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Review of technological advancement in food supply chain management: Comparison between USA and Africa

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Abstract

This review paper examines the technological advancements in food supply chain management, drawing a comparative analysis between the United States (USA) and Africa. The global food supply chain plays a critical role in ensuring the efficient and effective distribution of food products from producers to consumers. In recent years, technological innovations have revolutionized various aspects of the food supply chain, impacting areas such as production, distribution, traceability, and sustainability. The paper begins by providing an overview of the key technological trends in food supply chain management, encompassing the adoption of Internet of Things (IoT) devices, blockchain technology, artificial intelligence (AI), and data analytics. These innovations have the potential to enhance transparency, reduce waste, improve traceability, and optimize overall supply chain efficiency. A comparative analysis is then conducted, focusing on the disparities and similarities in the adoption and implementation of these technologies between the USA and Africa. The USA, as a technologically advanced region, has witnessed extensive integration of cutting-edge technologies in its food supply chain. This includes the utilization of IoT sensors for real-time monitoring, blockchain for transparent and secure transactions, and AI for predictive analytics and demand forecasting. In contrast, Africa, characterized by a diverse range of economies and infrastructural challenges, faces unique opportunities and obstacles in embracing advanced technologies in its food supply chain. The review explores initiatives and case studies that highlight the successful integration of technology in various African countries, shedding light on the potential for leapfrogging certain stages of traditional supply chain development. The discussion encompasses the role of government policies, private sector involvement, and international collaborations in shaping the technological landscape of food supply chain management in both regions. Furthermore, attention is given to the social and economic implications of technological advancements, emphasizing the need for inclusive approaches that address the specific needs of diverse communities. This review provides valuable insights into the current state of technological advancements in food supply chain management, offering a comparative perspective between the USA and Africa. By understanding the challenges and opportunities faced by each region, stakeholders can develop targeted strategies to enhance the resilience, sustainability, and inclusivity of global food supply chains in the face of evolving technological landscapes.

Keywords: Global Food Systems; Automation in Agriculture; Blockchain Technology; Sustainable Practices.

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1. Introduction

In the ever-evolving landscape of global food systems, technological advancements have emerged as pivotal catalysts, revolutionizing the way societies produce, distribute, and consume food (Hassoun et al., 2023, Pingali et al., 2019). This review embarks on an exploration of the technological intricacies within food supply chain management, with a specific focus on comparing the trajectories of innovation between the United States and the diverse continent of Africa. The juxtaposition of these two regions provides a compelling lens through which to examine the disparities and convergences in leveraging technology to address the complexities inherent in food supply chains. The United States, a powerhouse of technological innovation, has pioneered transformative solutions such as automation, artificial intelligence, and blockchain to optimize efficiency, enhance traceability, and ensure food safety (Hayat et al., 2023, Kotler, Kartajaya, & Setiawan, 2021). In contrast, Africa, with its rich agricultural tapestry, grapples with unique challenges, yet exhibits a burgeoning appetite for technological integration to overcome barriers and unlock its vast agricultural potential (John et al., 2023 and Agrawal 2023).

As we navigate this comparative journey, the overarching goal is to distil insights into how technology, as a unifying force, can bridge gaps, foster sustainability, and propel inclusive growth in food supply chains. Beyond a mere examination of advancements, this review aspires to illuminate the broader socio-economic implications and the potential for collaborative frameworks that transcend geographical boundaries. By scrutinizing the tech-driven trajectories of the USA and Africa, we seek not only to understand the present but also to envision a future where technology becomes a linchpin in ensuring equitable access to safe, nutritious food on a global scale.

1.1. Technological Advancements in the USA

Technological advancements have been a cornerstone of the American economy and society, and have contributed to international economic development (Awosusi et al., 2022, Hainsch et al., 2022.). The US Department of State has been executing public diplomacy programs that promote the value of science to the general public, and implements capacity-building programs in emerging markets that train young men and women to become science and technology entrepreneurs, strengthening innovation ecosystems globally (Krause et al., 2019, Lee, & Kim, 2021, Bjola, Cassidy, & Manor, 2019). The United States has been a leader in technological advancements, and has been at the forefront of many breakthrough technologies. The MIT Technology Review has compiled a list of 10 breakthrough technologies that they believe will have the biggest impact on the world in the years to come. (Diamandis, & Kotler, 2020, Huang, et al 2021, Li, 2022). The US has also been a leader in the field of Artificial Intelligence (AI), and has been promoting an international policy environment that further strengthens US leadership in AI technologies, protects national and economic security, and promotes US values. The US nanotechnology ecosystem has also been a focus of attention, with the US being one of the leading countries in the field of nanotechnology (Talebian, et al. 2021, Pokrajac, et al., 2021 and Singh, & Sengar, 2020). In addition, the US has seen the full-scale development of cloud computing, the ubiquity of smartphones, the increasing centrality of the Internet and especially the Internet of Things, and the democratization of finance through the rapid emergence of new financial technology (Bock, et al., 2020 and Jones, & Samples, 2023).

1.1.1. Innovation Hubs Igniting Africa: Beacons of Creativity Across the Continent

Across the bustling streets of Lagos, tech-savvy Nairobi, and beyond, Africa's entrepreneurial spirit is pulsating in a network of dynamic innovation hubs. These vibrant spaces are more than just co-working spaces; they're melting pots of ideas, nurturing the next generation of innovators and transforming the continent's technological landscape. (Tolochko, et al. 2020, Obayan, 2019, Kraus, Kraus, & Shtepa, 2021). Imagine Google's colourful campus, but with the vibrant energy of Lagos. That's CcHub, a bustling hub pulsating with the dreams of aspiring entrepreneurs. From AI-powered solutions to fintech applications, CcHub has birthed some of Africa's most successful start-ups, like Andela, the continent's leading software developer training company. Venture north to Nairobi, where iHub stands as a testament to Kenya's tech prowess. Established in 2010, it's the continent's oldest tech hub and has fostered pioneering solutions like M-Pesa, the revolutionary mobile money platform that redefined financial inclusion. South Africa brings us the Innovation Hub Pretoria, a haven for deep-tech innovators. With partnerships with giants like Siemens and Intel, it focuses on research and development in fields like robotics, artificial intelligence, and renewable energy. (Tamaseb, 2021, Ajah, 2023, Ibegbulam, Adeyemi, Fogbonjaiye, 2023, Friederici, et al. 2020).

These are just a few shining stars in a constellation of innovation hubs illuminating Africa. From Dakar's CTIC Dakar empowering Senegalese youth to Cape Town's Workshop17 fostering design thinking, each hub adds a unique flavour to the continent's tech ecosystem. While co-working spaces are the beating hearts of these hubs, their impact extends far beyond. They offer mentorship and training to aspiring entrepreneurs who receive invaluable guidance from seasoned professionals, honing their skills and turning ideas into viable businesses (Shrestha, Dem, & Shrestha, 2022, Kabelele, Banele, & Gomera, 2023). Hubs connect local talent with global investors, fostering partnerships and opening

doors to international markets. From high-speed internet to cutting-edge software, hubs provide the tools and infrastructure needed to turn dreams into reality. Innovation thrives on collaboration. Hubs create a sense of belonging, fostering a network of support and shared passion among Africa's brightest minds (Manning, & Richter, 2023, Lo, & Li, 2023, Maghsoudi, et al. 2023).

Despite their incredible potential, African innovation hubs face challenges. Limited access to funding, brain drain, and unreliable infrastructure remain hurdles to overcome. Yet, the opportunities are undeniable. (Olatunji, et. al. 2023, Moshtari, & Safarpour, 2023, Ikwuagwu et al., 2020) With a growing tech-savvy population, increasing investment, and the unwavering spirit of its entrepreneurs, Africa's innovation hubs are poised to propel the continent into a future brimming with technological marvels (Asingia, 2019, Bloom, 2023, Maduka et al., 2023).

Imagine a future where African-made drones deliver medicine to remote villages, farmers optimize their yields with AI-powered tools, and education is accessible to all through innovative online platforms. This is the future Africa's innovation hubs are working towards, a future where technology empowers, connects, and builds a brighter tomorrow. (Shaikh, Rasool, & Lone, 2022, Javaid, et. al. 2023)

As we explore the diverse landscape of African innovation hubs, we'll meet the passionate individuals driving change, learn about the ground-breaking solutions emerging from these spaces, and witness the transformative power of technology in action. Stay tuned for a journey into the beating heart of Africa's tech revolution!

1.2. Technological Landscape in Africa

The technological landscape in Africa is rapidly evolving. According to a report by Boston Consulting Group, Africa has been making steady progress in its digital maturity and in improving the key drivers of technological advancement and innovation (Bongomin, et. al 2020, Union, 2020). The report suggests that the digital industrial revolution provides a golden opportunity for the continent to realize its immense potential for tech start-ups. The emergence of new technologies such as blockchain, artificial intelligence, and big data analytics is expected to transform industries and improve well-being across the region (Alam, 2022, Chattu, 2021).

Furthermore, the OECD predicts that Africa will have the fastest urban growth rate in the world, with 45% of Africa's population expected to live in cities by 2025 (Awuah, & Abdulai, 2022, Cilliers, 2021). Tech giants such as Facebook and Google are building large cable networks to increase internet penetration on the continent (Abecassis, et. al 2020, Nothias, 2020, Tafese, 2022). The GSM Association reports that Africa now has more than 400 tech hubs that range from software engineering to mobile money to blockchain technology, with at least one active tech hub in almost every country (Gaschler, 2022, Signé, & Heitzig, 2022) Several African countries have emerged as global growth hotspots, such as Morocco's 200-company automotive cluster, Nigeria's start-ups that have attracted hundreds of millions of dollars in equity funding, and Kenya's fintech industry. To realize the immense potential for innovation in Africa in the digital age, each of its 54 nations must adopt a holistic approach that fits its own circumstances and needs. Each country should articulate national innovation strategies in specific sectors, enact policies that will stimulate innovation activity, and strengthen the enablers of innovation, such as digital infrastructure, skills training, investment, public-private R&D partnerships, and a robust and welcoming business environment. Africa's technological landscape is poised for growth and innovation, and the continent is well-positioned to take advantage of the digital industrial revolution to transform industries and improve well-being across the region (Ferguson, Soutter, & Neubert, 2019, Okunade et al., 2023, Signé, 2023).

1.2.1. Africa's Technological Revolution: Leapfrogging into the Future

Imagine a continent buzzing with innovation, where mobile money transactions eclipse bank cards, drones deliver medical supplies to remote villages, and farmers use AI-powered tools to optimize their crops. This isn't science fiction; it's the reality unfolding in Africa, a continent undergoing a remarkable technological transformation. While challenges remain, Africa's tech landscape is exploding with creativity and opportunity. From bustling metropolises like Lagos and Nairobi to rural villages illuminated by solar-powered lamps, a wave of innovation is sweeping across the continent, fuelled by a booming mobile phone market in Africa boasts the fastest-growing mobile market globally, with over 500 million subscriptions. This widespread adoption has powered mobile money revolutions, like M-Pesa in Kenya, transforming financial inclusion and revolutionizing how people send and receive money. Also, a youthful and tech-savvy population which is Over 60% of Africa's population under 25, with a thirst for technological solutions to everyday challenges. This young generation is driving the demand for innovation and actively shaping the continent's digital future. Thriving start-up ecosystem Tech hubs are emerging across Africa, nurturing a vibrant ecosystem of entrepreneurs, investors, and developers. These hubs are incubating ground-breaking solutions in sectors like healthcare, agriculture, and education, tailored to the unique needs of the continent.

Investment and collaboration of international investors are recognizing Africa's potential, pumping billions into tech start-ups and infrastructure projects. Additionally, collaborations between African countries and global tech giants are accelerating the spread of knowledge and expertise. This is just a glimpse into the vibrant tapestry of technology woven across Africa. The continent's tech revolution is still in its early stages, but its potential to leapfrog traditional development models and create a brighter future for all is undeniable. As we delve deeper into this dynamic landscape, we'll explore the challenges and opportunities shaping Africa's technological journey, showcasing the diverse innovations that are reshaping the continent and inspiring the world.

Africa has experienced a significant surge in mobile technology adoption. Mobile phones, particularly smartphones, have become widespread, enabling access to various services such as banking, healthcare, and education. Mobile money services have gained popularity, providing financial inclusion to a large segment of the population.

Internet penetration has been increasing steadily, driven by efforts to improve infrastructure and reduce the cost of data. Some regions, however, still face challenges related to reliable and affordable internet access. Initiatives like Project Loon and investments in undersea cables aim to address these issues. Financial technology (FinTech) has gained traction across the continent, with mobile banking services being widely adopted. This has helped bridge the gap for individuals who lack access to traditional banking services, promoting financial inclusion.

Several African countries have witnessed the rise of tech start-ups and innovation hubs. Cities like Nairobi (Kenya), Lagos (Nigeria), and Cape Town (South Africa) have become hubs for tech entrepreneurship, attracting both local and international investors. Given the challenges with traditional energy infrastructure in some regions, there has been a growing focus on renewable energy solutions. Solar power, in particular, has seen increased adoption in off-grid and rural areas. Some African countries are investing in e-government initiatives to improve public services, increase transparency, and reduce bureaucracy. These efforts aim to leverage technology to enhance governance and civic participation.

Despite the progress, Africa faces challenges such as digital inequality, infrastructure limitations, and cybersecurity concerns. Efforts are being made to address these issues, but sustained development is required for a more inclusive and secure technological landscape.

African countries are increasingly recognizing the importance of artificial intelligence and data science. Educational programs and initiatives are being introduced to develop skills in these areas, fostering innovation and competitiveness. The rollout of 5G technology is in its early stages in some African countries, promising faster and more reliable internet connectivity. However, challenges related to infrastructure development and affordability may affect the widespread adoption of 5G. With the growing reliance on digital technologies, there is an increased awareness of the importance of cybersecurity. Efforts are being made to strengthen cybersecurity measures to protect individuals, businesses, and government institutions from cyber threats. It's important to note that the technological landscape in Africa is dynamic, and ongoing efforts are being made to leverage technology for economic and social development. For the latest information, it is recommended to refer to recent reports and news sources.

1.2.2. The Booming Tech Landscape of Africa: Innovation and Challenges

Africa's technological landscape is undergoing a fascinating transformation. While the continent still faces challenges in terms of infrastructure and access, there's a vibrant ecosystem of entrepreneurs, investors, and developers pushing the boundaries of innovation. From mobile money revolutions to AI-powered solutions, Africa is rapidly embracing technology to tackle its unique challenges and leapfrog traditional development models.

Africa, often overlooked in discussions of global technological advancements, is experiencing a remarkable digital renaissance. The continent is swiftly emerging as a hotspot for innovation, boasting a tech landscape that is as diverse and dynamic as its cultural tapestry. In this blog post, we'll explore the flourishing innovation hubs, ground-breaking technologies, and the unique challenges that shape the booming tech landscape of Africa.

1.2.3. Innovation Hubs Across the Continent

Africa is witnessing the rise of innovation hubs and tech ecosystems, incubating start-ups that are making waves on a global scale. From Lagos to Nairobi, Cape Town to Accra, these hubs are becoming the breeding grounds for ingenious solutions to local and global challenges (De Beer et al., 2016).

Nairobi's Silicon Savannah often referred to as Silicon Savannah, Nairobi has become a nucleus for tech entrepreneurs. With a vibrant start-up scene, it has given birth to companies like M-Pesa, a mobile money service revolutionizing

financial inclusion (Van Hove, and Dubus, 2019). Nigeria's bustling city of Lagos has positioned itself as a major player in the tech space. With a plethora of start-ups focusing on fintech, healthtech, and edtech, Lagos is at the forefront of technological disruption. South Africa, particularly Cape Town, has emerged as a creative and tech-driven city. The city's ecosystem is fostering innovations in renewable energy, smart agriculture, and sustainable technologies. Africa is pulsating with an entrepreneurial spirit, and at the heart of this dynamism lie vibrant innovation hubs scattered across the continent. These are more than just co-working spaces; they're melting pots of ideas, nurturing the next generation of innovators and transforming Africa's technological landscape.

Imagine bustling streets teeming with tech-savvy minds, buzzing with the energy of collaboration and creativity. This is the reality in hubs like a vibrant space pulsating with the dreams of aspiring entrepreneurs. From AI-powered solutions to fintech applications, CcHub has birthed some of Africa's most successful startups, like Andela, the continent's leading software developer training company. iHub, Nairobi, Kenya, established in 2010, it's the continent's oldest tech hub and has fostered pioneering solutions like M-Pesa, the revolutionary mobile money platform that redefined financial inclusion.

The Innovation Hub Pretoria, South Africa being a haven for deep-tech innovators, focusing on research and development in fields like robotics, artificial intelligence, and renewable energy. Partnerships with giants like Siemens and Intel showcase the global connections these hubs foster. These are just a few shining stars in a constellation of innovation hubs illuminating Africa. From Dakar's CTIC Dakar empowering Senegalese youth to Cape Town's Workshop17 fostering design thinking, each hub adds a unique flavour to the continent's tech ecosystem. While co-working spaces are the beating hearts of these hubs, their impact extends far beyond. They offer Mentorship and training to aspiring entrepreneurs who receive invaluable guidance from seasoned professionals, honing their skills and turning ideas into viable businesses. And also, Hubs connect local talent with global investors, fostering partnerships and opening doors to international markets. From high-speed internet to cutting-edge software, hubs provide the tools and infrastructure needed to turn dreams into reality. Innovation thrives on collaboration. Hubs create a sense of belonging, fostering a network of support and shared passion among Africa's brightest minds.

Despite their incredible potential, African innovation hubs face challenges. Limited access to funding, brain drain, and unreliable infrastructure remain hurdles to overcome. Yet, the opportunities are undeniable. With a growing tech-savvy population, increasing investment, and the unwavering spirit of its entrepreneurs, Africa's innovation hubs are poised to propel the continent into a future brimming with technological marvels.

Imagine a future where African-made drones deliver medicine to remote villages, farmers optimize their yields with AI-powered tools, and education is accessible to all through innovative online platforms. This is the future Africa's innovation hubs are working towards, a future where technology empowers, connects, and builds a brighter tomorrow.

By fostering collaboration, inclusivity, and responsible development, Africa's innovation hubs can not only empower local communities but also inspire the world with their ingenuity and dedication to a brighter future.

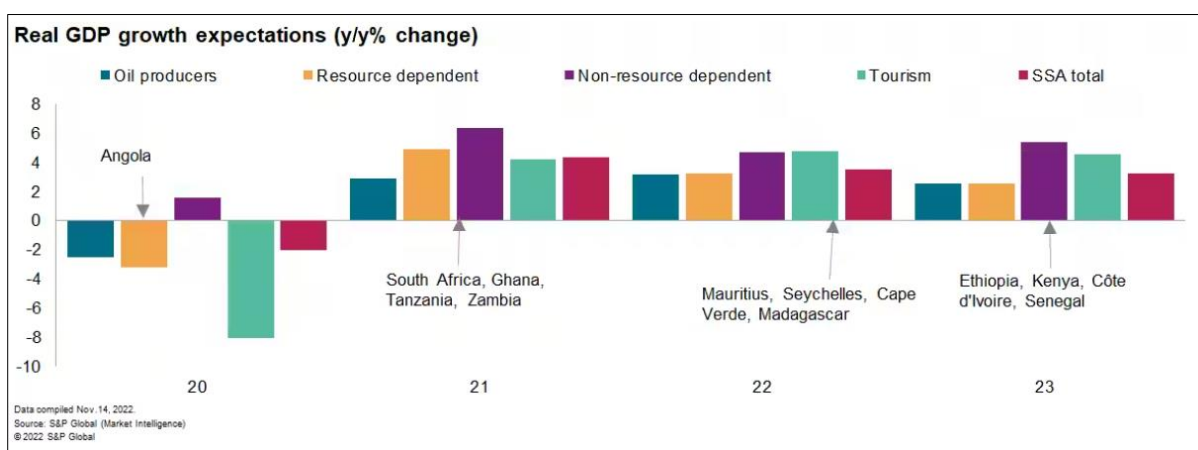


Figure 1 Real GDP Growth expectations for some Africa countries (S&P Global, 2022)

Figure 1 shows the real gross domestic product growth expectations for some Africa countries. Investor interest in natural gas, particularly in Mozambique, Tanzania, Republic of the Congo, and Cameroon/Guinea-Bissau, is further

contributing to regional economic growth, as Europe reduces its reliance on Russian gas imports. With the start of natural gas exports, Senegal is projected to achieve exceptional GDP growth in 2023, positioning itself as one of the top-performing countries in the region. Nigeria and other Africa countries are witnessing growth in technology and this is also driving growth of those economies with fintech and computer villages in Lagos contributing massively to Nigeria growth.

1.2.4. Ground-breaking Technologies Shaping Africa's Future

Africa's tech landscape is not merely mirroring global trends; it is crafting its own narrative with innovations tailored to its unique challenges and opportunities.

Mobile Technology Leapfrogging, with a large percentage of the population lacking traditional banking services, mobile technology has become a transformative force. Mobile payment systems like M-Pesa in Kenya have revolutionized financial transactions, leapfrogging traditional banking infrastructure (Ngugi, Pelowski, and Ogembo, 2010). Given the continent's strong ties to agriculture, technology is being harnessed to improve farming practices. Innovations such as precision agriculture, remote sensing, and blockchain for supply chain transparency are enhancing food security and economic growth. Addressing energy challenges, African countries are investing in renewable energy solutions. Solar power initiatives, wind energy projects, and off-grid innovations are bringing electricity to remote areas and fostering sustainable development. While Africa's tech landscape is flourishing, it is not devoid of challenges that can impede progress. Infrastructure Gaps: Inadequate infrastructure, including limited access to reliable internet and electricity, remains a hurdle. Efforts are underway to bridge these gaps, but infrastructural development is crucial for sustained growth. Start-ups often grapple with funding challenges. While the investment landscape is evolving, there's a need for more venture capital and angel investors to support the burgeoning tech ecosystem. To fully harness the potential of technology, there's a growing need for skilled professionals. Investing in education and skill development programs is essential to nurture the next generation of tech leaders. Africa's tech landscape is a story of resilience, innovation, and determination. As the continent continues to overcome challenges and build on its successes, it is positioning itself not just as a consumer but a creator of technology. The world is starting to take notice of Africa's tech prowess, and the narrative is shifting from one of challenges to one of boundless opportunities. As the digital revolution unfolds, Africa stands at the forefront, ready to make its mark on the global tech stage. One of the most significant drivers of Africa's tech surge is mobile phone penetration. With over 500 million mobile subscriptions, Africa boasts the fastest-growing mobile market globally. This widespread adoption has fuelled the rise of mobile money platforms like M-Pesa in Kenya, which have transformed financial inclusion and revolutionized how people send and receive money.

Mobile technology is also powering other sectors, such as agriculture, healthcare, and education. Apps are being developed to provide farmers with real-time market information and weather updates, while mobile health clinics are reaching remote areas to deliver essential services. Several African cities are emerging as tech hubs, attracting investment and fostering a thriving start-up scene. Lagos, Nairobi, Johannesburg, and Kigali are leading the charge, with co-working spaces, incubators, and accelerators nurturing the next generation of techpreneurs.

These start-ups are tackling a diverse range of challenges, from developing solar-powered irrigation systems to creating educational platforms tailored to the African context. Their solutions are not only addressing local needs but also attracting international attention, showcasing Africa's potential as a breeding ground for disruptive innovations.

1.2.5. Challenges and Opportunities

Despite the progress, Africa's tech landscape is not without its challenges. Limited access to affordable internet, lack of digital skills, and inadequate infrastructure remains significant hurdles. Additionally, navigating complex regulatory environments and attracting sustained investment can be challenging for young start-ups.

However, these challenges are also opportunities. Bridging the digital divide through increased infrastructure investment and promoting digital literacy will be crucial for inclusive growth. Governments, along with private and international partners, have a vital role to play in creating an enabling environment for tech to flourish.

1.2.6. The Future of African Tech

The future of Africa's tech landscape is brimming with possibilities. With its youthful population, entrepreneurial spirit, and increasing access to technology, the continent is poised for further acceleration. As the tech ecosystem matures and attracts more talent and investment, we can expect to see even more ground-breaking solutions emerge from Africa, shaping not only the continent's future but also impacting the world (Ukoba and Jen, 2022).

By embracing technology and fostering a culture of innovation, Africa can leapfrog traditional development models and achieve sustainable and inclusive growth. The continent's tech revolution is just beginning, and its potential to transform lives and economies is truly exciting.

The rise of artificial intelligence (AI) and machine learning (ML) holds immense potential for Africa, with applications in healthcare, agriculture, and governance (Waljee et al., 2022, Adebukola et al., 2022, Sanni et al., 2024). The growing adoption of blockchain technology could further revolutionize financial services and promote transparency in various sectors. Investing in STEM education and developing digital skills will be crucial for preparing the workforce for the jobs of the future. Collaboration and knowledge sharing between African countries and the global tech community will be essential for accelerating innovation and maximizing impact.

Africa's tech landscape is a story of resilience, ingenuity, and boundless potential. With continued investment, collaboration, and a focus on solving local challenges, the continent's tech revolution has the power to create a brighter future for all.

1.3. Comparison between the USA and Africa

Comparing the United States of America and Africa is a complex task, given that Africa is a continent of 54 diverse countries, each with its own unique history, culture, and socio-economic landscape. While generalizations can be dangerous, a brief overview of some key differences and similarities between the two is here presented.

1.3.1. Geography and Demographics:

The USA is the third-largest country in the world by landmass, while Africa is the second-largest continent. Africa is roughly 4 times the size of the USA. The USA has a population of around 330 million, while Africa's population is over 1.3 billion, making it the second-most populous continent after Asia (Seto et al., 2011). The USA is a predominantly white country with significant minority populations of African Americans, Hispanics, and Asians. Africa's population is much more diverse, with over 2,000 ethnic groups and numerous languages spoken. The USA has a nominal GDP of over \$21 trillion, making it the world's largest economy while Africa's combined GDP is around \$3.4 trillion, but individual countries vary greatly in terms of economic development (Stein, 2022).

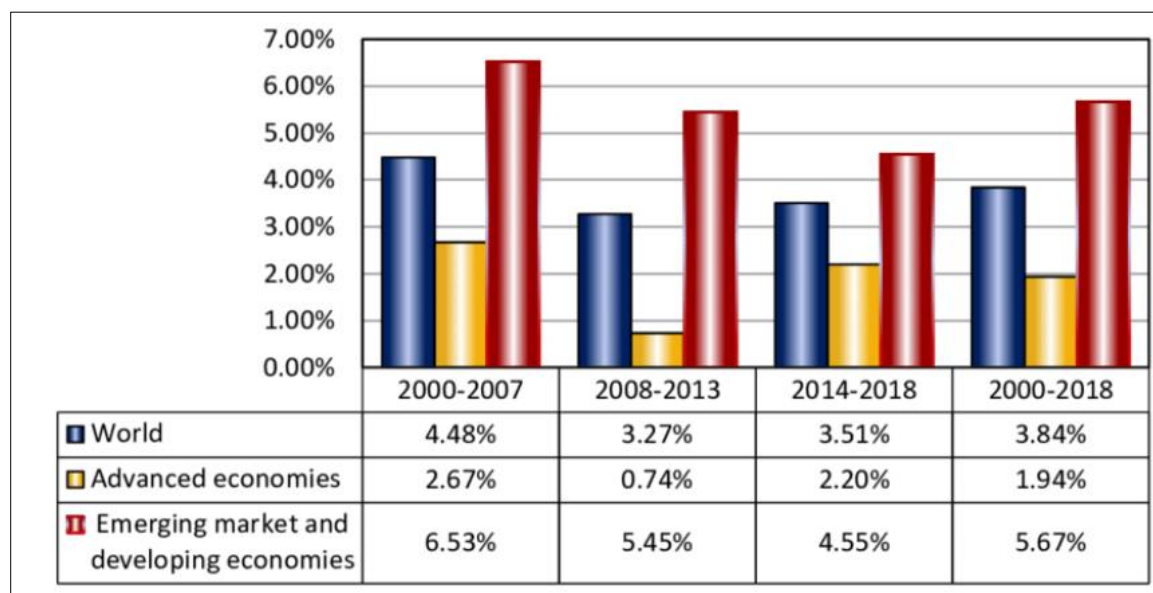


Figure 2 Comparison of real GDP growth in advanced economies, emerging market and developing economies (Mucha-Leszko, Kąkol, and Angowska, 2022)

As seen in figure 2, comparison of real GDP growth in advanced economies, emerging market and developing economies and in the world in: 2000-2007, 2008-2013, 2014-2018 and 2000-2018, annual averages in percentage (Mucha-Leszko, Kąkol, and Angowska, 2022).

Human Development Index (HDI): The USA has a high HDI of 0.920, while Africa's HDI varies considerably between countries, with some like South Africa having a high HDI of 0.788, while others like Niger have a low HDI of 0.354.

Infrastructure: The USA has a well-developed infrastructure, while infrastructure development in Africa is generally less advanced, with many countries facing challenges in areas like transportation, electricity, and sanitation.

1.3.2. Culture and Governance

Political Systems: The USA is a federal republic with a president and a bicameral legislature. Africa has a variety of political systems, including democracies, republics, and monarchies.

The USA is a predominantly Christian country, while Africa has a more diverse religious landscape, with Christianity, Islam, and traditional religions all having significant followings. Both the USA and Africa have rich and diverse cultures, but they differ greatly in terms of language, music, art, and traditions.

Both the USA and Africa are home to a young and growing population. Both are experiencing rapid urbanization. Both have a strong entrepreneurial spirit and a growing tech sector. Both face challenges related to poverty, inequality, and climate change. Comparing the USA and Africa is an exercise in appreciating diversity and recognizing the complexity of both entities. While significant differences exist in terms of size, population, and development, both share a dynamic spirit and a potential for significant growth in the future. Recognizing these differences and similarities can be a valuable step towards fostering understanding and collaboration between the two regions. The historical relationship between the USA and Africa has been complex, with periods of both colonialism and cooperation. The African diaspora in the USA has played a significant role in shaping American culture and society. There is growing interest in the USA in investing in Africa's economic development potential. Both the USA and Africa have much to learn from each other in areas such as governance, technology, and sustainable development.

1.4. Challenges and Opportunities

The journey of food, from farm to fork, is complex and fraught with challenges. Technological advancements, however, are transforming food supply chains, presenting both exciting opportunities and daunting hurdles. Comparing the landscapes of the United States and Africa reveals fascinating contrasts and shared aspirations in harnessing technology for a more efficient and sustainable food system.

1.4.1. Challenges

The US boasts a robust infrastructure of roads, cold storage facilities, and digital networks. In Africa, however, inadequate infrastructure creates bottlenecks, leading to post-harvest losses and spoilage. Rural areas often lack connectivity, hindering information flow and market access. While US farmers leverage data analytics, precision agriculture tools, and blockchain for traceability, many African farmers lack access to smartphones or internet, limiting their ability to adopt digital solutions. Bridging this digital divide requires affordable tech and digital literacy initiatives. Advanced technologies like AI-powered robotics and vertical farming carry high upfront costs. This limits their accessibility for small-scale farmers in Africa, further widening the technological gap. Innovative financing models are crucial to make these technologies financially viable. While automation in the US may optimize efficiency, concerns arise around water usage, energy consumption, and potential job displacement. In Africa, balancing technology adoption with environmental sustainability and fair labor practices requires careful consideration.

1.4.2. Opportunities

Data-driven tools can optimize resource use, improve yields, and minimize environmental impact. In the US, farmers use sensors and AI to monitor soil health, optimize irrigation, and tailor fertilizer application. Similar approaches can help African farmers adapt to climate change and increase resilience. Mobile platforms can connect African farmers directly to consumers, bypassing exploitative middlemen and increasing their profit margins. In the US, online marketplaces and blockchain applications are enhancing transparency and traceability, benefiting both producers and consumers. AI-powered sorting and automated systems can prevent food waste in processing and distribution. In the US, smart packaging technologies extend shelf life, while in Africa, solar-powered cold storage can minimize post-harvest losses.

Digital platforms can provide access to weather forecasts, market information, and financial services, empowering African farmers to make informed decisions and improve their livelihoods. Similarly, drones can deliver inputs and monitor crops in remote areas, increasing accessibility for US farmers as well.

1.4.3. Comparison: US vs. Africa

Comparing the United States and Africa is like contrasting a towering redwood to a vibrant savanna landscape – both awe-inspiring, yet vastly different ecosystems. However, beneath the surface of these dissimilarities lies a fascinating tapestry woven with threads of shared aspirations and challenges. The US, sprawled across North America, boasts the third-largest landmass globally, while Africa, encompassing 54 diverse countries, reigns supreme as the second-largest continent. The US boasts around 330 million inhabitants, while Africa's population surpasses 1.3 billion, showcasing the continent's demographic dynamism (Dwyer-Lindgren et al., 2022). The US is a predominantly white nation with significant minority populations, while Africa's cultural landscape explodes with over 2,000 ethnic groups and numerous languages, reflecting its rich tapestry of heritage. The US, a global economic powerhouse, boasts a nominal GDP exceeding \$21 trillion, whereas Africa's combined GDP stands at around \$3.4 trillion, highlighting significant economic disparities. The US enjoys a high HDI of 0.920, indicating advanced social and economic well-being. Africa's HDI varies greatly between countries, with South Africa holding a high HDI of 0.788, while nations like Niger face lower indexes like 0.354, showcasing the continent's development disparities. The US boasts a well-developed infrastructure of roads, energy grids, and advanced technologies. In contrast, infrastructure development in Africa is generally less advanced, with many countries facing challenges in areas like transportation, electricity, and sanitation.

Culture and Governance: The US functions as a federal republic with a president and a bicameral legislature. Africa presents a diverse range of political systems, including democracies, republics, and monarchies. The US is predominantly Christian, while Africa embraces a more diverse religious landscape, with Christianity, Islam, and traditional religions having significant followings. Both regions boast rich and diverse cultures, but they differ greatly in terms of language, music, art, and traditions. The US reflects a melting pot of European and immigrant influences, while African cultures showcase a stunning array of indigenous traditions and modern adaptations.

Despite their differences, the US and Africa share several noteworthy aspects like both regions boast a youthful demographic, presenting both challenges and opportunities for education, employment, and social development. The US and Africa are experiencing rapid urbanization, bringing about changes in social structures, economic opportunities, and infrastructure demands. The regions are witnessing a surge in innovation and entrepreneurship, with young minds leveraging technology to tackle local and global challenges. The US and Africa have committed to the UN's Sustainable Development Goals, aiming to address poverty, hunger, climate change, and other pressing issues.

Comparing the US and Africa is not about determining which is "better," but rather appreciating the unique tapestry of each region. While challenges and disparities exist, both the US and Africa share a dynamic spirit and a potential for significant growth. Recognizing these contrasts and shared aspirations can be a valuable step towards fostering collaboration, knowledge exchange, and mutual understanding. By leveraging their respective strengths and addressing common challenges, both regions can contribute to a more equitable and sustainable future for all.

The US emphasizes automation, resource optimization, and data-driven decision-making. Africa prioritizes access to basic technologies, rural connectivity, and affordability for small-scale farmers. The US benefits from established infrastructure and funding for research and development. Africa requires public-private partnerships and innovative financing models to bridge the funding gap. Technological advancements in the US aim to further optimize efficiency and sustainability. In Africa, the focus is on improving market access, reducing food losses, and empowering small-scale farmers. Food supply chain management stands at a pivotal juncture, with technology offering transformative solutions. While challenges remain, harnessing innovation responsibly can improve efficiency, reduce waste, and empower farmers across the globe. Both the US and Africa, despite their differing landscapes, share the ultimate goal of a robust and sustainable food system for all. The key lies in embracing inclusivity, prioritizing local needs, and fostering knowledge sharing for a future where technology nourishes, rather than disrupts, the journey of food.

1.5. Future Trends

The food supply chain management (FSCM) has been a critical area of focus for technological advancements in recent years. According to a review by the US Department of State, the use of data-driven systems for FSCM is expected to increase in the future, and will be the future for a more sustainable food supply chain.

In the United States, the adoption of Industry 4.0 technologies has helped different types of agri-food supply chains introduce and manage innovations in response to the challenges and opportunities that emerged following the COVID-19 pandemic. A recent study predicted a 4%–5% annual growth rate for the US market and that the future of supply chain management software will be in storage, inventory adjustment, and cycle counting.

In Africa, the adoption of technology in FSCM has been slow, but there are signs of progress. For example, the African Development Bank has launched a new initiative to support the development of agribusinesses in Africa through the use of digital technologies. In addition, the use of blockchain technology has been explored as a means of improving transparency and traceability in the food supply chain.

Overall, the future trend of technological advancements in FSCM is expected to be driven by the increasing use of data-driven systems, the adoption of Industry 4.0 technologies, and the use of blockchain technology to improve transparency and traceability. While the US has been a leader in technological advancements in FSCM, Africa is also making strides in this area, and there is potential for further growth and development in the future.

2. Conclusion

In conclusion, the review of technological advancements in food supply chain management reveals a landscape brimming with exciting opportunities and daunting challenges. Comparing the US and Africa highlights the diverse realities at play, with the US capitalizing on automation and data-driven solutions while Africa faces hurdles in accessing basic technologies. Despite these differences, both regions share a common goal: building a more efficient, resilient, and equitable food system. Bridging the digital divide, ensuring affordability, and prioritizing sustainability will be crucial for success. By collaborating, innovating, and adopting inclusive approaches, technology can transform the journey of food, from fertile fields to nourished communities, on both sides of the Atlantic and beyond. The future of food lies in harnessing the power of technology responsibly, ensuring that it empowers farmers, nourishes populations, and safeguards our planet for generations to come.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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