



AI and Sustainable Supply Chain Practices: ESG Goals in the U.S. and Nigeria

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Abstract

The integration of Artificial Intelligence (AI) into supply chain systems is rapidly reshaping how organizations approach sustainability and meet Environmental, Social, and Governance (ESG) goals. This explores the intersection of AI technologies and sustainable supply chain practices, with a comparative focus on the United States and Nigeria two countries representing vastly different stages of economic development, digital maturity, and regulatory capacity. AI offers transformative potential across all three pillars of ESG: from monitoring carbon emissions and optimizing energy use, to enforcing labor standards and improving transparency in sourcing. However, the realization of these benefits depends heavily on national infrastructure, regulatory environments, and the maturity of ESG frameworks. In the United States, AI is increasingly leveraged by corporations to drive ESG performance, aided by supportive policies, advanced data systems, and a well-established culture of sustainability reporting. Tools such as predictive analytics, machine learning, and real-time tracking systems are used to measure environmental impact, improve ethical sourcing, and automate compliance reporting. Conversely, in Nigeria, AI adoption for ESG purposes remains limited, hindered by infrastructure deficits, low data availability, and weak regulatory enforcement. Despite these challenges, emerging initiatives in sectors like agriculture and logistics demonstrate growing interest in AI-driven sustainability. This highlights key contrasts between the two countries in AI readiness, ESG integration, and systemic barriers to adoption. It also identifies opportunities for strategic reforms in Nigeria, including capacity building, investment in data infrastructure, and stronger public-private collaboration. Meanwhile, the U.S. must address issues of AI ethics, workforce adaptation, and equitable access to technology. Ultimately, this underscores the role of AI as a critical enabler of sustainable supply chains and emphasizes the need for inclusive, context-sensitive strategies to advance ESG objectives globally.

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1. Introduction

The accelerating urgency of climate change, social inequality, and corporate accountability has placed Environmental, Social, and Governance (ESG) considerations at the core of global business strategies, particularly within supply chains. ESG goals represent a framework for assessing the ethical and sustainability performance of organizations (Ezeamii *et al.*, 2023; Obianyo *et al.*, 2024). In supply chain management, ESG encompasses reducing environmental footprints (e.g., carbon emissions, resource consumption), ensuring fair labor practices and human rights protections, and promoting transparent, ethical governance practices. As global supply chains become increasingly complex and globalized, the integration of ESG goals is no longer optional but essential for long-term resilience, compliance, and stakeholder trust (Folorunso *et al.*, 2024; Bello *et al.*, 2024). Artificial Intelligence (AI) has emerged as a powerful enabler of sustainable and ethical supply chain transformation. Through

technologies such as machine learning, predictive analytics, computer vision, and natural language processing, AI can help organizations monitor environmental impact, optimize resource use, enhance traceability, and enforce regulatory and ethical standards (Ayo-Farai *et al.*, 2023; Ezeamii *et al.*, 2023). AI-powered tools are capable of analyzing vast datasets across the supply chain to identify inefficiencies, predict demand, optimize transportation routes, and flag human rights violations or fraud. These capabilities make AI a critical asset in meeting ESG benchmarks efficiently and at scale (Kumar & Choudhury, 2024).

The potential of AI in advancing ESG-aligned supply chain practices varies significantly between high-income and low-to middle-income countries (Ariyibi *et al.*, 2024; Belot, 2020). This focuses on a comparative analysis between the United States a developed economy with advanced technological infrastructure and regulatory maturity and Nigeria a developing country with emerging digital capabilities and significant ESG challenges. The United States has witnessed robust investment in AI, supported by institutional frameworks and growing ESG mandates, while Nigeria faces hurdles such as limited infrastructure, low data availability, and inconsistent regulatory enforcement (Mittal & Bansal, 2024; Olanipekun, Ilori & Ibitoye, 2020). However, Nigeria also presents opportunities for technological “leapfrogging,” where emerging technologies like AI can be deployed to bypass traditional development stages and address sustainability gaps more efficiently (Adewuyi *et al.*, 2024; Adigun *et al.*, 2024).

The rationale for comparing the U.S. and Nigeria lies in their contrasting positions in the global digital economy and their differing experiences with ESG implementation. By examining how each country integrates AI in pursuit of ESG objectives within supply chains, this identifies both best practices and systemic limitations (Ajayi *et al.*, 2024; Sanusi, 2023). The analysis also explores how developing economies like Nigeria can adapt AI applications to their local contexts while navigating infrastructural and regulatory constraints.

The objective of this review is fourfold. First, it aims to define the intersection of AI and ESG within supply chain systems, highlighting current applications and trends. Second, it evaluates the state of ESG integration and AI readiness in the United States, focusing on regulatory frameworks, corporate investment, and technological maturity. Third, it examines Nigeria’s ecosystem, identifying opportunities and obstacles to the adoption of AI for sustainable supply chain practices. Finally, the review compares both countries to identify pathways for innovation, policy reform, and inclusive technological development.

By providing a comprehensive comparative analysis, this contributes to the growing discourse on how AI can support global sustainability goals, particularly in diverse economic contexts. It underscores the importance of context-sensitive strategies that align technological innovation with ESG imperatives, ensuring that both developed and developing economies can build resilient, ethical, and environmentally sustainable supply chains (Ramdoo, *et al.*, 2021; West, Kraut & Ei Chew, 2019).

2. Methodology

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was employed to ensure a transparent, comprehensive, and replicable literature review process on the topic of AI and sustainable supply

chain practices with a focus on ESG goals in the United States and Nigeria. This methodology facilitated the systematic identification, screening, eligibility assessment, and inclusion of relevant academic, institutional, and policy-based sources. The search strategy was conducted across multiple electronic databases, including Scopus, Web of Science, IEEE Xplore, ScienceDirect, and Google Scholar. Grey literature from reputable sources such as the World Economic Forum, World Bank, OECD, United Nations reports, and regional development institutions was also included to capture emerging trends, government policies, and non-academic insights. Keywords and Boolean combinations used in the search included: "Artificial Intelligence AND ESG AND Supply Chain," "AI in logistics AND sustainability," "AI AND supply chain Nigeria," "AI AND ESG goals United States," "sustainable supply chain AND developing countries," and "digital transformation AND supply chain governance."

A total of 417 articles and documents were initially identified. After removing 102 duplicates, 315 sources were screened by title and abstract. Of these, 186 were excluded based on irrelevance to AI or ESG in supply chains. The remaining 129 full-text articles were assessed for eligibility using inclusion criteria such as relevance to AI applications in ESG-aligned supply chains, geographic focus on Nigeria and/or the U.S., publication date between 2013–2024, and academic or institutional credibility. A final selection of 72 sources was included in the review.

The selection process was documented using a PRISMA flow diagram to enhance transparency. The included sources were synthesized thematically to extract key findings related to infrastructure readiness, regulatory frameworks, investment patterns, human capital, and ESG policy integration in both countries. The final synthesis supported a comparative, evidence-based analysis of how AI contributes to sustainable supply chain practices in distinct economic contexts.

2.1 AI applications in sustainable supply chains

Artificial Intelligence (AI) is playing an increasingly central role in reshaping supply chains to meet Environmental, Social, and Governance (ESG) goals as shown in figure 1. By harnessing large volumes of data and applying advanced computational techniques, AI enables real-time decision-making, predictive analytics, and automated compliance mechanisms (Adaramola *et al.*, 2024; Kolade, *et al.*, 2021). This section examines the applications of AI in achieving sustainability across the three ESG pillars: environmental protection, social responsibility, and effective governance.

AI has become a vital tool in addressing environmental concerns within supply chains. One of the most critical applications is carbon footprint tracking, where AI algorithms analyze data across logistics operations from procurement to transportation and warehousing to calculate greenhouse gas emissions with precision. This enables companies to identify emission hotspots, model scenarios for emission reduction, and make informed decisions on route optimization or modal shifts that minimize environmental impact (Arshad, 2023; Eyeghre *et al.*, 2023).

AI also contributes significantly to waste reduction by improving inventory management and demand forecasting. Machine learning models can predict consumer demand with greater accuracy, reducing overproduction and unsold inventory that often ends up as waste. In manufacturing and warehousing, AI-powered vision systems can detect product

defects early, helping to reduce scrap and rework, which in turn conserves raw materials and energy (Ajibola *et al.*, 2024;

Ezeamii *et al.*, 2024).

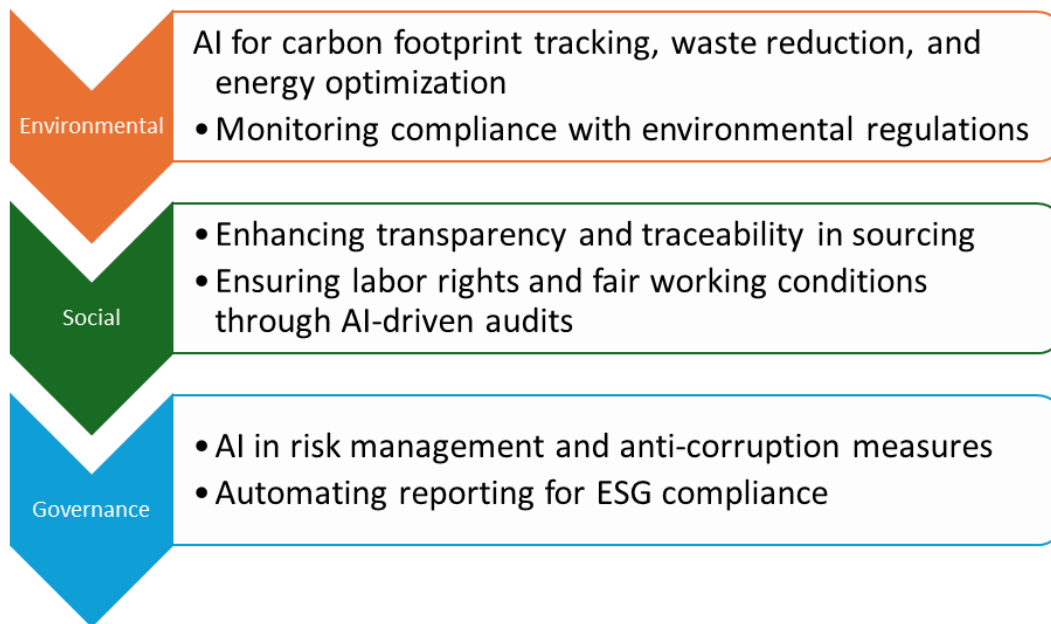


Fig 1: AI Applications in Sustainable Supply Chains

Additionally, AI facilitates energy optimization through smart energy management systems. These systems monitor consumption patterns in real time and adjust energy loads to minimize peak usage or shift energy-intensive operations to times of lower grid demand. In sectors like cold-chain logistics, AI helps maintain optimal temperature controls while reducing energy costs.

Another critical environmental application is in monitoring compliance with environmental regulations. AI tools can continuously analyze operational data and flag violations or inefficiencies related to emissions, hazardous waste handling, or resource usage (Adhikari *et al.*, 2024; Obianyo *et al.*, 2024). This ensures organizations meet environmental standards while avoiding costly penalties and reputational damage.

AI also strengthens the social dimension of ESG by promoting human rights, labor protections, and ethical sourcing in global supply chains. One emerging application is the use of AI for labor rights and workplace condition audits. Computer vision systems, wearable sensors, and natural language processing tools can be deployed to monitor factory conditions, detect unsafe behaviors, or even interpret worker grievances expressed through digital platforms (Eyeghre *et al.*, 2023; Ajibola & Olanipekun, 2019, Olanipekun & Ayotola, 2019). These tools enable early detection of issues such as excessive working hours, unsafe environments, or unfair compensation practices.

AI further enhances transparency and traceability in sourcing practices an area crucial for ethical supply chains. Blockchain integrated with AI enables end-to-end visibility of products from source to consumer, verifying the origins of raw materials and ensuring compliance with labor and environmental standards. This is particularly important in sectors like agriculture, mining, and textiles, where supply chains are often opaque and vulnerable to exploitation. By analyzing trade flows, transaction histories, and supplier networks, AI can identify high-risk suppliers or regions associated with labor abuses or environmental degradation

(Ilori & Olanipekun, 2020).

Governance, the third pillar of ESG, also benefits significantly from AI applications. AI is increasingly used in risk management and anti-corruption measures, particularly in procurement and contract management. Algorithms can detect anomalies in transaction patterns, flagging potential fraud, bribery, or conflicts of interest (Ogunyankinnu *et al.*, 2022; Folorunso *et al.*, 2024). Natural language processing can analyze contract documents or emails to uncover non-compliance or unethical practices.

Moreover, AI supports automated reporting and ESG compliance, reducing the burden of manual data collection and ensuring accuracy in disclosures. Natural language generation tools can produce ESG reports aligned with frameworks like the Global Reporting Initiative (GRI) or the Task Force on Climate-Related Financial Disclosures (TCFD). Machine learning models can also assess ESG performance based on real-time data, allowing organizations to monitor their progress continuously and communicate it to stakeholders transparently (Saxena *et al.*, 2022; Pesqueira and Sousa, 2024).

In summary, AI offers transformative capabilities in aligning supply chain practices with ESG goals. From tracking emissions and ensuring fair labor practices to managing compliance and ethical governance, AI not only enhances operational efficiency but also enables organizations to build more resilient, responsible, and sustainable supply chains. As both regulatory and stakeholder expectations for sustainability rise, AI's role will become increasingly indispensable in bridging the gap between economic performance and ESG accountability (Yigitcanlar *et al.*, 2021; Zhao and Gómez, 2023).

2.2 ESG integration and AI readiness in the U.S.

The United States has positioned itself as a global leader in both artificial intelligence (AI) development and corporate environmental, social, and governance (ESG) initiatives. The convergence of these domains is reshaping supply chains,

driving the integration of AI technologies to meet increasingly rigorous ESG expectations as shown in figure 2 (Khan and Jalal, 2023; Yu, 2023). However, the U.S. experience also highlights several challenges, including concerns around data privacy, ethical AI deployment, and the socioeconomic implications of automation. This section explores the regulatory environment, corporate culture, practical implementations, and obstacles that define ESG integration and AI readiness in the United States (Ogunyankinnu, *et al.*, 2022, Kolade, *et al.*, 2022).



Fig 2: ESG Integration and AI Readiness in the U.S.

The regulatory landscape in the U.S. has evolved to support ESG disclosures and the responsible development of AI, creating a conducive environment for the integration of both into supply chain operations. A major milestone is the U.S. Securities and Exchange Commission (SEC) proposal requiring public companies to disclose climate-related financial risks, including Scope 1, 2, and in some cases Scope 3 emissions (Georgiev, 2022; Oreshkova, 2023). This regulation, though still under debate, has already spurred corporations to adopt technologies, including AI-based carbon accounting tools, to prepare for compliance and ensure transparency.

In the realm of data privacy, a critical component of ESG governance the California Consumer Privacy Act (CCPA) has set a precedent for responsible data use. This law mandates greater transparency in how companies collect and process personal data, indirectly influencing AI design in supply chains, especially in tracking consumer behavior or employee conditions (Niebel, 2021; She, 2022). Additionally, federal initiatives such as the National AI Initiative Act and guidance from agencies like the National Institute of Standards and Technology (NIST) provide ethical and technical frameworks for AI development, including risk mitigation strategies that align with governance goals in ESG. The U.S. corporate sector has demonstrated a strong commitment to ESG reporting, bolstered by institutional investors increasingly demanding sustainability metrics. Organizations such as BlackRock and Vanguard have emphasized ESG performance in investment decisions, creating financial incentives for companies to enhance their

sustainability profiles (Davidson and Hargreaves, 2023; Hannes *et al.*, 2023). As a result, many large corporations have incorporated AI tools into their ESG strategies, particularly in data collection, real-time monitoring, and reporting.

AI has become central to sustainability intelligence platforms that aggregate data from across global supply chains to produce dashboards aligned with reporting frameworks such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-Related Financial Disclosures (TCFD) (Olanipekun, 2020). Companies like Microsoft and Amazon have invested in AI not only to optimize logistics and reduce emissions but also to monitor supplier compliance and improve workplace safety through AI-enabled sensors and predictive analytics. Several U.S.-based firms offer illustrative examples of how AI is advancing ESG objectives. IBM's Watson Supply Chain uses AI to predict disruptions, optimize inventory, and reduce waste, all of which contribute to both environmental sustainability and economic efficiency (Tsolakis *et al.*, 2023; Wolniak, 2024). Similarly, Microsoft's Project Bonsai, an AI platform for industrial control systems, helps manufacturers reduce energy usage and emissions while maintaining productivity.

In the logistics sector, UPS uses AI to design efficient delivery routes through its ORION system (On-Road Integrated Optimization and Navigation), which significantly reduces fuel consumption and carbon output (Lysenko *et al.*, 2023; Veluru, 2023). On the social side, AI tools are being used to monitor supplier practices and labor conditions. Despite these advances, the integration of AI in ESG-focused supply chains is not without challenges. Data privacy remains a contentious issue, particularly when collecting employee or third-party data for ESG audits or social monitoring. While laws like the CCPA provide some guardrails, there remains ambiguity in how AI systems should handle sensitive information, especially in global supply chains involving multiple jurisdictions with differing privacy laws (Ajayi, Olanipekun & Adedokun, 2024).

Ethical concerns surrounding AI's role in governance and decision-making also persist. Algorithmic bias can result in discriminatory practices, particularly in social audits or hiring systems used in supply chain labor management (Imana *et al.*, 2021; Akter *et al.*, 2022). Ensuring transparency and accountability in AI models is essential to maintain trust and align with ESG principles. The lack of standardized ethical AI regulations across states and industries further complicates implementation.

Another growing concern is the displacement of human labor due to automation. While AI increases efficiency, it also threatens traditional logistics and warehouse jobs, raising questions about the social implications of AI adoption. Without strategic workforce reskilling and inclusion programs, the social pillar of ESG may be undermined.

The United States has demonstrated substantial progress in embedding ESG principles within AI-enabled supply chains through robust regulatory frameworks, strong investor pressure, and high levels of corporate commitment (Salazar, 2023; Sürücü and Caylan, 2024). However, to sustain this momentum, greater attention must be paid to ethical AI development, data governance, and workforce transitions. As supply chains continue to digitalize, the U.S. faces the challenge of not only leading in innovation but doing so in a manner that aligns with the core values of sustainability,

equity, and accountability.

2.3 ESG integration and AI readiness in Nigeria

The integration of Environmental, Social, and Governance (ESG) principles into supply chains in Nigeria remains a developing concept, marked by significant opportunities but also constrained by infrastructural, regulatory, and institutional limitations (Akpan *et al.*, 2023; Ogolime and Ibrahim, 2024). As a lower-middle-income country with complex socio-economic challenges, Nigeria is gradually recognizing the importance of aligning with global sustainability standards. However, the application of Artificial Intelligence (AI) to support ESG objectives in Nigerian supply chains is still at a nascent stage as shown in figure 3. Key factors such as limited policy support, data infrastructure gaps, and low digital literacy levels hinder broad-based adoption. Nonetheless, a few emerging AI-driven initiatives in agriculture, logistics, and energy sectors suggest early potential for progress (Folorunso, *et al.*, 2024, Kolade, *et al.*, 2024).

Nigeria lacks a coherent and enforceable policy framework explicitly focused on ESG compliance, especially as it relates to AI-enabled supply chains. While there are scattered efforts under broader environmental or social policy mandates such as the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Nigerian Code of Corporate Governance the practical implementation and enforcement of ESG standards remain weak (Brown, 2021; Ogunkan, 2022). There is currently no regulatory obligation for most Nigerian firms to disclose carbon emissions, social impact metrics, or governance indicators. Furthermore, the country lacks a national strategy for ethical AI development or usage in business operations, which creates a governance vacuum and limits the integration of responsible AI into corporate ESG agendas (Olanipekun Kehinde & Ayeni Naomi, 2024).

A critical barrier to AI deployment in Nigerian supply chains is the inadequacy of digital infrastructure and data systems. Broadband penetration remains uneven, particularly in rural and peri-urban areas, where most agricultural and industrial supply chains are rooted (Hutchings *et al.*, 2022; Berkhout *et al.*, 2023). Data is often manually recorded, fragmented, or stored in non-digital formats, making it difficult to implement AI tools that require large, structured datasets for effective learning and prediction. Additionally, Nigeria suffers from frequent power outages, which disrupt connectivity and cloud-based AI operations.

Moreover, a lack of standardized data collection practices, cybersecurity protocols, and interoperability between systems means that even when digital technologies are present, they are often underutilized or inefficient (Lee *et al.*, 2021; Hasan *et al.*, 2023). These limitations also impede the ability of businesses to adopt AI tools for carbon footprint tracking, labor audits, or governance analytics key components of ESG reporting.

Despite systemic barriers, several promising initiatives point to Nigeria's potential to use AI for ESG-oriented supply chain transformation. In agriculture, AI-powered platforms like Zenvus use sensors and machine learning algorithms to optimize irrigation, monitor soil health, and improve crop yields sustainably (Signé, 2023; Polwaththa *et al.*, 2024). These tools not only increase productivity but also minimize environmental degradation, aligning with ESG goals.

In the energy sector, AI is being integrated into renewable

energy systems to enhance grid efficiency and forecast consumption patterns. Startups such as Arnergy are leveraging smart energy management systems to deliver solar energy solutions to off-grid communities, combining sustainability with inclusive access to power.

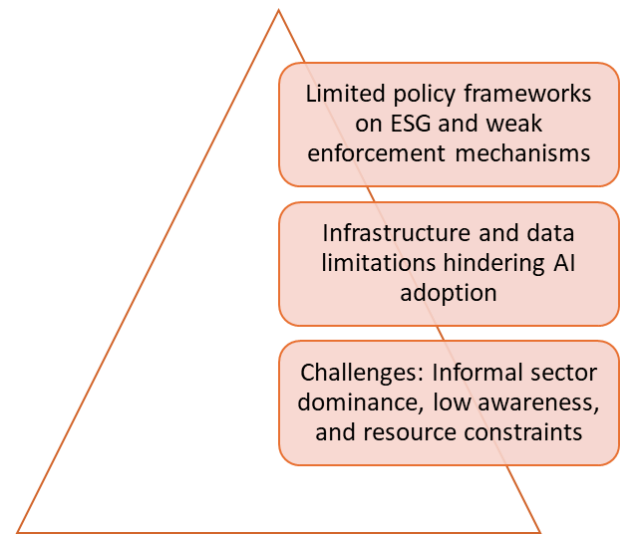


Fig 3: ESG Integration and AI Readiness in Nigeria

Logistics platforms like Kobo360 use AI to optimize freight operations, reduce empty miles, and improve fuel efficiency. By leveraging real-time data and predictive analytics, these platforms help minimize environmental impact while improving cost efficiency for businesses, illustrating a practical application of AI to meet ESG targets in transport and distribution (Olayinka, 2021; Boppiniti, 2021).

The dominance of the informal sector in Nigeria's economy accounting for over 50% of employment poses a major challenge for formal ESG integration. Informal businesses often lack the digital tools, record-keeping practices, or regulatory exposure necessary to adopt AI or report ESG metrics. Furthermore, awareness of ESG principles and AI technologies remains low among business owners, supply chain managers, and policy-makers alike (Li *et al.*, 2023; Svärd *et al.*, 2024).

Resource constraints further complicate adoption. Most Nigerian enterprises, particularly small and medium-sized enterprises (SMEs), lack access to the financial capital, technical expertise, or institutional support required for AI deployment or ESG reporting. Limited government investment in research and development exacerbates this gap, making it difficult for local innovators to scale up sustainable technology solutions (Whitfield and Staritz, 2021; Adebisi *et al.*, 2022).

Nigeria's journey toward ESG-aligned, AI-enabled supply chains is in its early stages, constrained by weak policy frameworks, infrastructural deficits, and limited awareness. However, early adopters in agriculture, energy, and logistics suggest that with targeted reforms particularly in digital infrastructure, regulatory policy, and public-private collaboration the country holds potential to leapfrog traditional development pathways. By fostering inclusive digital transformation, Nigeria can build more sustainable, ethical, and resilient supply chains aligned with global ESG standards (Benjamin and Foye, 2022; ASA and ZOSU, 2023).

2.4 Comparative analysis: U.S. vs. Nigeria

The integration of Artificial Intelligence (AI) into sustainable supply chain management reveals stark contrasts between the United States and Nigeria, shaped by differences in ESG policy maturity, technological readiness, institutional capacity, and economic development (Mbhalati and Masehela, 2024; Sebastião *et al.*, 2024). These differences underscore both the challenges and opportunities facing global supply chain sustainability, particularly in how countries with divergent contexts can align with Environmental, Social, and Governance (ESG) goals through AI.

The United States has developed a relatively mature ESG policy environment, underpinned by regulations, market incentives, and investor expectations. ESG reporting is increasingly mandated or encouraged by institutions like the U.S. Securities and Exchange Commission (SEC), while state-level laws such as the California Consumer Privacy Act (CCPA) support data governance (Esty and Cort, 2021; Mariani, 2023). Many American companies report sustainability performance using standardized frameworks such as GRI, SASB, and TCFD, often leveraging AI to enhance reporting accuracy and transparency. The presence of federal initiatives, like the NIST AI Risk Management Framework, also provides ethical guidance on AI deployment in line with governance objectives.

In contrast, Nigeria lacks a coherent and enforceable ESG policy framework. ESG compliance is largely voluntary and driven by international donor expectations or corporate social responsibility (CSR) motivations rather than regulatory enforcement (Korcheva, 2023; Goqingco, 2023). Data protection laws are still emerging, and ESG reporting practices remain fragmented and inconsistent. Furthermore, the absence of clear AI governance frameworks limits the development of responsible AI systems tailored to local ESG needs.

AI capability in the United States is supported by advanced digital infrastructure, widespread broadband access, cloud computing availability, and large-scale investment in R&D. American companies have access to rich datasets, high-performance computing resources, and skilled AI talent, which enable the development and deployment of sophisticated AI tools across supply chains (Sambasivan *et al.*, 2021; Reed *et al.*, 2022). From predictive logistics to real-time emissions monitoring, AI is deeply embedded in U.S. supply chain operations and ESG compliance systems.

Nigeria, however, faces substantial challenges in AI capability. Digital infrastructure remains underdeveloped, especially in rural areas where many supply chain activities particularly in agriculture and raw material extraction are based (Kumar *et al.*, 2022; Lubag *et al.*, 2023). Data availability is limited by poor digitization practices, manual record-keeping, and low interoperability across systems. Furthermore, Nigeria suffers from brain drain and a shortage of AI professionals, hindering the local development of scalable AI solutions. The power supply is also unreliable, affecting connectivity and operational consistency of AI systems.

Institutional weaknesses further widen the gap between the U.S. and Nigeria. In the U.S., a well-defined legal system, independent regulatory bodies, and a strong innovation ecosystem support ESG-aligned AI development (Francis Onotole, *et al.*, 2022). Corporate governance culture emphasizes transparency, accountability, and sustainability,

creating an environment conducive to ethical AI adoption. Conversely, Nigeria faces institutional challenges such as weak enforcement of regulations, corruption, and a lack of public sector coordination. Cultural norms may also limit awareness or prioritization of ESG issues, particularly in informal supply chains where sustainability is often secondary to immediate economic survival (Mohieldin *et al.*, 2022; Morris, 2023). Economic constraints including limited access to financing for small and medium-sized enterprises (SMEs) make it difficult to invest in AI systems or ESG-compliant practices. The dominance of informal enterprises also reduces the reach of institutional ESG frameworks.

Despite the disparities, there are promising avenues for collaboration between the U.S. and Nigeria to foster inclusive AI adoption and ESG integration. U.S.-based multinational corporations operating in Nigeria can serve as conduits for technology transfer, introducing AI-powered ESG tools adapted to local contexts. Public-private partnerships can support knowledge sharing, particularly through capacity-building programs and joint research initiatives (Strasser *et al.*, 2021; Chileshe *et al.*, 2023).

Moreover, international development agencies and academic institutions can play a vital role in promoting South-North collaboration. These efforts can include the creation of open-access AI models for ESG tracking, funding for infrastructure development, and co-development of ethical guidelines sensitive to socio-economic realities in Nigeria (Bell *et al.*, 2022; Geopolitics *et al.*, 2023). By learning from the U.S.'s successes and tailoring them to Nigeria's unique conditions, it is possible to bridge the digital and sustainability divide.

The comparative analysis of the U.S. and Nigeria reveals a pronounced asymmetry in ESG integration and AI readiness, yet it also highlights the potential for mutual benefit through cross-country collaboration (Koundouri *et al.*, 2023; Mohieldin *et al.*, 2023). While the U.S. leads in technology and policy maturity, Nigeria has the opportunity to leapfrog conventional models through strategic partnerships and localized innovation. Bridging these gaps will be essential to achieving truly global, AI-enabled, and sustainable supply chains.

2.5 Pathways Forward

As the intersection of Artificial Intelligence (AI) and Environmental, Social, and Governance (ESG) practices continues to shape the future of sustainable supply chains, both developed and developing nations must navigate unique challenges and leverage distinct opportunities (Hao and Demir, 2024; Oyewole *et al.*, 2024). The United States and Nigeria, though differing greatly in economic maturity, digital infrastructure, and institutional capacity, can each benefit from targeted reforms and strategic collaborations. To maximize the potential of AI in advancing ESG outcomes, a forward-looking strategy must prioritize ethical governance, inclusive innovation, and cross-border partnerships.

In the United States, the rapid deployment of AI in supply chains presents both an opportunity and a responsibility. While the country has made substantial progress in ESG integration and AI development, a more cohesive and nationally unified framework for ethical AI governance is needed. Current efforts are dispersed across states and sectors, creating inconsistency in implementation and enforcement. To ensure that AI supports ESG objectives without exacerbating inequality or bias, the U.S. must adopt national standards emphasizing transparency, accountability,

data privacy, and algorithmic fairness (Fernandes *et al.*, 2024; Ozkan, 2024).

Another critical area for improvement is workforce adaptation. The automation of logistics, manufacturing, and supply chain operations through AI has led to concerns over job displacement, particularly among low-skilled workers. A sustainable transition demands large-scale investment in reskilling programs that prepare workers for roles in AI supervision, data analysis, and ESG compliance (Renda and Schaus, 2021; George and Baskar, 2024). Community colleges, vocational training centers, and industry-led initiatives must align curricula with the demands of AI-enhanced sustainable supply chains.

Furthermore, the U.S. must broaden its ESG vision to include inclusive and equitable practices, ensuring that sustainability benefits are shared across all segments of society (Eisaqui and Brasil, 2021; Ayyoob and Sajeev, 2024). This includes increasing support for minority-owned suppliers, encouraging ethical sourcing from disadvantaged regions, and using AI to identify and mitigate inequities within supply chain networks.

For Nigeria, the pathway forward must begin with capacity building at both the institutional and enterprise levels. Government agencies, private firms, and academic institutions need investment in human capital development focused on AI literacy, data governance, and ESG awareness. Establishing AI research hubs and incubators with a sustainability focus can foster local innovation and reduce dependence on foreign technologies.

Nigeria also requires clear, context-specific policies that integrate ESG goals with digital transformation efforts. A national ESG-AI strategy should define regulatory standards, ethical guidelines, and incentives for sustainable innovation. Simultaneously, creating an enabling legal environment through data protection laws, cybersecurity regulations, and ESG reporting mandates will build trust and encourage broader adoption (Singh, 2022; Olteanu and Ionaşcu, 2023). International partnerships will be essential to overcome resource constraints and leverage global expertise. Nigeria can benefit from South-North collaborations, including joint research with U.S. universities, participation in international AI ethics frameworks, and engagement with multilateral agencies such as the World Bank and UNDP. These partnerships can support infrastructure development, training programs, and access to open-source ESG-AI tools tailored to the needs of emerging economies.

Multinational corporations (MNCs) and non-governmental organizations (NGOs) play a vital role in bridging the ESG-AI gap between the U.S. and Nigeria. MNCs operating across both countries can act as conduits for technology transfer and ESG standardization, embedding AI-enabled sustainability practices into their global supply chains. By holding suppliers to uniform ESG criteria and providing them with tools for compliance, MNCs can raise performance across borders.

NGOs, meanwhile, contribute through advocacy, education, and implementation support. Organizations focused on ethical AI, environmental justice, and fair labor can help monitor corporate ESG commitments, empower local stakeholders, and ensure accountability. NGOs can also facilitate grassroots awareness campaigns and pilot projects demonstrating how AI can improve sustainability outcomes in agriculture, logistics, and energy sectors.

Advancing AI-driven ESG practices requires coordinated action tailored to national contexts yet informed by global

experience. While the U.S. must focus on ethical governance, inclusive innovation, and workforce transformation, Nigeria must prioritize capacity building, localized policies, and international collaboration. Together, through cross-sector and cross-border cooperation, both nations can contribute to the development of resilient, intelligent, and equitable supply chains that meet the demands of a rapidly evolving global economy (Hipsher, 2021; Giedraityte, 2022).

3. Conclusion

This comparative analysis of AI integration in sustainable supply chains within the context of ESG (Environmental, Social, and Governance) goals in the United States and Nigeria reveals critical insights into the opportunities and challenges faced by both developed and developing economies. The United States, with its advanced digital infrastructure, regulatory maturity, and corporate sustainability culture, demonstrates how AI can be harnessed to enhance transparency, optimize resource efficiency, and automate ESG compliance. In contrast, Nigeria faces systemic barriers such as limited policy frameworks, infrastructural deficits, and fragmented data ecosystems, but shows potential through emerging innovations in agriculture, logistics, and energy.

The strategic importance of AI in advancing global ESG goals cannot be overstated. AI enables real-time data collection, predictive analytics, and process automation, which are essential for reducing carbon emissions, improving labor conditions, and ensuring ethical governance throughout supply chains. As ESG compliance becomes a cornerstone of global trade and investment standards, AI serves as a transformative tool for aligning operational efficiency with sustainability imperatives.

However, the pathway toward sustainable, intelligent supply chains must account for diverse economic, institutional, and technological realities. While countries like the U.S. can lead in ethical AI innovation and global standard-setting, nations like Nigeria require tailored approaches that emphasize capacity building, policy development, and inclusive access to digital technologies. Multinational corporations, development agencies, and NGOs have a pivotal role to play in bridging these divides through collaboration and knowledge transfer.

Fostering AI-enabled ESG practices across varied contexts demands not only technological advancement but also ethical stewardship, inclusive policies, and global solidarity. A shared commitment to sustainability, equity, and innovation will be essential in building resilient supply chains that contribute meaningfully to both local development and global environmental and social progress.

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