommendations

i. To increase the awareness and adoption level of AI/DS for sustainable development in Edo State, there should be a launch of public awareness campaigns to demonstrate AI/DS success stories (e.g., smart agriculture projects), using local languages and community radio to reach rural populations. By bridging awareness gaps and fostering an enabling ecosystem, Edo State can harness AI/DS to drive equitable and sustainable development in line with the global digital transformation agenda.

ii. To maximize the impact of AI/DS for sustainable development, there should be a development of a state-level AI strategy aligned with Nigeria's National Digital Economy Policy and the SDGs. This strategy should include regulatory guidelines, funding mechanisms, incentives, capacity building, infrastructure development, cross-sector collaboration, and community engagement.

iii. The government and stakeholders should take deliberate steps to tackle the challenges impeding effective utilization. This will cause enjoying the benefits that come with AI/DS to the optimum.

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