The Potential of Artificial Intelligence in South African Rural Development

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OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada.
ISSN 1923-6654 (print) ISSN 1923-6662 (online) www.oidaijsd.com
Also available at https://www.ssrn.com/index.cfm/en/oida-intl-journal-sustainable-dev/

Abstract: This paper investigates the capacity of artificial intelligence (AI) technology in rural development projects in South Africa. The study explores how AI can be used to address socioeconomic issues faced by rural communities in South Africa and advance sustainable development. By using prior research and practical examples, this paper aims to highlight the potential advantages, disadvantages, and implications of using AI for rural development in South Africa. Rural areas in South Africa may gain access to vital services, including healthcare, education, and infrastructure, by leveraging the capabilities of AI. AI can also optimise agricultural techniques, enhance productivity, and create new economic opportunities. Overall, this article emphasises the capacity of AI to enable positive transformations and empower rural communities in South Africa in the digital era. However, it is vital that the possible negative associations of excessive reliance on AI in rural development, such as job displacement, concerns about data privacy, and the exacerbation of existing inequities within communities. In many rural regions of South Africa, the significant expenses associated with deploying and maintaining AI systems may also be unaffordable. Even though AI has the potential to make things better and give rural communities more power, it is important to be aware of the bad things that could happen, like people losing their jobs and inequality getting worse. The substantial financial burdens linked to the installation and upkeep of AI technology could potentially hinder the ability of numerous rural regions in South Africa to fully benefit from these advancements.

Keywords: artificial intelligence, rural development, South Africa, socio-economic challenges, sustainable development.

Introduction

Rural communities in South Africa encounter a range of socio-economic challenges, including limited access to essential services, inadequate infrastructure, high poverty rates, unemployment, and inequality (Rapanyane & Sethole, 2020). These challenges impede the overall development and well-being of rural populations, exacerbating the disparities between urban and rural areas. There has been a growing interest in harnessing artificial intelligence (AI) technologies to address complex social issues and drive sustainable development initiatives. The objective of this study is to examine the potential of AI in advancing rural development efforts in South Africa, specifically in enhancing livelihoods, improving service delivery, and promoting inclusive growth in rural areas (Mhlanga, 2021).

By leveraging AI solutions, rural areas in South Africa can overcome resource limitations and achieve better outcomes with their limited resources, ultimately improving the quality of life for rural communities. The potential of artificial intelligence in rural development in South Africa has gained attention in recent years. For example, (Kene-Okafor, 2021) mentions that a startup called Aerobotics uses AI-powered drone technology to help farmers monitor crop health, detect pests, and optimise irrigation in rural areas. AI offers innovative solutions to enhance healthcare delivery, optimize agricultural practices, and facilitate infrastructure development AUDA-NEPAD (2022), making it a promising tool for addressing socio-economic challenges and improving access to essential services in rural communities. The positive impact of AI on addressing resource constraints and improving the quality of life for rural populations in South Africa is evident. Moreover, the successful implementation of AI technologies in rural

development initiatives not only provides immediate benefits but also lays the groundwork for ongoing exploration and application in this context (Gwagwa et al., 2021). The use of AI in rural development projects in South Africa has the potential to revolutionize various sectors and improve overall socio-economic conditions (Gikunda, 2024).

Digital infrastructures supported by artificial technologies have become pervasive and essential for navigating the social world (de-Lima-Santos & Ceron, 2021). While this holds true for some developed countries, the pace of digital transformation in developing nations remains slow. Research conducted by Townsend et al. (2013) reveals that the digital divide exacerbates existing inequalities and underscores the limitations of relying solely on artificial technologies for social navigation. For instance, in a remote village without internet access, residents may struggle to access online educational resources, hindering students' ability to keep up with their peers in more connected areas and impeding their academic progress (Salemink et al., 2017). According to Naidoo (2020), digital transformation in Africa is progressing, although with certain obstacles. However, there is still a significant disparity in internet connectivity and proficiency in digital skills compared to more advanced regions. Lusweti & Omieno (2023) support this notion, stating that entrepreneurs in rural areas have historically faced challenges due to limited internet access, computers, and training, resulting in a digital divide that hampers economic progress in the current information age. As the demand continues to grow, there is a need for a stronger push towards technological advancement and innovation, specifically focusing on developing AI solutions for rural areas. The increasing availability of smartphones and internet access in Africa presents great potential for the adoption of AI technologies to improve various sectors, including healthcare, agriculture, and finance. Therefore, this paper examines the potential of artificial intelligence in rural development in South Africa.

Literature Review

Artificial intelligence (AI) is expanding and offering numerous beneficial possibilities. It involves the development of intelligent systems that can perform tasks typically done by humans. AI has the potential to revolutionize various industries, improving efficiency and productivity in areas such as speech recognition and autonomous vehicles. This paper aims to explore the applications of AI in rural development, specifically in agriculture, healthcare, financial solutions, education, and job creation. By understanding the capabilities and potential impact of AI, we can better prepare for the future of technology and innovation. For instance, in healthcare, AI can accurately analyze medical images to detect abnormalities, reducing the time and costs associated with diagnosis. This example is supported by research conducted by (Pinto-Coelho, 2023). In Kenya, the startup Ilara Health utilizes AI technology to provide affordable and accessible healthcare services to underserved communities through diagnostic tools and telemedicine, as highlighted by (Njanja, 2024). Additionally, the research investigates how AI can contribute to achieving the Sustainable Development Goals (SDGs) and the National Development Plan (NDP). The SDGs play a crucial role in guiding and ensuring holistic societal development. They are categorized into three pillars: society, economy, and environment, as depicted in Fig 1 by (Vinuesa et al., 2020).

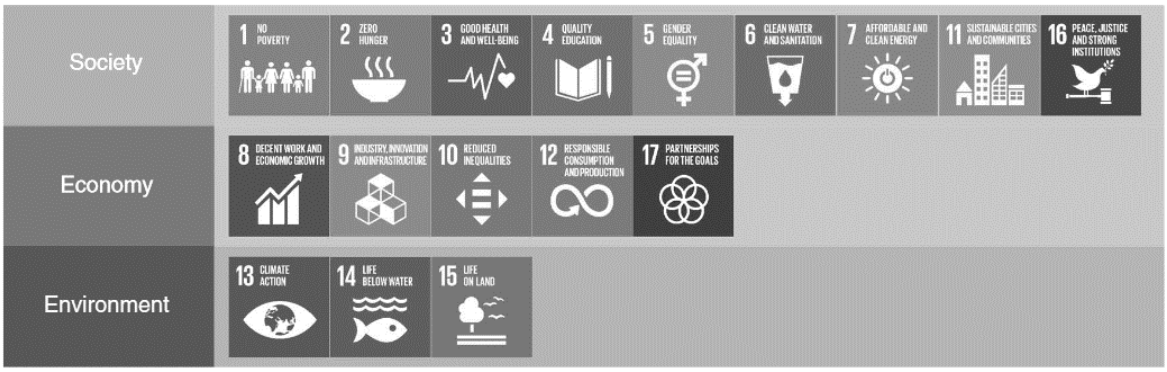

Figure 1 Categorization of the Sustainable Development Goals
Source: adapted from Vinuesa et al. (2020)

Similarly, South Africa is committed to achieving the Sustainable Development Goals (SDGs) and aligning with the National Development Plan (NDP) to eliminate poverty and reduce inequality by 2030. To accomplish these goals, South Africa focuses on harnessing the potential of its citizens, promoting an inclusive economy, strengthening

capacities, improving government capabilities, and fostering leadership and cooperation across different sectors of society, as outlined in the government's plan (Government of South Africa, 2012).

Figure 2 National Development Plan 2030
Source: Adapted from The Domino Foundation, (n.d.)

Both the National Development Plans (NDPs) and Sustainable Development Goals (SDGs) complement each other and focus on development. While these frameworks are designed for national and global contexts, rural development in South Africa would greatly benefit from the joint implementation of NDPs, SDGs, and AI strategies. Incorporating AI can offer expedited and effective strategies and ideas, leading to significant time savings. It is crucial to recognize that rural development is essential, and therefore, NDPs and SDGs should not be solely applied to urban environments; rural communities must equally reap the benefits. When both rural and urban areas are developed in parallel, all individuals will experience positive outcomes.

Artificial Intelligence in Agriculture

According to Gadzala (2018), it is believed that AI technologies will soon be widely accepted in Africa, especially on smartphones. Boakye's research (2023) provides evidence of transformative results in the adoption of digital technologies in agriculture productivity in other parts of Africa as well. For instance, in Ethiopia, the government-sponsored initiative known as Farmer Hotline where it offers farmers free advisory services through interactive voice response (IVR) and short message service (SMS) on how to maintain crop health and boost production (Boakye, 2023).

It is important to note that not all farmers readily adopt AI due to the various challenges they face in embracing this innovation. According to Aruleba & Jere (2022), the digital divide is a significant issue in modern society, highlighting the challenges individuals face in fully utilizing the benefits of Information and Communication Technology (ICT). Additionally, smallholder farmers, as noted by Boakye, (2023), are slow to adopt innovations. Increasing the use of smart farming technologies among local farmers would require the development of policies and programs that enhance farmers' ICT skills and ensure the availability, accessibility, and affordability of digital approaches. According to Luthuli & Naidoo (2023) rural women engaged in informal trades commonly use three social media platforms, namely WhatsApp, Facebook, and Instagram. Mobile usage in informal trade primarily serves to promote and attract new clients and provide valuable information on business growth strategies. The farming community also requires more user-friendly banking solutions.

AI technology has the potential to transform agricultural methods and enhance the productivity and sustainability of rural areas. Naresh et al. (2020) argue that rural areas can benefit from optimal resource allocation, improved crop monitoring and management, and smarter decision-making processes with the incorporation of AI technologies. AI can address issues related to unequal mechanization distribution, handle massive datasets with precision and speed, and safeguard data privacy and security in rural regions. Furthermore, the development of appropriate medical artificial intelligence technologies for rural regions can greatly improve healthcare outcomes in developing nations, narrowing the disparity in healthcare services between urban and rural areas. Additionally, employing AI in rural connectivity offers significant advantages for rural areas, including increased access to information, improved

communication networks, and the potential for economic and social empowerment for rural residents (Chaerowati & Ibrahim, 2019).

AI technology has the potential to bring about improvements and advancements in various aspects of rural development. Machine learning (ML) and data processing advancements are transforming how AI handles vast amounts of data, which could lead to sustainable development in rural communities through the identification of robust and useful patterns (West & Allen, 2018). According to Mhlanga (2021), the use of AI can help overcome literacy barriers among the poor by providing speech recognition and text-based functionalities. AI can also assess microinsurance claims for farmers, leading to increased productivity, revenue, and food security. However, it's important to note that AI resources may not be accessible or affordable for rural populations, exacerbating digital gaps and increasing isolation. Focusing solely on AI could also overlook the value of local knowledge and community engagement, resulting in ineffective initiatives (Plackett, 2022). Additionally, rural areas often lack sufficient high-speed internet access, which can hinder the integration of AI technologies (Sackman, 2023). However, access to the internet is helping to bridge the digital divide between rural and urban communities (Lusweti & Omieno, 2023). AI plays a crucial role in rural development, particularly in areas such as agriculture, healthcare, and education. In agriculture, AI technologies can enhance productivity and sustainability by providing data-driven insights for improved crop management and yield forecasting. Soil health analysis, crop monitoring, and optimized irrigation schedules are among the capabilities of AI in agriculture (Sackman, 2023).

Rural areas often face a digital divide, characterized by limited access to high-speed internet and modern technology, which are essential for implementing AI applications (Aruleba & Jere, 2022). Therefore, it is necessary to take steps to narrow this digital divide in rural regions by ensuring access to high-speed internet and modern technological infrastructure. This is crucial for facilitating the integration of AI technology into rural development. Ultimately, incorporating AI technology into rural regions has the potential to revolutionize sectors such as agriculture, healthcare, and connectivity, leading to improved production, sustainability, and quality of life for rural populations. However, it is important to note that the implementation of AI in rural areas may also result in economic vulnerability, particularly in the agricultural sector. According to Sparrow et al. (2021), the integration of AI can create fragility in the broader economy and society, potentially leading to job losses in agriculture and rural areas.

On the other hand, Ai Exploration Zone, (n.d.) highlights the numerous significant advantages of AI in rural development. By adopting AI technologies, rural communities can improve their economies through resource optimization and increased productivity. Precision agriculture, for example, leverages AI to assess soil conditions, monitor crop growth rates, and analyze weather patterns. This enables farmers to customize treatments, irrigation methods, and seed placement, ultimately resulting in improved productivity and profitability (Ai Exploration Zone, n.d.). The table below provides a visual representation of AI-based solutions for agricultural development.

Benefits of Precision Agriculture	Examples of Precision Agriculture Use-Cases
• Increased efficiency in crop management • Reduced use of water, pesticides, and fertilizers • Lower production costs • Improved crop quality and yield	• Identifying soil nutrient levels and needs • Monitoring weather patterns • Tracking crop growth and development • Early detection of plant diseases and pests

Figure 3 AI solutions for agricultural development is precision agriculture.
Source: Adapted from Ai Exploration Zone, (n.d.)

Fig 3 contributes to SDGs 1 and 2, which focus on eradicating hunger and eliminating poverty. These goals are essential for the development needed to improve food security. The NDPs 1and 4 can also be realized, as they contribute to the economy, and employment, and speak to an inclusive rural economy. By achieving these goals, we can ensure a more sustainable future for all and create a more equal society where everyone has access to necessities.

In addition, by focusing on inclusive rural economies, we can empower marginalized communities and help them thrive in a rapidly changing world. Overall, implementing these strategies will lead to a more prosperous and equitable society for all and create a sustainable future for future generations. Increasing these activities calls for financial solutions that can enhance sustainability and support long-term growth.

Financial Solutions and Artificial Intelligence

Africa's 1.4 billion people are unbanked, underbanked, and underserved, emphasising the importance of digital and financial inclusion for businesses to thrive (Bailey, 2023). This is supported by The World Bank (2022) that financial inclusion involves responsibly and sustainably offering inexpensive and helpful financial products and services, transactions such as payments, savings, credit, and insurance to individuals and enterprises, this financial inclusion supports SDG 7.

Many individuals from rural communities, especially women involved in small-scale farming, tend to sell their produce as informal traders. According to Luthuli & Naidoo (2023) when it comes to informal traders, an increasing number of their consumers are utilising mobile payment solutions; consequently, cash transactions are decreasing as this trend continues. The development of their networks using digital technology has also made it possible for these informal women traders to get access to new suppliers and new opportunities.

Rural communities in South Africa face challenges, including limited access to healthcare, inadequate infrastructure, and high levels of poverty and unemployment. Recognizing the resilience and resourcefulness of rural communities is crucial in finding innovative solutions to enhance their quality of life. For example, in Zimbabwe, rural communities have implemented community health worker programmes to provide basic healthcare services to remote areas where clinics are scarce. Additionally, some communities have established small-scale agriculture projects to create jobs and improve food security for residents. Research by Park et al. (2019) emphasizes the growing gaps in infrastructure quality between urban and rural areas attributed to increased interconnectedness and digitalization. Rural areas face challenges like social exclusion and the negative effects of disconnection.

Digital expansion can benefit rural Africa can boost economic growth, improve healthcare, and increase social and political participation through strategic investments and initiatives, enabling practical tasks like job hunting and online banking (Naidoo, 2023). These benefits encompass improved healthcare accessibility through telemedicine, enhanced agricultural productivity via precision farming techniques, and increased educational opportunities through online learning platforms. Moreover, AI can help tackle rural infrastructure challenges by improving transportation routes and managing resources efficiently. The integration of AI technologies in rural development initiatives has the potential to boost economic growth, improve quality of life, and narrow the digital gap between urban and rural areas (Finio & Downie, 2023). Moreover, Finio & Downie (2023) AI in finance involves utilising technology, such as sophisticated algorithms and ML, to analyse data, automate tasks, and enhance decision-making within the financial services sector.

According to WEF (2020), value delivery may involve customizing offerings to meet specific client preferences or engaging through various channels using intelligent solutions like chatbots, virtual clones, and digital voice assistants. Financial Services Review (2023) states that AI-powered chatbots and virtual assistants are revolutionizing customer service by offering round-the-clock assistance. Chatbots embedded in mobile apps, websites, and voice assistants may now help and direct users in faraway locations with simple tasks. According to Finio & Downie (2023) AI in finance is ushering in a new era characterised by data-driven decision-making, enhanced efficiency, heightened security, and improved consumer experience within the financial industry.

Furthermore, AI is ushering in a new era of personalised banking services with superior ML algorithms. Banks can use consumer data to obtain insight into their specific needs and preferences. This allows them to tailor their services and solutions to match the unique needs of individuals and communities. For example, some banks are developing financial products specifically for farmers based on their seasonal income patterns (Financial Services Review, 2023). Financial support plays a crucial role in boosting the confidence of farmers. This support also allows for the farming industry to adopt health care support to both their employees and livestock.

Health Care through Artificial Intelligence

SDG 3, focused on guaranteeing healthy lifestyles and fostering well-being for all at all ages, will significantly improve with the integration of digital technology, as stated by (Owoyemi et al., 2020). Africa, with a population of over one billion, has the potential to address its health issues, particularly in maternity and child health, infectious diseases, and non-communicable diseases, by leveraging digital technologies such as AI (Owoyemi et al., 2020).

The NDP 8 also focuses on promoting health, as it is one of the country's priorities due to poor rural medical care, which forces patients to travel long distances. Emergency medical personnel also face road infrastructure issues. Lack of medical resources in rural areas sometimes delays treatment, worsens health concerns, and causes preventable deaths. The lack of healthcare facilities and transportation means many people in these places cannot meet their medical needs. Disadvantaged groups are disproportionately affected by the lack of treatment, leading to health inequities (Lee et al., 2020). Digital innovation is transforming the health sector, and the digitisation of patient records makes it easy to access and track progress. The use of digital applications has opened more possibilities, such as the use of AI.

The positive impact of AI technologies in rural development endeavours is evident through the various advantages it brings to underserved communities. For instance, in South Africa, AI-powered drones are utilized to deliver medical supplies to remote clinics, reducing travel time and facilitating healthcare accessibility for rural residents. Extensive research is being conducted, and according to Denvir (2019), rural medical researchers and practitioners have a responsibility to ensure that their patients are involved in and benefit from this paradigm shift. The influence and impact of the AI revolution on medicine are expected to significantly increase in the next decade. According Mondal et al. (2023) rural locations in poor nations sometimes lack healthcare facilities, resources, and staff. As a result of the lack of medical attention, rural areas face a public health emergency. A lack of work environment for superspecialist physicians exacerbates this imbalance. Many rural hospitals are now connected to urban hospitals via telemedicine, allowing for remote consultations and access to specialized care. This integration facilitates the inclusion of rural health data in large healthcare datasets. This data and AI for diagnosis, treatment strategy planning, research, and more could improve rural health care.

According to Engineer IT (2023) the CSIR is creating a ML-powered diagnostics system that uses cutting-edge algorithms to autonomously help medical professionals diagnose diseases with greater accuracy and speed in rural areas with inadequate diagnostic facilities. New medical professionals may make mistakes, but ML can help. This also speeds up disease diagnosis, which is often delayed by human intervention in traditional treatments. ML can limit infectious illness spread by providing accurate and fast diagnoses (Engineer IT, 2023). The expansion of AI projects in healthcare will bring benefits to rural South Africa. The projects have the potential to significantly enhance healthcare access in rural, resource-deprived populations. AI can assist healthcare providers in diagnosing and treating underserved individuals with greater efficiency and precision. AI will help bridge the healthcare gap between urban and rural South Africans, ensuring equal access to care for everyone.

Artificial Intelligence Education for rural development

AI has the potential to tackle current educational challenges, transform teaching methods, and speed up progress towards SDG 4, according to (UNESCO, n.d.). This also contributes to NDP 7 education and training, which is essential for ensuring that rural communities have access to quality education. Access to AI will significantly boost literacy levels in these communities.

AI can offer excellent education and training to people in both urban and rural areas. AI can provide rural areas with customised learning, interactive virtual classrooms, and adaptive learning systems. This increases literacy, occupational skills, further education, and job opportunities. Integrating digital tools and resources with traditional teaching methods through AI education can enhance student engagement and performance in rural areas. According to Meehirr (2023) utilising artificial intelligence for personalised learning, individuals can engage in training at their own speed and at their convenience. AI technology assists in forecasting individuals' learning patterns to tailor material to each learner's objectives and previous achievements (Meehirr, 2023).

As to Ai Exploration Zone (n.d.), Kolibri by Learning Equality is recognised as a highly successful AI-powered educational solution for rural regions. This open-source platform offers high-quality educational content even in regions with restricted internet connectivity. Kolibri utilises AI algorithms for personalised learning, allowing teachers to track student progress in real-time. Kolibri has been adopted in a variety of rural places around the world, with considerable improvements in students' academic performance. Teachers can use AI technology to detect areas where their pupils may be underperforming and provide focused support to help them achieve. As a result, the overall quality of education in these neglected communities has significantly improved, allowing pupils to realise their full potential (Ai Exploration Zone, n.d.).

AI-driven education solutions are an important part of rural change. AI empowers rural students through personalized learning experiences, access to high-quality educational resources, and opportunities for knowledge sharing. Additionally, digital literacy training is crucial for senior members of rural communities to learn how to use AI

effectively and understand the associated benefits and challenges. It is essential for the South African government to establish suitable policies and infrastructure to support growth opportunities and contribute to long-term development. Improving access to education is critical for empowering citizens and driving economic prosperity. Furthermore, investing in renewable energy sources which aligns to (SDG 7 and NDP 3) and sustainable practices can assist to safeguard the environment (SDG 13, 14,15 and NDP 3) while also ensuring future prosperity. Implementing these policies can create a more equitable society and lay the foundation for South Africa's long-term prosperity.

Rural job creation with Artificial Intelligence

The Gordon Institute of Business Science (GIBS) predicted, as reported by IT News Africa in 2018, that AI could quadruple South Africa's economic growth and boost profitability by 38% by 2035. In the third quarter of 2023, the Quarterly Labour Force Survey (QLFS) shows that the number of employed individuals rose by 399,000 to 16.7 million, up from 16.3 million in the second quarter of 2023 (Government of South Africa, 2023). While this is good news it is important that there is still much work to be done to further decrease the unemployment rate. AI puts many traditional jobs at risk, and new roles will demand digitally fluent employees. Therefore, training is important to upskill employees with skills that will enhance their ability to fit into the new jobs that come about through the disruption of AI. According to Aguera et al. (2020) digital skills are critical for agricultural innovation and equitable growth since they enable rural labourers to access low-cost technological solutions while also organising high-skilled occupations through internet of things (IoT) and AI development for entrepreneurship.

Rural labourers can utilize cost-effective IoT and AI advancements to enhance their career opportunities, highlighting the significance of digital skills in agricultural advancement and fair growth. On average, 44% of skills in all jobs need to change, according to (WEF, 2020). Firms value analytical and creative thinking, digital literacy, curiosity and lifelong learning, resilience and adaptation, systems thinking, AI, and big data. Global citizenship, sensory processing, manual dexterity, endurance, and precision are unsought. The AI-driven revolution, as discussed by Homegarden (2024), is intriguing due to its dual effects. While AI automates monotonous jobs, it frees humans to focus on creativity, critical thinking, emotional intelligence, and complex problem-solving. It also creates jobs. The effects of AI on jobs are complex and developing. AI can boost productivity, automate routine chores, and establish new industries, creating jobs in some sectors (Jain, 2023).

According to (OECD, 2022) rural youngsters have potential work opportunities in agriculture and the agro-food value chain. The increasing demand for diversified and greater value added agricultural and food products in Africa and developing Asia is driven by growing populations, urbanisation, and rising incomes of the working class. As noted by PNET in 2024, South Africa grapples with a significant skills shortage, revealing a noticeable mismatch between the labour market's needs and the workforce's skills. Inadequate education and training systems, as well as brain drain, are significant factors to this scarcity. The migration of highly skilled workers to seek opportunities elsewhere leads to brain drain, while skill mismatches emerge from the swift pace of technological advancement. To tackle this difficulty, a variety of strategies are needed, including improving education and vocational training, establishing innovation centres, attracting, and keeping skilled individuals, and encouraging partnerships between academic institutions and businesses to ensure that skills match market demands (PNET, 2024).

According to Banga & te Velde. (2018) lower labour costs than growing and industrialised nations, Sub-Saharan African countries are likely to join global value chains. The primary concern lies in the digital gap between developed, emerging, and developing nations. Sub-Saharan Africa faces the risk of falling behind digitally. Countries lacking adequate digital infrastructure will face challenges in competing as global value chains become increasingly automated and digital.

Conclusions

Aligning AI initiatives with SDGs and NDPs is vital to benefit all people in both rural and urban communities Vinuesa et al. (2020); The Domino Foundation (n.d.). African healthcare, finance, agriculture, and education could benefit from AI. Africa might lead AI adoption for its people with the right infrastructure and support. AI could boost innovation and tackle African social challenges, but its widespread adoption may raise data privacy and job loss concerns. Some African countries lack AI technology, creating a digital divide that could deepen inequalities. AI-driven agricultural solutions boost crop yields and reduce waste, boosting food security and economic stability. Such technologies' high implementation and maintenance costs may expand South Africa's urban-rural digital divide. AI may also eliminate jobs and worsen economic inequality in neglected areas.

South African rural communities could benefit from AI technology for socio-economic and environmental issues. AI-driven solutions can improve rural access to crucial services, agricultural output, and sustainable development. Rural

development initiatives Gwagwa et al. (2021) can benefit from AI resource allocation, decision-making, and service delivery. South Africa must foster cross-sector collaboration, information sharing, and learning to explore AI's rural sustainable development potential. By partnering, sharing best practices, and addressing rural AI adoption, stakeholders may address its pros and cons and maximise its benefits. AI can revolutionize farming practices in rural South Africa. AI-enabled precision farming (Ai Exploration Zone, n.d.), predictive analytics, and soil health monitoring increase production, resource use, and climate. AI advances rural farmers' yields, food security, environmental resilience, and economic prosperity.

Rural healthcare access, diagnostic accuracy, and illness prevention and treatment can benefit from AI. Rural residents can benefit from telemedicine Njanja (2024), AI-based diagnostics, and data analytics for early intervention, personalised treatment, and better health. AI can improve healthcare, reduce inequalities Townsend et al. (2013), and improve rural well-being. AI can bridge the healthcare gap between urban and rural South Africans, ensuring equitable access to healthcare for all. AI-driven financial solutions can improve economic development, promote financial inclusion, and enhance access in rural South Africa. AI-driven predictive analytics, credit scoring algorithms, and mobile banking systems can help rural individuals access loans, insurance, and savings. AI for financial inclusion assists rural communities in developing financial stability, obtaining capital for entrepreneurship, and entering the formal economy.

AI could improve remote school and community education, learning, and digital literacy. AI-powered educational tools, customised learning platforms, and virtual coaching can match learning needs, increase access, and bridge the rural digital divide. Rural schools may educate youngsters for the digital age by integrating AI into curriculum, training teachers in AI, and offering digital learning tools. AI technology can promote innovation, entrepreneurship, and resilience in rural areas in response to environmental, economic, and social challenges. Rural workers can benefit from digital skills in agricultural innovation and equitable growth by using cost-effective technological solutions and participating in high-skilled professions including IoT and AI development (Aguera et al., 2020). AI-powered solutions help rural communities improve their economies, create sustainable livelihoods, and adapt to a rapidly changing digital environment. Lack of full understanding of AI and inadequate training in AI skills can lead to job losses (Sparrow et al., 2021). The adoption of AI in South Africa has the potential to improve job opportunities, foster entrepreneurship, and stimulate economic development in rural areas. Artificial intelligence innovations in agriculture, healthcare, finance, and education can improve rural businesses' competitiveness, employment opportunities, and innovation. Rural communities may establish sustainable livelihoods, empower local businesses, and boost economic growth by investing in AI skills, entrepreneurship, and ecosystem-building.

AI has the potential to significantly transform various sectors of South African rural development, including agriculture, healthcare, financial solutions, education, and job creation. South Africa can strategically utilize AI technologies to generate new opportunities for rural development, address socio-economic challenges, and build resilient communities that benefit from AI advancements. AI has the potential to transform rural development in South Africa by addressing challenges in agriculture, healthcare, education, and infrastructure. Policymakers can use AI technology to improve the quality of life, economic opportunities, and resilience of rural areas, fostering sustainable development and social inclusion. Addressing the digital divide, building capacity and skills, and tackling ethical and legal issues related to rural AI adoption are essential to fully harness AI's potential for rural development. To ensure AI fosters inclusive and equitable development in rural South Africa, policymakers should adopt a comprehensive and cooperative strategy.

Recommendations

To leverage the benefits of AI for rural development in South Africa, policymakers should prioritise proposals that correspond with SDGs and NDPs.

- Allocate funding to improve digital infrastructure and connectivity in rural areas to promote accessibility to the internet and technology.
- The government should allocate funds to support rural communities in implementing AI technology to enhance agricultural productivity.
- Offer training and digital education programmes to improve digital literacy and technical skills in rural communities.
- Assess and analyse the impact of AI projects in rural areas to verify their efficacy in addressing important issues and fostering sustainable development.

- Collaborating with private companies to improve infrastructure, roads, and energy efficiency through initiatives like wind farms and solar energy.
- Increasing access to banking services in rural areas to encourage the implementation of artificial intelligence.
- Expand access to health solutions using AI and such as telemedicine to rural regions.

REFERENCES

Aguera, P., Berglund, N., Chinembiri, T., Comninos, A., Gillwald, A., & Govan-Vassen, N. (2020, June 10). *Paving the way towards digitalising agriculture in South Africa*. https://researchictafrica.net/wp/wp-content/uploads/2020/09/PavingthewaytowardsdigitalisingagricultureinSouthAfricaWhitepaper272020105251.pdf

Ai Exploration Zone. (n.d.). *AI for Rural Development: Bridging the Gap*. Retrieved March 31, 2024, from https://www.aiexplorationzone.com/ai-for-rural-development/

Aruleba, K., & Jere, N. (2022). Exploring digital transforming challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific African*, *16*, e01190. https://doi.org/10.1016/j.sciaf.2022.e01190

AUDA-NEPAD. (2022). *AI for Africa: Artificial Intelligence for Africa's Socio-Economic Development*. https://www.nepad.org/publication/ai-africa-artificial-intelligence-africas-socio-economic-development

Bailey, B. (2023, October 25). *Microsoft, Flutterwave to drive financial inclusion, innovation*. https://businessday.ng/financial-inclusion/article/microsoft-flutterwave-to-drive-financial-inclusion-innovation/

Banga, K., & te Velde., D. W. (2018). *Skill needs for the future*. https://pathwayscommission.bsg.ox.ac.uk/sites/default/files/2019-09/skill_needs_for_the_future.pdf

Boakye, A. (2023). Estimating agriculture technologies' impact on maize yield in rural South Africa. *SN Business & Economics*, *3*(8), 149. https://doi.org/10.1007/s43546-023-00530-4

Chaerowati, D. L., & Ibrahim, I. S. (2019). Utilization of information technology for sustainable rural development. *Journal of Physics: Conference Series*, *1375*(1), 012058. https://doi.org/10.1088/1742-6596/1375/1/012058

de-Lima-Santos, M.-F., & Ceron, W. (2021). Artificial Intelligence in News Media: Current Perceptions and Future Outlook. *Journalism and Media*, *3*(1), 13–26. https://doi.org/10.3390/journalmedia3010002

Denvir, J. (2019). Artificial Intelligence and the Challenge for Rural Medicine. *Marshall Journal of Medicine*, *5*(4), 3. https://doi.org/10.33470/2379-9536.1246

Engineer IT. (2023, June 30). *CSIR driving SMART innovations to boost SA's healthcare system in rural areas*. https://www.engineerit.co.za/article/csir-driving-smart-innovations-boost-sas-healthcare-system-rural-areas

Financial Services Review. (2023, July 31). *AI Driven Banking Transformation Bridging The Gap Between Rural and Urban Communities*. https://www.financialservicesreview.com/news/aidriven-banking-transformation-bridging-the-gap-between-rural-and-urban-communities-nwid-1133.html

Finio, M., & Downie, A. (2023, December 8). What is artificial intelligence (AI) in finance? *What Is Artificial Intelligence (AI) in Finance?* https://www.ibm.com/topics/artificial-intelligence-finance

Gadzala, A. (2018, November 14). *Coming to life: Artificial intelligence in Africa. Atlantic Council*. https://www.atlanticcouncil.org/wp-content/uploads/2019/09/Coming-to-Life-Artificial-Intelligence-in-Africa.pdf

Gikunda, K. (2024). *Harnessing Artificial Intelligence for Sustainable Agricultural Development in Africa: Opportunities, Challenges, and Impact*. https://doi.org/10.48550/ARXIV.2401.06171

Government of South Africa. (2012, August 15). *National Development Plan 2030*. https://www.gov.za/sites/default/files/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf

Government of South Africa. (2023, November 14). *Statistics South Africa on Quarterly Labour Force Survey quarter three 2023*. https://www.gov.za/news/media-statements/statistics-south-africa-quarterly-labour-force-survey-quarter-three-2023-14

Gwagwa, A., Kazim, E., Kachidza, P., Hilliard, A., Siminyu, K., Smith, M., & Shawe-Taylor, J. (2021). Road map for research on responsible artificial intelligence for development (AI4D) in African countries: The case study of agriculture. *Patterns*, *2*(12), 100381. https://doi.org/10.1016/j.patter.2021.100381

Homegarden, T. (2024, March 5). *The 2024 Job Market: Navigating AI, Uncertainty And Opportunities*. https://www.forbes.com/sites/forbescoachescouncil/2024/03/05/the-2024-job-market-navigating-ai-uncertainty-and-opportunities/?sh=6e49b829d3bb

Jain, A. (2023). Job Displacement Due to Artificial Intelligence and Machine Learning – A Review. *International Journal For Multidisciplinary Research*, *5*(6), 10958. https://doi.org/10.36948/ijfmr.2023.v05i06.10958

Kene-Okafor, T. (2021, January 21). *South African startup Aerobotics raises $17M to scale its AI-for-agriculture platform*. https://techcrunch.com/2021/01/21/south-africa-startup-aerobotics-raises-17m-led-by-naspers-foundry/?guccounter=1

Lee, H., Kim, D., Lee, S., & Fawcett, J. (2020). The concepts of health inequality, disparities and equity in the era of population health. *Applied Nursing Research*, *56*, 151367. https://doi.org/10.1016/j.apnr.2020.151367

Lusweti, S., & Omieno, K. (2023). Using I-Hubs for Bridging The Gap of Digital Divide in Rural Kenya. *Buana Information Technology and Computer Sciences (BIT and CS)*, *4*(2), 54–62. https://doi.org/10.36805/bit-cs.v4i2.5165

Luthuli, N., & Naidoo, G. M. (2023). *Informal Women Traders Using Digital Technology in Esikhawini Township to Advance Their Businesses*. *12*(3).

Meehirr, K. (2023, June 6). *How AI Is Personalizing Education For Every Student*. https://elearningindustry.com/how-ai-is-personalizing-education-for-every-student

Mhlanga, D. (2021). Artificial Intelligence in the Industry 4.0, and Its Impact on Poverty, Innovation, Infrastructure Development, and the Sustainable Development Goals: Lessons from Emerging Economies? *Sustainability*, *13*(11), 5788. https://doi.org/10.3390/su13115788

Mondal, H., Mondal, S., & Singla, R. K. (2023). Artificial Intelligence in Rural Health in Developing Countries. In J. Moy Chatterjee & S. K. Saxena (Eds.), *Artificial Intelligence in Medical Virology* (pp. 37–48). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-0369-6_3

Naidoo, G. M. (2020). Digital Communication: Information Communication Technology (ICT) Usage for Teaching and Learning. In M. Montebello (Ed.), *Advances in Educational Technologies and Instructional Design* (pp. 1–19). IGI Global. https://doi.org/10.4018/978-1-5225-9304-1.ch001

Naidoo, G. M. (2023). *Digital Development of Rural Communities in Sub-Saharan Africa*.

Naresh, R. K., Chandra, M. S., Vivek, ., Shivangi, ., Charankumar, G. R., Chaitanya, J., Alam, M. S., Singh, P. K., & Ahlawat, P. (2020). The Prospect of Artificial Intelligence (AI) in Precision Agriculture for Farming Systems Productivity in Sub-Tropical India: A Review. *Current Journal of Applied Science and Technology*, 96–110. https://doi.org/10.9734/cjast/2020/v39i4831205

Njanja, A. (2024, February 12). *Kenya's Ilara Health Gets $4.2M Backing to Expand Clinic-Support Services*. https://techcrunch.com/2024/02/12/ilara-health-gets-4-2m-funding/

OECD. (2022, April). *Jobs for Rural Youth The Role of Local Food Economies*. https://www.oecd-ilibrary.org/sites/692c0ca1-en/1/3/1/index.html?itemId=/content/publication/692c0ca1-en&_csp_=ad22e961c155a84094fbb5c015d69350&itemIGO=oecd&itemContentType=book

Owoyemi, A., Owoyemi, J., Osiyemi, A., & Boyd, A. (2020). Artificial Intelligence for Healthcare in Africa. *Frontiers in Digital Health*, *2*, 6. https://doi.org/10.3389/fdgth.2020.00006

Park, S., Freeman, J., & Middleton, C. (2019). Intersections between connectivity and digital inclusion in rural communities. *Communication Research and Practice*, *5*(2), 139–155. https://doi.org/10.1080/22041451.2019.1601493

Pinto-Coelho, L. (2023). How Artificial Intelligence Is Shaping Medical Imaging Technology: A Survey of Innovations and Applications. *Bioengineering*, *10*(12), 1435. https://doi.org/10.3390/bioengineering10121435

Plackett, B. (2022). The rural areas missing out on AI opportunities. *Nature*, *610*(7931), S17–S17. https://doi.org/10.1038/d41586-022-03212-7

PNET. (2024, March). *Pnet Job Market Trends Report MAR-24*. https://www.pnet.co.za/wp-content/uploads/2024/04/Pnet-Job-Market-Trends-Report_MAR-24_Final.pdf

Rapanyane, M. B., & Sethole, F. R. (2020). The rise of artificial intelligence and robots in the 4th Industrial Revolution: Implications for future South African job creation. *Contemporary Social Science*, *15*(4), 489–501. https://doi.org/10.1080/21582041.2020.1806346

Sackman, M. (2023, June 23). Medium. *Breaking Barriers: Examining the Impact of AI on Rural Communities*. https://mikeysackman.medium.com/breaking-barriers-examining-the-impact-of-ai-on-rural-communities-dbd14801c6dc

Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies*, *54*, 360–371. https://doi.org/10.1016/j.jrurstud.2015.09.001

Sparrow, R., Howard, M., & Degeling, C. (2021). Managing the risks of artificial intelligence in agriculture. *NJAS: Impact in Agricultural and Life Sciences*, *93*(1), 172–196. https://doi.org/10.1080/27685241.2021.2008777

The Domino Foundation. (n.d.). *National Development Plan*. Retrieved April 17, 2024, from https://www.dominofoundation.org.za/national-development-plan/

The World Bank. (2022, September 13). *Financial Inclusion*. https://www.worldbank.org/en/topic/financialinclusion/overview

Townsend, L., Sathiaseelan, A., Fairhurst, G., & Wallace, C. (2013). Enhanced broadband access as a solution to the social and economic problems of the rural digital divide. *Local Economy: The Journal of the Local Economy Policy Unit*, *28*(6), 580–595. https://doi.org/10.1177/0269094213496974

UNESCO. (n.d.). *Artificial intelligence in education*. Retrieved April 20, 2024, from https://www.unesco.org/en/digital-education/artificial-intelligence

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, *11*(1), 233. https://doi.org/10.1038/s41467-019-14108-y

WEF. (2020, February 4). *AI has started a financial revolution—Here's how*. https://www.weforum.org/agenda/2020/02/how-ai-is-shaping-financial-services/

West, D., & Allen, J. (2018, April 24). *How artificial intelligence is transforming the world*. https://www.brookings.edu/articles/how-artificial-intelligence-is-transforming-the-world/