GSMA

AI for Africa: Use cases delivering impact

July 2024

GSMA

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Authors and contributors

Authors: Eugénie Humeau and Tanvi Deshpande

Contributor: Daniele Tricarico

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List of acronyms

AI	Artificial Intelligence
CDR	Call Detail Records
DFS	Digital Financial Services
EWS	Early Warning System
GDP	Gross Domestic Product
GIS	Geographic Information System
GPT	Generative Pre-trained Transformer
GPU	Graphic Processing Unit
HPC	High Performance Computing
HWC	Human-Wildlife Conflict
IoT	Internet of Things
IVR	Interactive Voice Response
LLM	Large Language Model
ML	Machine Learning
MNO	Mobile Network Operator
NLP	Natural Language Processing
NRM	Natural Resources Management
PAYG	Pay-As-You-Go
PPP	Public-Private Partnership
R&D	Research and Development
SHS	Solar Home System
USSD	Unstructured Supplementary Service Data

Definitions

AI for Development: We use the term 'AI for development' to refer to the use of AI and its applications with the potential to address development challenges in low- and middle-income countries.

Algorithm: A process or set of rules to be followed in calculations, especially by a computer, to solve a problem.

Artificial intelligence: Artificial intelligence (AI) is comprised of widely different technologies that can be broadly defined as "self-learning, adaptive systems."[1] AI has the capability to understand language, solve problems, recognise pictures and learn by analysing patterns in large sets of data.

Big Tech: In this report, Big Tech players refer to the large tech companies known globally, including Google, Microsoft, IBM, Meta, and Amazon. The terms 'Big Tech' and 'large tech companies' are used interchangeably in some contexts.

Compute: Compute refers to the process of performing calculations or computations required for a specific task, such as training an AI model. It also encompasses the hardware components, like chips, that carry out these calculations, as well as the integrated systems of hardware and software used to perform computing tasks.[2]

Computer vision: A type of AI that enables computers and other machines to identify and interpret visual inputs from images and videos.[3]

Generative AI: A type of AI that involves generating new data or content, including text, images or videos, based on user prompts and by learning from existing data patterns.

Machine learning: A subfield of AI, broadly defined as the capability of a machine to imitate intelligent human behaviour and learn from data without being explicitly programmed.[4]

NLP: A field of machine learning in which machines learn to understand natural language as spoken and written by humans, instead of the data and numbers normally used to program computers.

Predictive AI: A type of AI that uses statistical analysis and machine learning algorithms to make predictions about potential future outcomes, identify causation and assess risks.[5]

Remote sensing: Acquiring information from a distance via remote sensors on satellites, aircrafts and drones that detect and record reflected or emitted energy. All objects on Earth reflect, absorb or transmit energy, with the amount varying by wavelength. Researchers can use this information to identify different Earth features as well as different rock and mineral types.[6]

1 Definition by the International Telecommunication Union (ITU).
2 AI Now Institute. (2023). Computational Power and AI.
3 Definition taken from Microsoft Azure's dictionary on cloud computing.
4 Definition by the MIT Sloan School of Management, based on the definition by AI pioneer Arthur Samuel.
5 Definition from the Carnegie Council for Ethics in International Affairs.
6 Definition by NASA Earthdata.

Executive summary

The potential of AI in Africa

AI holds immense potential to boost Africa's economy and to support the Sustainable Development Goals (SDGs) on the continent. While AI is already being developed and deployed to support a range of use cases across African countries, little research has focused on building a body of evidence of AI use cases for development on the continent. This report is based on the analysis of over 90 use case applications identified in Kenya, Nigeria, and South Africa – which benefit from thriving tech ecosystems – across agriculture and food security, energy, and climate. While many AI use cases are relatively nascent, with some being deployed as part of projects or pilot schemes, a number of commercially viable solutions have also emerged. Often, AI is being incorporated into existing digital products and services, acting as an enabler to make digital solutions more relevant and efficient, amplify their impact, and facilitate scaling.

The agritech sector is seeing most of the AI innovation, especially in Kenya and Nigeria where agriculture continues to play a significant role in the economy. AI is already being used for agricultural advisory, with companies like TomorrowNow and ThriveAgric providing farm-level insights to farmers, and for financial services with companies like Apollo Agriculture developing alternative credit assessment methods. AI is also being deployed in the energy sector, especially in Nigeria, where emerging technologies like Internet of Things (IoT) act as an entry point for advanced data analytics in smart energy management. Use cases such as energy access monitoring and productive use asset financing, developed by companies like Nithio, remain at a developing or nascent stage but present significant potential to reduce energy poverty. AI is also supporting climate use cases especially for biodiversity monitoring and wildlife protection in Kenya and South Africa, driven by large tech companies like Microsoft's AI for Good Lab and non-profit organisations such as Rainforest Connection.

AI fundamentals and enabling environment

The increasing availability of data generated by remote sensing technologies, such as on-the-ground sensors, drones with high-resolution cameras, and satellites, has led to the development of many AI-driven use cases across sectors. Analysis of geospatial and remote sensing data, powered by machine learning (ML), can support a wide range of use cases and activities such as monitoring soil conditions for effective crop management, mapping energy access in off-grid areas to inform energy planning, and monitoring climate change impacts on ecosystems. Despite these advancements, the availability of locally relevant data remains limited in Africa and poses a major obstacle to developing and deploying tailored solutions that address challenges that are unique to the continent. In addition to barriers in accessing government and domain-specific data, one of the most significant gaps is in language data. The scarcity of local language data limits the relevance of AI-enabled services and poses a significant barrier to the development of generative AI solutions that rely on language models.

Infrastructure and compute capacity in Africa is growing, and countries like South Africa have emerged as regional leaders. Increasing investments in data centres from large tech companies and Mobile Network Operators (MNOs) in Nigeria and Kenya are also driving momentum in the region, bringing critical storage and computing capacity to the local level. However, the high costs of hardware such as Graphic Processing Units (GPUs) and cloud computing still constitute a major barrier to AI deployment and adoption, especially for local entrepreneurs and researchers with limited financial resources. As local compute ecosystems continue to develop, there is an opportunity for countries in Africa to tap into their mobile-first markets to build capacity in distributed-edge computing. In Kenya for example, deeptech company Fastagger develops ML capabilities on edge devices, including on lower-end smartphones.

Across countries, a significant skills gap still undermines the development of the AI ecosystem and use cases. While universities offer AI-related courses, they often fail to keep pace with industry needs, and students have limited opportunities for practical learning and hands-on experiences. There is also a disproportionate focus on core AI skills, such as ML and data science, with less emphasis on building the multidisciplinary skillsets needed to leverage AI to address pressing socioeconomic challenges. Despite these challenges, organisations like Data Science Nigeria (DSN) offer upskilling and mentorship programmes to build a pipeline of AI talent. In parallel, end users require a foundational level of digital literacy to access AI-enabled services, which are primarily accessible through digital channels like mobile devices. However, lack of knowledge and skills remains one of the greatest barriers to adoption and use of digital tools and services, especially for women, low-income and rural communities, and persons with disabilities.

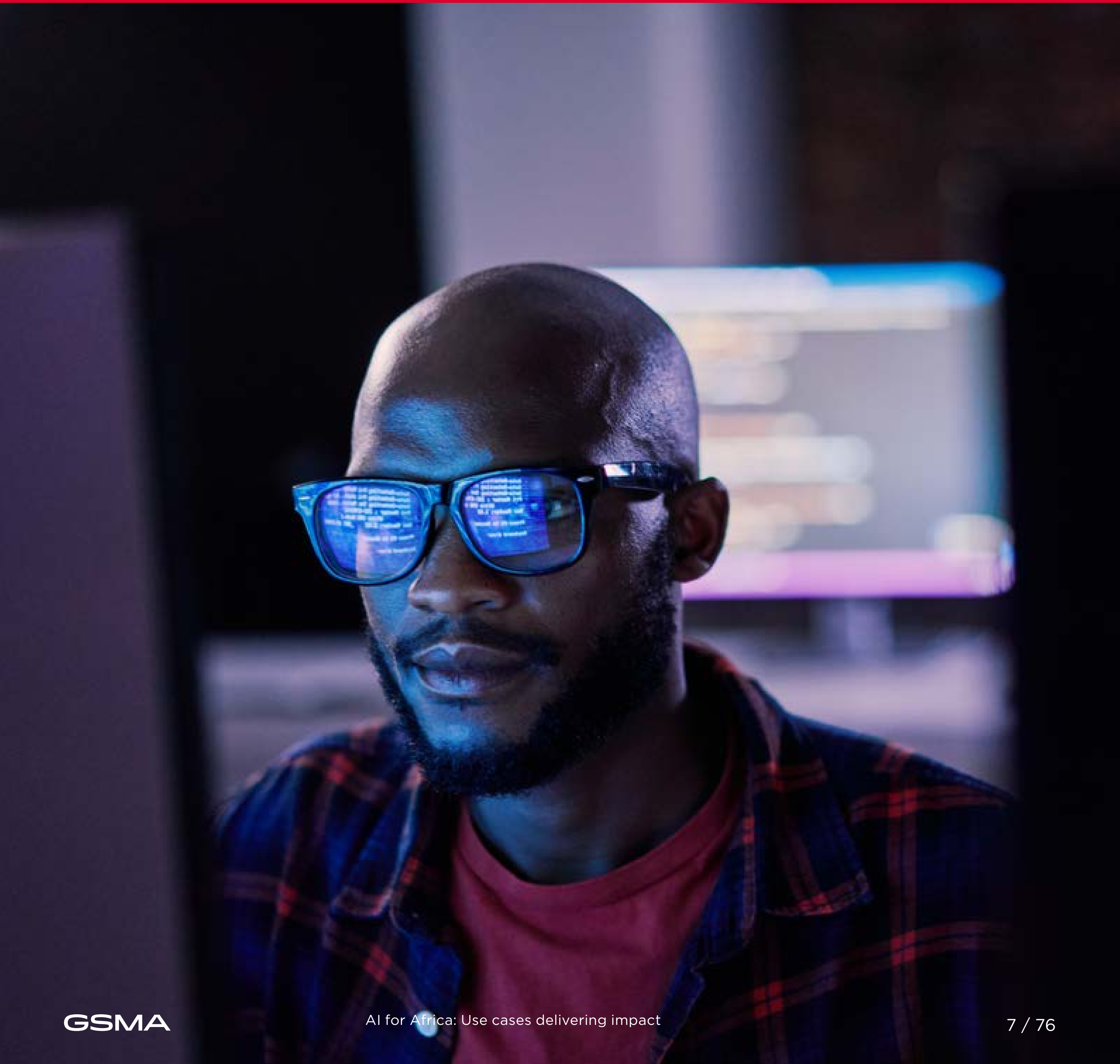
While Kenya, Nigeria and South Africa are all regional tech leaders and have solid digital foundations that can serve as the building blocks for AI development, key challenges remain in the ecosystem. Despite wide enthusiasm about the potential of AI for Africa for example, private sector investors remain risk-averse about investing in deeptech, and startups have to rely on grant funding from development partners and development finance institutions (DFIs). Similarly, low public and private sector investment in Research and Development (R&D) may undermine the development of local solutions. While some countries in Africa have already developed national AI strategies, Kenya, Nigeria and South Africa are still in the process of drafting their own – but have adopted inclusive formulation processes. Most frameworks across the continent remain in their infancy, highlighting the need to shift from policy formulation to implementation and to ensure ethical, responsible and safe use of AI.

High-level recommendations

Different stakeholders – governments, development partners, DFIs, NGOs and Civil Society Organisations (CSOs), large tech companies and startups, and research and academic institutions – can take a number of actions and collaborate to ensure that impactful innovations in Africa can be deployed and scaled. This involves investing in domain-specific and local language data, adopting participatory approaches to data collection, unlocking access to existing data sources, and ensuring data privacy and security. Strengthening baseline infrastructure and promoting renewable energy, providing hardware and cloud credits, enhancing edge computing capabilities and building institutional capacity will be essential to boost local compute capacity. In addition, fostering academic-industry collaboration, raising awareness and building capacity in the public sector will be essential to create a pipeline of AI talent while ensuring informed policymaking. To foster adoption and usage of AI-enabled services, enhancing digital skills among end users and integrating emerging skills like prompt-engineering into upskilling programmes will be key, especially as generative AI solutions gradually grow in Africa.

Stakeholders across sectors can also focus on supporting the wider tech and AI ecosystem to foster an environment conducive to innovation and AI deployment across use cases. This involves engaging in partnerships to unlock access to critical resources for AI entrepreneurs and researchers, and to support the development of the AI ecosystem through data-sharing or infrastructure-sharing initiatives. Adopting a consortium-based approach has the potential to help address the financing gap, while adopting innovative finance mechanisms can de-risk investments. Combining funding with technical assistance and go-to-market support can also help founders in their scaling journey. Increased R&D spending will be essential to support local research capacity, while local-global knowledge exchange can drive further momentum and raise awareness about local innovation. As countries work on developing national AI strategies, it will be critical to ensure a collaborative and inclusive process, to include principles for the ethical and safe use of AI, and to establish a clear roadmap for implementation. Policymakers can also consider rolling out regulations in a phased manner to allow innovation to flourish.

1. Introduction

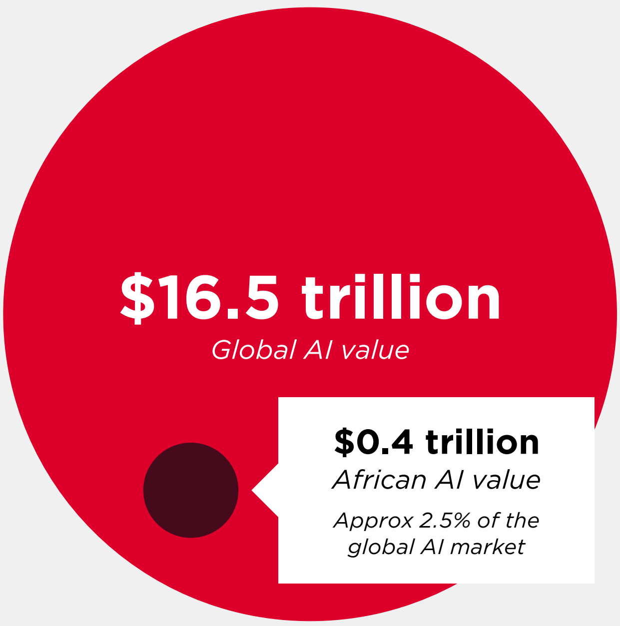


Over the past year, artificial intelligence (AI) and its transformative potential has captured global attention. The potential of AI in helping achieve the 2030 Sustainable Development Goals (SDGs) is well established.[7,8] AI applications can create social and economic impact, especially in low- and middle-income countries where innovative approaches to inclusive and sustainable development are most needed. Africa represents only 2.5% of the global AI market, yet recent estimates suggest that AI could increase Africa's economy by $2.9 trillion by 2030—the equivalent of increasing annual Gross Domestic Product (GDP) growth by three per cent.[9] This boost in economic growth could translate into significant development impacts for the continent, providing employment opportunities and helping to raise millions out of poverty.

Figure 1

Estimated annual value of the AI market in Africa relative to the global market

($ trillion, 2023)

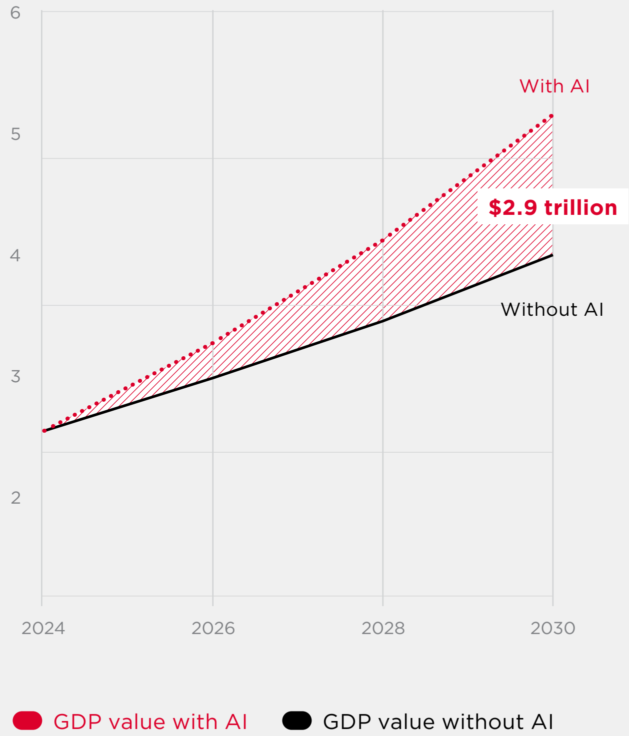


Source: AI4D Africa

Figure 2

Potential value added by AI to the African economy

($ trillion, 2024-2030)



Source: AI4D Africa

7 Smith, M. & Neupane, S. (2018). Artificial intelligence and human development: Toward a research agenda. IDRC.
8 Bankhwal, M. et al. (2024). AI for social good: Improving lives and protecting the planet. McKinsey Digital.
9 AI4D Africa. (2024). AI in Africa: The state and needs of the ecosystem.

Mobile connectivity in Sub-Saharan Africa continues to drive digital transformation and socioeconomic advancements. A growing proportion of the population is connected to and using mobile internet, and smartphone penetration is expected to reach 88% by 2030, creating new opportunities for digital inclusion and usage of AI-enabled services.[10] Countries such as Kenya, Nigeria and South Africa already have some of the most advanced tech ecosystems in the region. Kenya is particularly renowned for pioneering mobile money through M-Pesa, while Nigeria has produced several African unicorns. These countries also have tech-related policies that have fostered a relatively conducive environment for innovation and entrepreneurship. Their solid digital foundations can serve as building blocks for the development, deployment and adoption of AI.

However, unlocking the potential of AI will require overcoming several challenges. While the coverage gap has significantly reduced, the usage gap in Sub-Saharan Africa still stands at 59%, meaning that millions of people who live within the footprint of a mobile broadband network are not using mobile internet. Significant digital divides exist and disproportionately affect low-income groups, those who are less educated, rural populations and women, and digitalisation and AI risk exacerbating existing socioeconomic inequalities. Kenya, Nigeria, and South Africa have critical infrastructure gaps and undergo regular power outages. In addition, insufficient availability of data and lack of data ecosystems, low levels of digital skills and literacy, fragmented or non-enforced policies and nascent research capacities constitute key barriers for the development of the AI ecosystem. AI also brings significant risks in terms of data privacy, bias and discrimination that need to be addressed to ensure safe and responsible use of the technology.

While there has been an acceleration of technology companies leveraging AI and initiatives to develop and promote the use of AI on the continent, these have not necessarily focused on addressing socioeconomic or development challenges. Most existing use cases are typically found in sectors such as IT services, computer software, or management consulting.[11] There is a lack of focus on building local, inclusive, and sustainable AI solutions[12] that can help address the SDGs in Africa. There is a pressing need to identify and test models and use cases that can address development challenges, are tailored to meet the specific needs of local communities, and have the potential to be scaled to amplify their impact. Considering the diverse contexts and cultures across Africa, fostering equitable partnerships to build AI use cases for development and nurture the growth of local ecosystems will be critical to harness the potential of AI to help achieve the SDGs on the continent.

10 GSMA. (2023). The Mobile Economy Sub-Saharan Africa 2023.
11 The AI Media Group South Africa. State of AI in Africa Report 2022.
12 In this report, local, inclusive and sustainable AI solutions refers to AI applications that are tailored to local needs and constraints to foster inclusivity and prioritise addressing development challenges in line with the SDGs.

2. Research objectives and methodology

Research objectives

This research seeks to identify AI-enabled use cases and solutions that address development challenges related to agriculture and food security, energy and climate action. It focuses on Kenya, Nigeria and South Africa, who are all technology leaders on the continent and in their sub-region, and present significant potential to leverage AI for development.

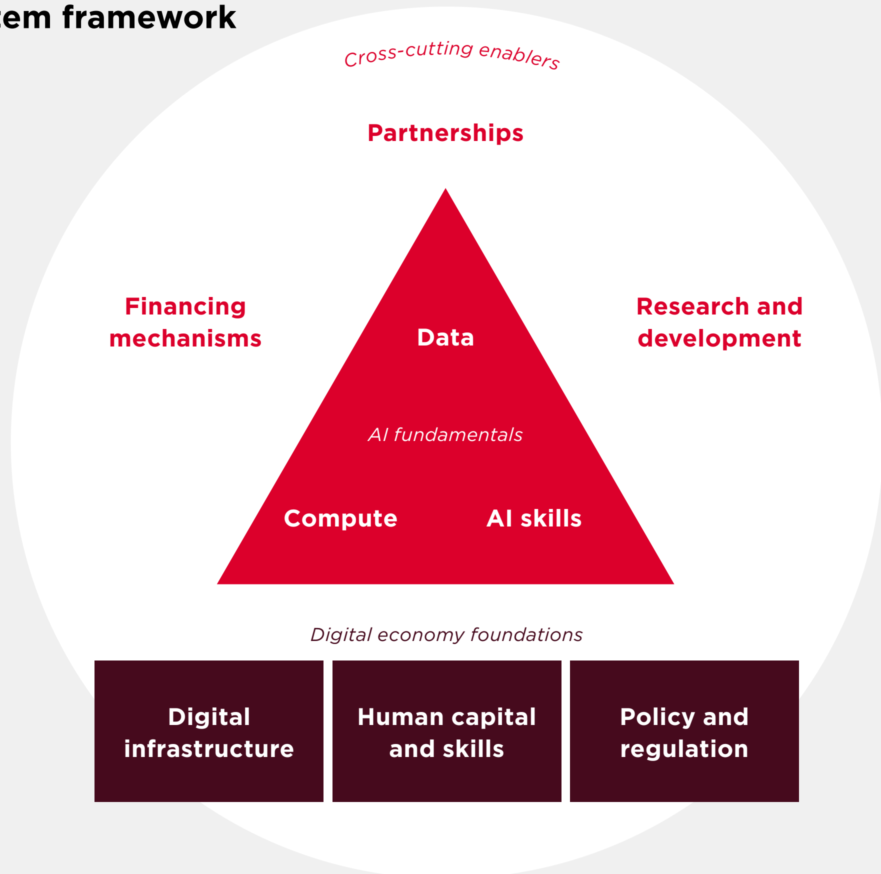
More specifically, the research seeks to:

1. Identify AI-enabled use cases and solutions across the selected sectors, highlight their key requirements and assess their potential for impact, scale and constraints.
2. Provide a landscape overview of the AI ecosystem in each country to identify gaps and opportunities to improve the enabling environment and development of AI-enabled use cases.
3. Offer a set of recommendations for key stakeholders, pinpointing ways to catalyse the development of the AI ecosystem delivering impact in the region.

To address the objectives of the research, we investigated the following key pillars of the AI ecosystem to understand how they impact the development and scalability of use cases: the digital economy foundations, encompassing digital infrastructure, human capital and skills, and policy and regulation; the AI fundamentals, including data, AI-specific skills, and compute capacity; and cross-cutting enablers, such as partnerships, financing mechanisms, and research and development.

While we have separated the enablers of each main pillar in our framework (Figure 3) to show that the AI ecosystem sits on top of a broader digital/technology ecosystem, we have grouped them in the report as certain elements such as infrastructure, skills and policy can be understood as part of a spectrum.

Figure 3
The AI ecosystem framework



This report relies on desk-based research and validation through diverse stakeholder engagement. The methodology is outlined in Table 1.

Table 1
Research methodology

Data source	Objective
Desk-based research Review included grey literature and industry-specific reports, academic publications, databases of research institutes and multilateral organisations, national digital development policy documents and local news articles.	• Develop an understanding of the AI for development landscape in Africa and in Kenya, Nigeria and South Africa, and existing initiatives supporting AI for development efforts. • Inform a landscape review of existing AI-enabled use cases and solutions in agriculture and food security, energy and climate action and the stakeholders involved in their implementation.
Semi-structured interviews • Consisting of 25-30 key informant interviews in each country. • Over 10 key informant interviews with regional and global experts.	• Identify gaps and opportunities to strengthen the enabling environment in each country and identify key stakeholders involved in building local AI ecosystems. • Explore sector-specific use cases and identify key requirements and considerations for their development, deployment and adoption.
Focus group discussions Between 12-16 experts in each country, including CSOs, non-governmental organisations (NGOs), academia, private sector and development partners.	• Bring stakeholders together to discuss early research findings at the country level and identify recommendations.
Expert Advisory Group (EAG) Eleven domestic, regional and global experts, including development partners, private sector, investors, industry associations and CSOs. EAG members were convened twice during the research through online meetings and interviewed individually.	• Provide guidance on key aspects to include and investigate for the research. • Provide country-level and sector-level guidance and expertise. • Share feedback and input on research findings.

Research scope and limitations

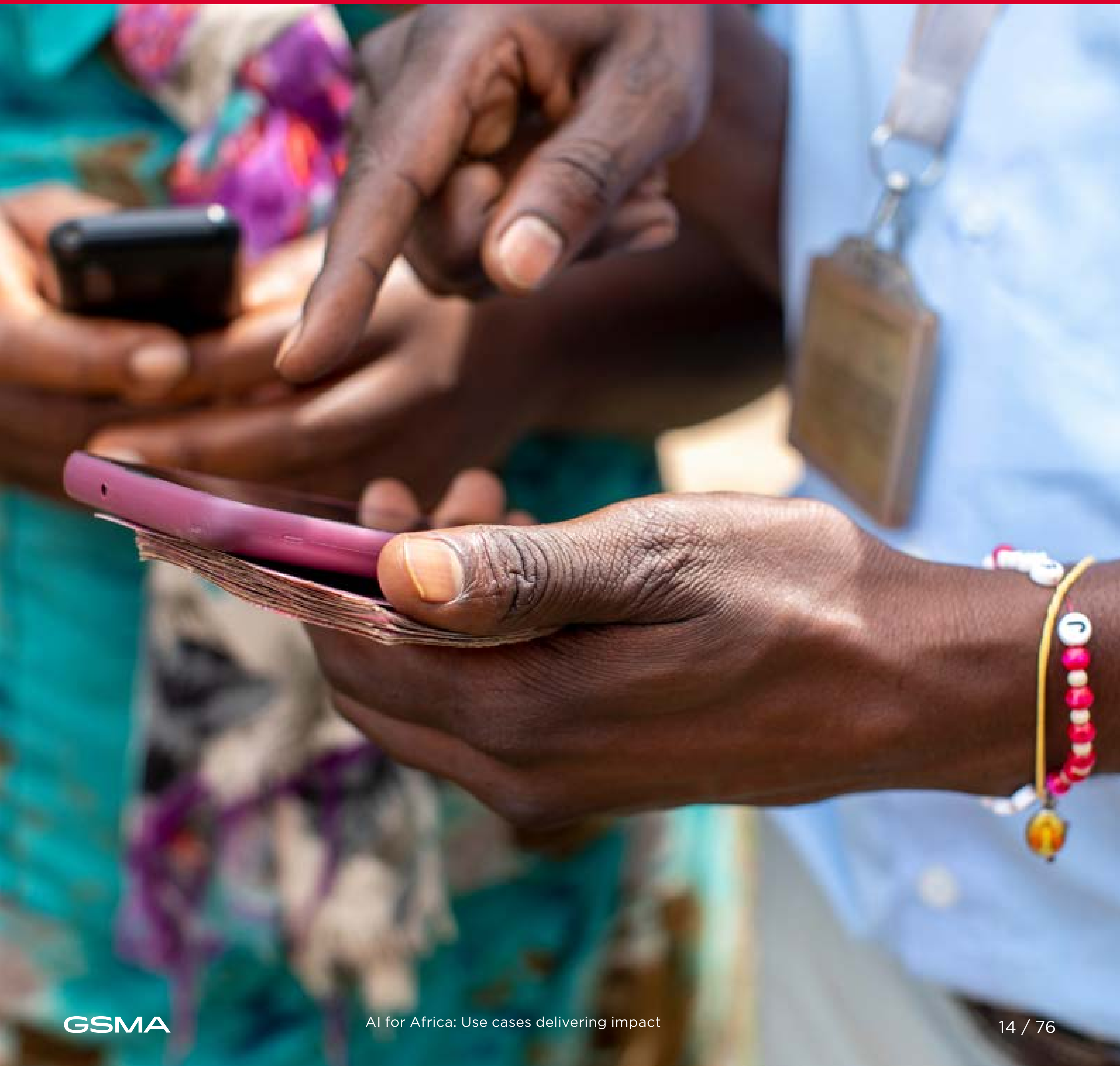
The research focuses on Kenya, Nigeria and South Africa while also including regional insights and trends. The report aims to identify maturing, developing, and emerging AI-enabled use cases and solutions deployed in these countries to address challenges related to agriculture and food security, energy, and climate action. It underlines the importance of local, inclusive, and sustainable AI solutions, i.e. developed with a deep understanding of the local context, culture, and needs of African communities, that are accessible to all segments of society, mitigate existing inequalities, and are sustainable in the long-term.

The research covers a broad range of stakeholders involved in building or using AI solutions. These include startups and large tech companies, as well as government agencies, NGOs, academia, and CSOs. In exploring AI use cases, we examine how these stakeholders are leveraging AI in different ways to improve the impact of and expand the reach of their products or services, understand their customers and target markets better, and to streamline internal operations and processes. The results span a wide range of use cases and applications developed with different models and approaches, including products and services, projects and programmes, and pilots.

The analysis of the use cases and their characteristics and requirements presented in this report are based on the limited sample identified through secondary research, key informant interviews, and focus group discussions conducted in the three countries and at a regional level. This research seeks to offer insights into AI use cases in the region but does not provide an exhaustive overview of AI solutions. Therefore, the findings are suggestive of emerging trends rather than providing definitive conclusions. Further research is needed to conduct a deep dive into the specific requirements, barriers, and inclusivity and ethics considerations in each of these sectors and countries in the development, deployment, and adoption of AI-enabled services.

This report explores the role that AI can play to address development challenges in agriculture and food security, energy and climate, and provides an assessment of the key pillars of the AI ecosystem in Africa and across Kenya, Nigeria, and South Africa. The report is complemented by three detailed **country-level reports** examining the potential of AI for development in Kenya, Nigeria, and South Africa. While the country reports delve into the geographical contexts and sector-specific use cases applications, this report seeks to introduce key concepts around AI and includes regional and cross-country insights and learnings.

3. Defining AI



What is AI?

AI can be defined as the ability of a machine or computer to perform tasks that typically require human intelligence. Algorithms serve as the backbone of every AI system, providing the instructions that guide the system to process and analyse data. These algorithms are tailored to the specific task at hand, such as recognising images or processing language. AI models are trained using vast datasets that represent the task or problem they aim to address and learning patterns from that data. One of the most prominent techniques used to train AI models is ML, which mirrors human learning processes by deriving insights from data through identification of similarities and relationships to make predictions and decisions.[13] Within the realm of AI and ML, predictive AI and generative AI are two different approaches to problem-solving, representing different techniques of creating, classifying, and analysing data.

Predictive AI is a branch of advanced data analytics that makes predictions using historical data combined with historical modelling, data mining techniques and ML. Predictive AI is designed to assess historical data, discover patterns, observe trends, and use that information to predict future trends. Popular predictive analytics models include classification (categorising data based on historical data), clustering (grouping data based on similar attributes), and time series models (using various data inputs at a specific time frequency).[14] Predictive AI has been a longstanding field within AI, but has seen significant advancements in recent years, particularly with the rise of deep learning and neural-network-based models.[15]

Generative AI is a newer field that involves generating new data or content based on user prompts and by learning from existing data patterns. Generative AI has received global attention with the launch of OpenAI's ChatGPT in November 2022, due its potential to democratise access to AI. By leveraging natural language processing (NLP) to extract meaning from text or speech, it reduces barriers to entry and expands the pool of potential users. Generative AI relies on large-scale foundational models, such as large language models (LLMs), which are trained on substantial volumes of data and possess a broad understanding of various domains, unlike traditional AI models that are task-specific and require extensive fine-tuning for different applications.[16,17]

AI has therefore created new opportunities to carry out a wide range of tasks. It encompasses various computer science fields and sub-fields, many of which have undergone extensive research over several decades. Regardless of the specific approach employed in AI system development, access to sufficient data, computing power and skills is essential. Recent advancements in AI have primarily been propelled by the availability of extensive datasets and robust computing resources, enabling models to be trained efficiently with large volumes of data within shorter timeframes.[18] However, these advancements have predominantly been driven by datasets from the Global North, which may not be appropriate or representative for African contexts, and carry inherent risks of exacerbating biases present in the data they are trained on. Ensuring the availability of locally relevant data and empowering local talent to process and analyse this data will be critical for Africa to harness the full potential of AI technologies while addressing the unique challenges and needs of the continent.

13 Microsoft. (2024). AI in Africa: Meeting the Opportunity.
14 IBM: What is predictive analytics?.
15 Deep learning is a subfield of machine learning, and neural networks make up the backbone of deep learning algorithms. It is the number of node layers, or depth, of neural networks that distinguishes a single neural network from a deep learning algorithm. See: IBM.
16 IBM. (2022). What are foundation models?.
17 eWeek. (2024). Generative AI vs Predictive AI: What's the difference?
18 Microsoft. (2024). AI in Africa: Meeting the Opportunity.

AI fundamentals in Africa

Data

The availability of extensive, diverse and representative data is a prerequisite for training AI models and ensuring they can derive valuable insights. Traditionally, data was collected manually and proactively, and often resulted in structured databases with predefined formats used for specific purposes. Digital technologies have enabled and accelerated the generation of new processes to collect data, contributing to the development of big data. Often these innovative datasets do not contain insights on their own, but rather must be analysed and complemented by other data sources to derive valuable insights. Five fundamental characteristics of data shape its usability and are crucial to effectively store, manage, and analyse data. These considerations also ensure data quality and reliability, ultimately harnessing the power of data to make informed and evidence-based decisions.

Figure 4

The five Vs of big data

	Volume	Velocity	Variety	Veracity	Value
Description	Amount of data generated, collected, and stored	Speed at which data is generated, processed, and analysed	Diversity of data types and sources, including structured data (e.g. databases) unstructured data (e.g. text, images), and semi-structured data (e.g. XML, JSON)	Accuracy, reliability, and trustworthiness of data	Usefulness and significance of data in deriving actionable insights
Implications	With the advent of emerging technologies, the volume of data being produced has grown exponentially	Real-time or near real-time data streams require rapid processing to extract actionable insights	Managing and integrating diverse data types is a challenge in advanced data analytics	Data quality issues, such as inaccuracies and data bias, inconsistencies, and incompleteness, can impact the reliability and relevance of analysis and decision-making	Data analytics fundamentally seeks to extract value from data to enhance decision-making processes

Source: GSMA AI for Impact

The spectrum of data necessary for AI for development spans across a multitude of sources and types, many of them overlapping. It includes, for example, socioeconomic data, geospatial and remote sensing data, domain-specific data such as climate and weather data or agronomic data, as well as language data.

These come in various forms, either structured and stored in a standardised format, or unstructured, such as text, images, or audio. Managing and integrating diverse data types makes it difficult in contexts with limited resources and data management capabilities.

Building AI solutions for Africa entails ensuring that these datasets reflect the complexities and nuances unique to the continent, rather than mirroring datasets from the Global North, which may not accurately capture African realities and could perpetuate biases. Prioritising the collection and utilisation of locally relevant data is an imperative. While there have been significant strides from governments, academia, CSOs and the private sector to increase data availability, high-quality and locally relevant data remains limited or difficult to access and constitutes a barrier to the development and scaling of AI solutions.

Figure 5

Examples of data types and sources for AI for development

Raw data*	Collection method/device	Providers/data sources
Socio-economic data	Household surveys	Government agencies (e.g. Bureau of Statistics)
Geospatial and remote sensing data	Satellites, aircrafts, drones with high-resolution cameras	Space agencies, commercial satellite imagery providers, mapping companies
Domain-specific data (e.g. agriculture, energy)	IoT sensors, smart meters, secondary data (e.g. advisory content)	Government agencies, research institutions, agritech companies, private weather data organisations
Language data	Secondary data (e.g. research outputs), recording devices	Big Tech, social media platforms, academic and research institutions, government agencies, NGOs, CSOs

*non-exhaustive examples

In addition to the various types of data necessary for training AI models, there is a critical need for data that accurately represents different demographic groups, particularly gender-disaggregated data. The datasets used to train AI algorithms often mirror existing societal inequalities. Women in Africa, for instance, are at heightened risk of experiencing AI bias because they have historically been underrepresented in datasets, which is exacerbated by the insufficient collection of gender-disaggregated data in African countries. Without sufficient data on African women, algorithms are more likely to perpetuate or even amplify biases against them.[19]

Figure 6

Generation and usage of datasets globally

Note: This map shows how often 1,933 datasets were used (43,140 times) for performance benchmarking across 26,535 different research papers from 2015 to 2020. Countries are distorted by frequency of usage. Data sets originating in the US account for the most usages (26,910).
Source: Mozilla Foundation

Governments have committed to expanding data availability in Africa and building open-source datasets. Government initiatives include Kenya's Open Data Initiative, Nigeria's Open Data Development Initiative, and South Africa's Open Data Portal, which aim to democratise access to government data. However, these governments lack expertise and resources for data curation, resulting in datasets that are not regularly updated and are often incomplete or not available in usable formats. This limits their relevance and usability for local developers and researchers. Challenges also persist in ensuring cybersecurity and personal data protection due to inadequate legislation and a low level of public awareness.[20]

Domain-specific data is critical to tailor AI solutions that are relevant and impactful within a given domain. While locally relevant domain-specific data is increasingly available, it is often built for specific use cases and remains limited in scale. Most accessible domain-specific data is from the Global North, which is inadequate for African contexts. For example, AI solutions for agricultural advisory services should be based on data from local farming practices and incorporate insights from African scientific publications in agronomy, but these are largely unavailable or difficult to access. As a result, agritech startups allocate their limited resources to building new data or engaging in partnerships to fine-tune existing AI models.

19 UNESCO/OECD/IDB. (2022). The Effects of AI on the Working Lives of Women.
20 Positive Technologies. (2023). Cybersecurity threatscape of African countries 2022-2023.

The availability of high-resolution remote sensing data has accelerated but remains in the possession of international space agencies and large tech companies. This prevents a lack of level playing field in data access and use, giving these entities a substantial edge over small organisations and startups. The world space economy is estimated at $400 billion, but Africa only controls $200 million of that economy.[21] To address this, specialised organisations such as Digital Earth Africa make Earth observation data free and accessible, translating satellite data into decision-ready information that provides insights into a range of issues.[22] In 2023, NASA and IBM released an open-source geospatial model with a wide range of potential applications, such as tracking changes in land use, monitoring natural disasters, and predicting crop yields.[23]

One of largest gaps in the availability of data is language (Box 1). The adoption and usage of AI-enabled services largely depends on their relevance to potential users. This entails offering solutions in local languages to ensure inclusivity and accessibility, in addition to other considerations such as user-friendliness and relevance of the service. In addition, emerging language-based generative AI solutions, which represent a leap for the democratisation of AI, operate on user prompts. This means that AI models need to be trained on local languages for NLP, but language datasets remain limited in Africa.

There are untapped opportunities to leverage data from the private sector. For example, MNOs have vast amounts of data, such as voice recordings on call detail records (CDR), that could be used to build and train locally relevant LLMs. This data is likely to reflect a diverse range of accents and linguistic nuances, providing valuable insights into local language use. Mobile big data, once aggregated and anonymised, could also be integrated to geospatial models and provide insights to inform energy planning as well as disaster risk management.[24] However, the lack of clear data-sharing frameworks gives rise to uncertainty about how data can be shared with external parties, what privacy protections are required, and what liability may arise, which can deter MNOs from engaging in data-sharing partnerships. The lack of viable commercial return also acts as an important barrier. There are internal trade-offs that must be made and ultimately could lessen the potential of mobile big data to inform and drive AI models.[25]

It is crucial to ensure that shared data fully complies with existing data privacy and protection regulations and follows best practices, such as anonymisation. Robust enforcement of personal data and privacy laws, along with provision of clear guidance on data-sharing for the private sector, would facilitate data-sharing for AI applications. The GSMA AI for Impact initiative[26] has developed the Mobile Privacy Principles, which describe the ways in which the privacy of mobile consumers should be respected and protected when they use mobile apps and services that access, use or collect their personal data. Previous research also examines how these principles are applied in the context of mobile big data.[27] More broadly, it is important to adhere to data standards such as the globally recognised FAIR Principles, Findability, Accessibility, Interoperability and Reusability.[28] GIZ's AI Practitioners Guide also details best practices in data collection, data storage, and data access and use.[29]

21 The Africa Report, 2023. Kenya's Taifa-1, the first satellite designed locally, rockets into the space economy.
22 Digital Earth Africa.
23 Earthdata. (2023). NASA and IBM Openly Release Geospatial AI Foundation Model for NASA Earth Observation Data.
24 GMSA. (2019). Mobile Big Data Solutions for a Better Future.
25 GSMA. (2018). Scaling Big Data for Social Good: The need for sustainable business models.
26 The AI for Impact initiative develops global partnerships to accelerate action and achieve impact in alignment with the SDGs. A taskforce of mobile operators and an advisory panel of UN agencies and partners define the technical, commercial and ecosystem requirements to deliver viable data-driven products and services that adhere to principles of privacy and ethics.
27 GSMA. (2016). Mobile Privacy Principles: Promoting consumer privacy in the mobile ecosystem.
28 Go Fair: Fair Principles.
29 Data4SDGs. (2023). Artificial Intelligence Practitioners' Guide: Kenya.

Box 1

Building local language datasets: Challenges and opportunities

Language-based generative AI solutions in Africa are limited by the scarcity of language corpora, non-fixed spelling, and few academic definitions of local languages. Existing LLMs are primarily trained on data from Western and English-speaking countries that are not representative of regional realities and lead to biases and inaccuracies when used in African contexts.

Figure 7

Prevalence of internet content in African languages compared to global benchmarks

(% of internet content in language, 2023)

Global Benchmarks	English	52.60%
	Hindi	0.10%
Top African Languages	Afrikaans	0.003%
	Twi	0.00195%
	Swahili	0.00135%
	Malagasy	0.00022%
	Bambara	0.00025%
	Venda	0.000115%
	Hausa	0.00011%
Average with other African languages*		0.000999%
Sum of African Languages		0.01999%

African languages
0.02%

2,650 x
more content
in English than
African languages

*Afrikaans, Twi, Swahili, Bambara, Malagasy, Hausa, Venda, Haitian, Haitian Creole, Igbo, Luba-Katanga, Ndonga, Kirundi, Tokelau, Tswana, Akan, Chichewa, Chewa, Nyanja, Fulah, Ganda, Masai

Source: AI4D Africa

Building a language corpus for local languages can increase AI usage at the last-mile but presents several challenges. Developing a comprehensive corpus that encompasses all these languages is an enormous and intricate task that requires a wide range of expertise. Each language, with its own unique syntax, semantics, and idiomatic expressions, requires individual attention and tailored datasets. Initiatives like Mozilla Common Voice have recently achieved a milestone by expanding its open-source language dataset to include 100 languages. However, such initiatives are often dependent on grants and donor funding, posing limitations to their sustainability and potential for impact at scale.

Conventional data collection methods have traditionally neglected the requirements of end users, instead prioritising academic or urban-centric datasets. Fine-tuning existing LLMs, or building alternative models, requires collecting data that authentically captures the nuances and diversity of language usage, particularly at the grassroot level. There is a need for bottom-up approaches, encouraging community involvement in data collection through techniques such as voice journaling to ensure the data accurately reflects their lived experiences. Voice journaling builds language data using voice recordings, via recording devices or mobile phones. It is particularly valuable in contexts where literacy rates are low and to capture the diverse range of accents, dialects, and ways of speaking prevalent within a community or region.

Infrastructure and compute

Unlocking the potential of AI requires access to the underlying infrastructure and computing power to train AI models. Infrastructure encompasses physical components, including facilities with storage capacity such as data centres, as well as broader enablers, such as reliable electricity and the availability of high-speed broadband and mobile internet. Computing power refers to hardware and software enablers like high-performance computing (HPC), GPUs and cloud computing systems. Together, these enablers allow for the storage capacity and computing power required for processing complex algorithms, analysing vast datasets, and executing advanced AI applications and models.

Emerging technologies like AI need lower latencies[30] than those tolerated by applications now, which entails bringing more of the internet's capabilities closer to its edge (i.e. users). The edge is where data is produced and consumed, and where much of it is processed by the chips in phones and laptops. While hyperlocal processing power is generally adequate for certain uses like ready-to-use AI applications, tasks that involve training AI models, such as geospatial foundational models and weather forecasting models, often require a level of computational capacity that surpasses what personal devices can provide, hence the need for cloud-based computing, where large volumes of data are crunched in data centres.[31]

Box 2

What are the benefits of edge computing?

Edge computing complements traditional cloud computing by providing a decentralised and responsive approach to data processing, and has several benefits:

- **Low latency:** By processing data closer to the point of generation, edge computing reduces the time it takes for data to travel between devices and central servers, resulting in lower latency.
- **Bandwidth efficiency:** Edge computing can help optimise network bandwidth by processing and filtering data locally before transmitting only relevant information to the central cloud.
- **Real-time processing:** Applications that require real-time or near real-time processing can benefit from the localised computation offered by edge computing.
- **Privacy and security:** Edge computing can enhance data privacy and security by keeping sensitive information closer to its source and reducing the need for extensive data transmission over networks.

Africa has fewer data centres than it needs, which means that data is often hosted on distant servers and travels through underwater fibre-optic cables. Submarine cables are the backbone of the digital economy, carrying almost 99% of the world's internet traffic. Yet Africa is connected to just a handful of these cables, with five submarine cables spanning its western coast from South Africa to Nigeria. This means that the continent is particularly vulnerable to disruption in these networks, unlike other parts of the world that have robust network redundancy and where traffic can easily be rerouted. Limited data storage capacity in Africa means that it depends more heavily on these few submarine cables.[32] It is estimated that African countries will need to more than double their data centre hosting capacity by 2030.[33]

30 Latency refers to the time it takes for data to travel from its source to its destination and back again. In networking, computing and communication systems, latency can impact the speed and responsiveness of interactions. Lower latencies indicate faster response times, improving user experience, while higher latency can lead to delays and slower performance.

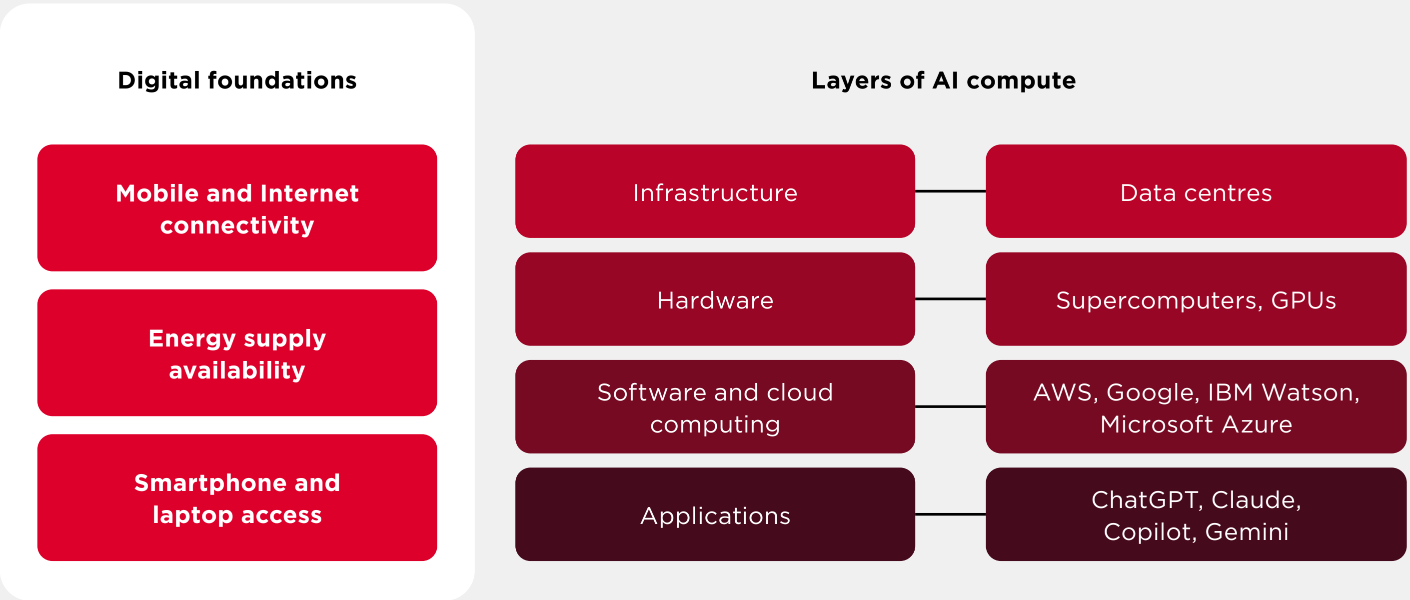
31 The Economist. (2024). The internet got better and faster by moving data closer to users.

32 The Economist. (2024). Damage to undersea cables is disrupting internet access across Africa.

33 AI4D Africa (2024). AI in Africa: The state and needs of the ecosystem.

However, local storage capacity is rapidly expanding across the continent. South Africa and Nigeria, for example, are considered 'rising giants' in terms of compute capacity.[34] South Africa has one of the two supercomputers in Africa—the other one being in Morocco[35]—and more than two-thirds of the continent's capacity sits within the country. Nigeria's data centre capacity is also accelerating, driven by private sector investments.[36] Of the 20 African countries with the greatest demand for cloud infrastructure, Nigeria is projected to require the lion's share (20%) of investment required by 2030. Kenya is in the early stages of its compute development, but benefits from increasing investments to build data centres.[37] The country is also a regional tech hub and benefits from the presence of various Big Tech players with cloud computing resources.

Figure 8
AI infrastructure and compute layers



As AI applications become more complex and widespread, the energy demand of data centres will escalate. To mitigate these impacts, there is a growing emphasis on making data centres more energy efficient. Data centres such as Amazon Web Services (AWS) in South Africa and Africa Data Centres in Nigeria are exploring renewable energy sources, while in Kenya, Ecocloud Data Centre is the first African data centre fully powered by geothermal energy. Countries in Sub-Saharan Africa can develop strategic partnerships and investments with leading technology companies, not only to bridge infrastructure gaps, but also to develop sustainable compute technology. Given their lower dependency on fossil fuels compared to other regions globally, these countries have the potential to champion innovative, environmentally friendly data centre infrastructure and pioneer new approaches to clean computing.[38] For instance, over 90% of Kenya's energy is generated from renewable sources.[39]

34 Tony Blair Institute for Global Change. (2023). State of Compute Access: How to Bridge the New Digital Divide.
35 University Mohammed VI Polytechnic. (2021). UM6P launches the Data Center and Africa's most powerful SuperCalculator for scientific research and innovation.
36 TechCabal. (2024). Nigeria's 8 subsea cables spur new investment in hyperscale data centres.
37 Tony Blair Institute for Global Change. (2023). State of Compute Access: How to Bridge the New Digital Divide.
38 Ibid.
39 Economist Intelligence. (2023). Investor interest in Kenya's renewable energy sector rises.

Despite expanding capacity, the high cost of hardware still constitutes a barrier to the development and deployment of AI by local actors with limited financial resources. While the absolute costs of compute are similar across regions, they are disproportionately high for African practitioners when considering income levels. In South Africa and Kenya for instance, the price of a GPU represents 22% and 75% of GDP per capita respectively, making it nine and 31 times more expensive than in high-income countries.[40] The demand for GPUs has driven up costs, with Nvidia's most powerful GPUs selling for as much as $40,000. This trend exacerbates inequalities in access to computing resources, particularly with Big Tech companies like Meta spending several billions of dollars to acquire GPUs.[41]

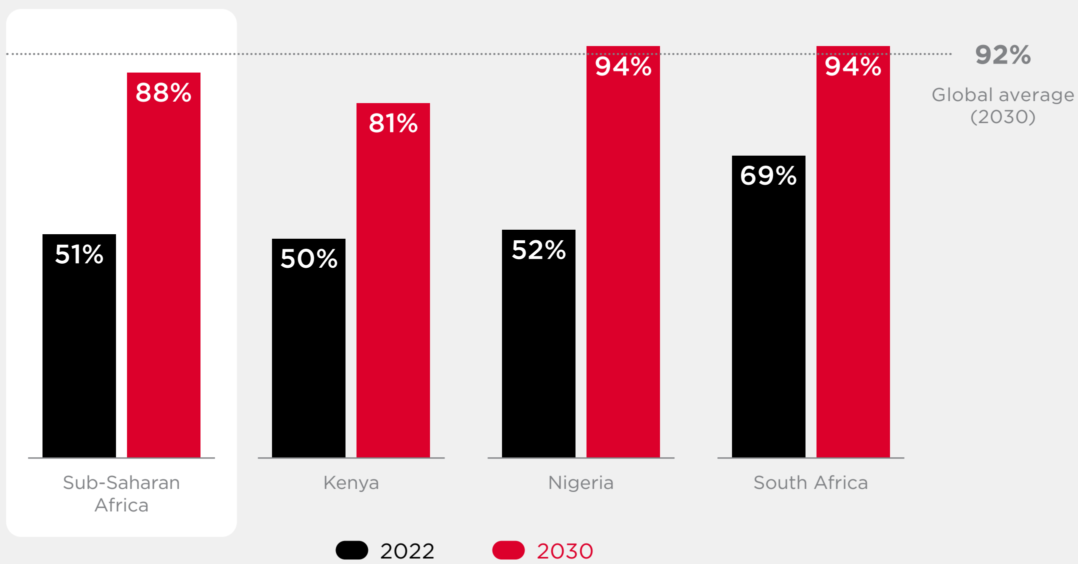
In some cases, large tech players with a local presence such as AWS, Google and Microsoft fill in some gaps by providing free access to cloud computing to ecosystem actors under credit mechanisms. The Kenya Education Network also provides computing power to AI researchers, while the National Centre for Artificial Intelligence and Robotics recently procured GPUs in Nigeria. In South Africa, Microsoft has expanded the cloud services available for public and private sector organisations in its data centres in Johannesburg and Cape Town.[42] While helpful, these initiatives remain insufficient and limited in scope, and addressing affordability challenges will be critical in the long term.

As local compute ecosystems continue to develop, countries in Sub-Saharan Africa have an opportunity to tap into their mobile-first markets to build capacity into distributed, or hyperlocal, edge computing, where tasks take place entirely on devices such as phones and laptops, to reduce reliance on high-powered data centres. Smartphones can act as a second best solution for edge computing in low-resource environments. After large amounts of data have been trained on foundational models, AI models can be transferred to smartphones for fine-tuning. Some ready-to-use AI applications can also be run directly on smartphones, such as image recognition in agriculture. Smartphone penetration stands at 51% in Sub-Saharan Africa and is expected to reach 88% by 2030, creating opportunities for mobile-based edge computing.[43]

Figure 9

Current and projected smartphone adoption by country

(% of connections, 2022 vs. 2030)



Source: GSMA Intelligence

40 AI4D Africa. (2024). Compute - AI in Africa: The state and needs of the ecosystem.
41 DCD. 2024. Meta to operate 600,000 H100 GPU equivalents of compute by year-end.
42 Microsoft (2022). Microsoft expands cloud services in South Africa data centres to drive growth and competitiveness.
43 GSMA. (2023). The Mobile Economy Sub-Saharan Africa 2023.

> "If we equip people with better phones and provide adequate financing, we could shift the focus and invest in better computing at the edge rather than computing in the cloud."
>
> **– Agritech Startup in Nigeria**

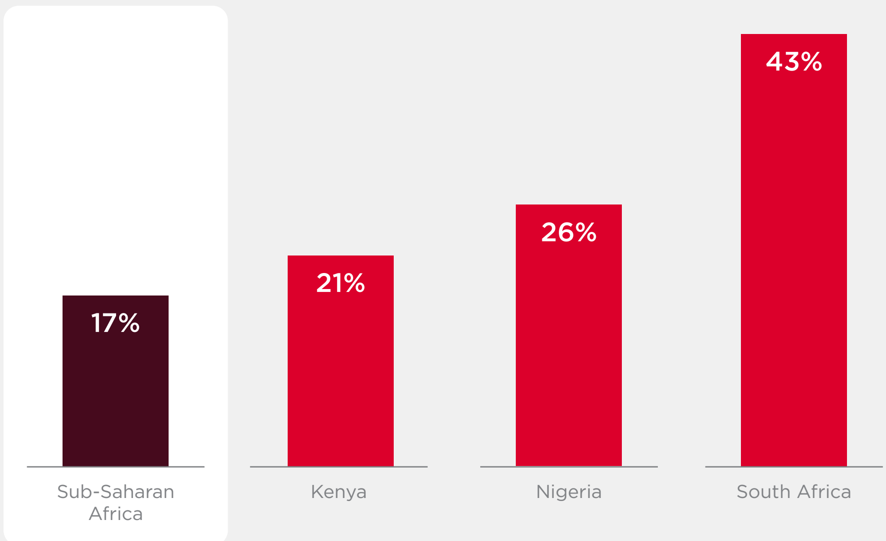
Despite the projected growth of smartphone adoption, many will continue to be lower-grade smartphones with inexpensive chips, on which AI applications do not work. Smartphone adoption is less likely among marginalised groups such as women, persons with disabilities or those living in rural areas. Finding ways to reduce the cost of mobile devices and support device financing will be critical to ensure more equitable access to mobile devices for all segments of society. Similarly, making devices work for low-resource settings will be essential to ensure usage in rural areas with low connectivity. While 5G is expected to grow, many rural areas will still depend on older network generations, especially countries like Nigeria with significant infrastructure gaps. In Kenya, deep tech startup Fastagger is developing a software infrastructure that allows ML and AI models to run directly on edge devices, including on lower-end smartphones (→ ***Spotlight in Kenya report***).

Increased connectivity significantly enhances edge computing capabilities by reducing latency and allowing real-time processing. The adoption of 4G has accelerated in recent years across Sub-Saharan Africa and is expected to more than double to 45% over the next five years. Momentum for 5G is also growing and Sub-Saharan Africa is expected to have 226 million 5G connections in 2030, equivalent to an adoption rate of 17%. Nigeria and South Africa will account for almost half of these connections. As a larger share of the customer base will continue to migrate to 4G, 5G growth in the region will be slow but steady. In addition, mobile data traffic is expected to quadruple in the region over the next five years.[44]

Figure 10

Projected percentage of 5G connections by country

(% of connections, 2030)



Source: GSMA Intelligence

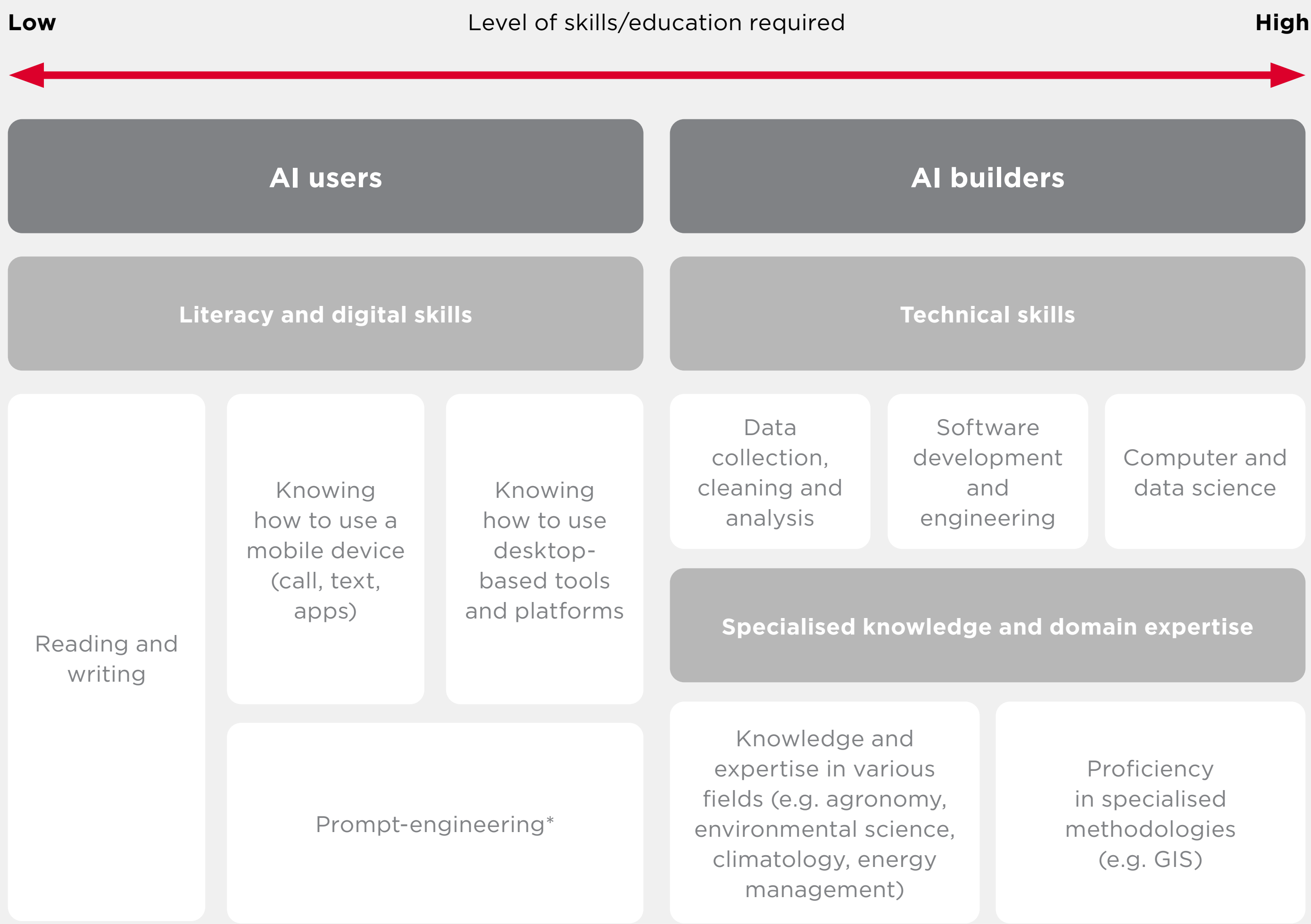
44 GSMA. (2023). The Mobile Economy Sub-Saharan Africa.

Capacity and skills

AI skills encompass a range of competencies required to understand, develop and use AI-enabled products and services. While AI builders require a wide range of technical skills and specialised knowledge, end users typically only interact with the end-product and require basic digital skills and literacy rather than technical skills.

Figure 11

Skillsets required by AI builders and AI users



* Prompt-engineering is defined as the practice of designing inputs for generative AI tools that will produce optimal outputs.[45]

45 McKinsey. (2024). What is prompt engineering?

AI builders

Building and developing AI solutions entails a wide range of technical skills including programming and software development, mathematics and statistics, ML and data science. Institutions like Strathmore University in Kenya, Covenant University in Nigeria, and the University of Pretoria in South Africa have updated their curricula to incorporate AI-related courses and programmes. However, courses often fall short of adequately preparing students for the demands of the industry, leading to a critical mismatch between the skills available on the market and employer expectations.

Universities fail to keep pace with the rapidly evolving tech industry and sometimes provide outdated educational content. In Kenya and Nigeria, the scarcity of professors with robust AI expertise and qualifications appears to be a significant challenge. Academic institutions typically lack the financial resources to recruit them, impacting the quality of courses offered. Consequently, students may end up learning concepts that are no longer relevant or missing out on crucial advancements. In addition, the focus is often on software development and engineering as a proxy for AI skills, with little consideration for complementary skills. For example, experts in Kenya and Nigeria pointed out that students lack robust understanding of the mathematical foundations essential to data science. Some universities on the continent, however, such as Dedan Kimathi University of Technology (DEKUT) in Kenya and Carnegie Mellon University in Rwanda, are renowned for training data scientists from Africa to international levels.

The lack of opportunities to practically apply skills and gain hands-on experience is also a major barrier. Resource constraints, such as limited access to laptops and high connectivity, prevents students from applying their theoretical knowledge. In addition, limited collaboration between industry and academia restricts their engagement with the private sector and exposure to industry challenges. As a result, the pipeline of skilled AI professionals remains limited and local tech startups struggle to find the right talent. Large tech companies such as Microsoft or IBM also encounter difficulties in securing the necessary expertise and have to account for longer and more comprehensive training programmes when hiring talent from within the region. While they can afford to do so, this is often not the case for local startups. This trend is exacerbated by the global demand for AI professionals, resulting in a brain drain that further reduces the pipeline of AI talent in African countries.

Large tech players, industry associations and CSOs are working to address these challenges by offering upskilling programmes and certifications. In Nigeria for example, Data Science Nigeria (DSN) offers free training sessions in AI, data science and digital skill-related classes (→ ***Spotlight in Nigeria report***).[46] The African Institute for Mathematical Science (AIMS), a pan-African initiative, provides mathematical science training across various African countries, including South Africa. In addition, access to online resources, ranging from YouTube tutorials to online certifications, facilitates self-learning and can contribute to skills enhancement. Through its AI Skills Initiative, Microsoft offers free courses to learn how to harness the power of AI and drive Africa's growth in the digital age.[47]

Beyond technical skills, there is also a need to develop multidisciplinary skillsets and incorporate AI skills into various fields to address societal challenges. While data scientists bring significant technical expertise, they tend to lack the sectoral knowledge and experience required to understand the wider context, opportunities and risks around AI. For example, while computer scientists and engineers take the lead in building LLMs, the support of linguists and anthropologists is important to ensure linguistic nuances and cultural sensitivities are included in the datasets used to train the models. Similarly, developing climate and environmental forecasts requires domain experts that can bring a wealth of knowledge in climatology and meteorology as well as proficiency in leveraging remote sensing techniques and Geographic Information Systems (GIS) methodologies. Increasing gender diversity among AI workers is also essential to reduce the likelihood of biased algorithms that perpetuate existing gender disparities. A more balanced gender perspective is needed in the design and development of AI but is limited by the low uptake of STEM education among women in Africa.[48]

To ensure the responsible and safe use of AI, there is also a need to build capacity among policymakers and members of the judiciary. The UNESCO has developed a framework for the digital capacity building of governments, focusing on the aspects including data use and governance, systems thinking, AI fundamentals, and privacy and security.[49] It is essential to build awareness about AI and its implications for policymaking and governance among these stakeholders, to ensure that principles of responsible and ethical AI are safeguarded effectively.

AI users

By contrast, end-users do not necessarily need advanced technical or digital skills but do require some foundational level of digital literacy, including an understanding of how their data is being used by the applications they access. They are more likely to use the end-product and services delivered through channels such as digital platforms, mobile applications, or SMS notifications. Adoption and usage of AI-enabled applications therefore requires literacy and digital skills such as reading and writing, and knowing how to use a mobile device for calls, messaging and apps. It also entails making these solutions relevant and easy to use, providing relevant information, products and services that meet users' needs and capabilities and that are available in local languages.

> "When it comes to the potential of AI in Africa, the technology will only be adopted and relevant if it is invisible for people to use. You use AI for better decision-making and for it to be useful, it has to be invisible and easily accessible."
> **– AI Startup in Kenya**

46 Data Science Nigeria: DSNai.
47 Microsoft Corporate Social Responsibility: AI skills.
48 UNESCO/OECD/IDB. (2022). The Effects of AI on the Working Lives of Women.
49 UNESCO: Digital Capacity Building for Governments.

Emerging AI-enabled solutions such as generative AI represent a leap for the democratisation of the technology as it eliminates the need for specialised knowledge to leverage AI capabilities.[50] Through natural language, it enables almost anyone with access to a mobile device to interact with AI systems without coding and to create results without technical expertise. By asking a question in their native language, users can create content and summarise data. This broadens the reach of AI beyond technical experts to include anyone with internet access and a mobile device.[51] Generative AI solutions thus require digital skills and literacy, as well as the awareness and ability to carefully craft input prompts, referred to as prompt-engineering.[52] For example, prompts should include a clear instruction and encourage logical reasoning, instructing the model to break down instructions into a logical progression of separate tasks.

Figure 12

What makes a good prompt?

"What should I do to improve my crop yields?"

The prompt is too broad and does not provide enough context about the specific crop, current practices, or challenges the farmer is facing. This makes it difficult for the gen-AI solution to generate relevant and actionable advice.

"I'm growing avocados and I want to improve my productivity. I've started using fertilisers. What do you recommend as my next steps?"

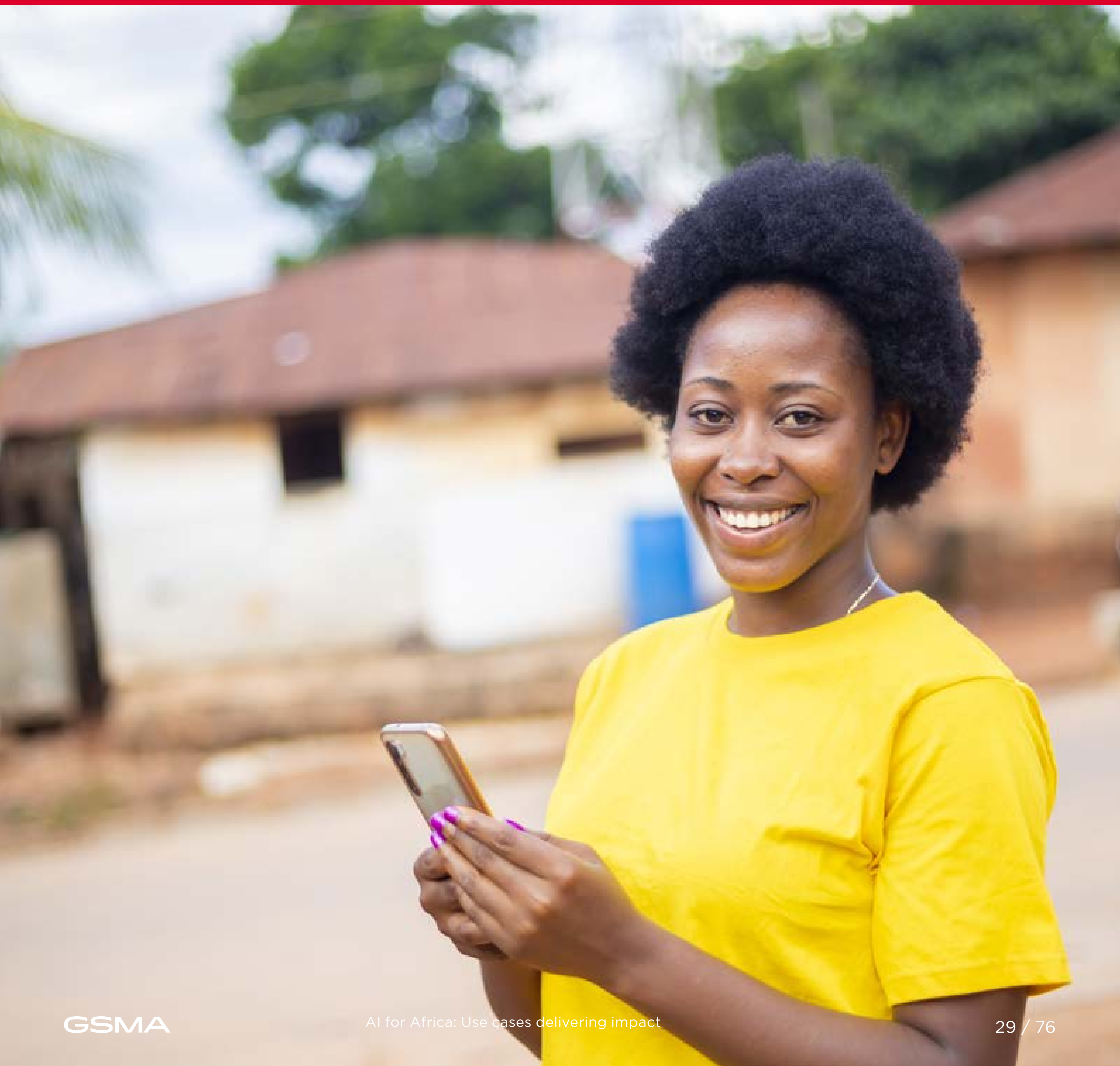
The prompt specifies the crop and provides context about the farmer's current practices. This allows the model to generate tailored recommendations based on the farmer's situation and objectives.

In Kenya, Nigeria and South Africa, however, literacy and digital skills remain a challenge, especially for marginalised groups. Lack of knowledge and skills is one of the greatest barriers to adoption and use of digital tools and services, which is likely to have an impact on the ability of people to use AI-enabled applications. According the 2023 GSMA Consumer Survey, literacy and digital skills continues to be one of the most reported barriers to mobile internet adoption, with 42% of men and 51% of women citing difficulties with reading and writing as a challenge in Nigeria.[53] Those who are more likely to report this barrier tend to be poor, women, living in rural areas and over the age of 35 years old. Structural inequalities such as poverty, access to quality education and schools, or opportunities to learn digital skills are disproportionately present in these groups.

This emphasises the need for targeted training programmes and alternative voice-based solutions to reach the underserved and ensure they understand and can benefit from the transformative potential of AI-enabled solutions. Governments, the private sector, and CSOs fill some of the gaps through targeted initiatives, but these are often small-scale and limited in scope, with lower potential for structural change. Multi-stakeholder collaboration and coordination efforts will be critical to address these systemic challenges. For example, the GSMA launched the Mobile Internet Skills Training Toolkit (MISTT) to teach people basic skills to access and use mobile internet.

50 Microsoft. (2024). AI in Africa Meeting the Opportunity.
51 Ibid.
52 The Economist. (2024). What is prompt-engineering for artificial intelligence?
53 GSMA. (2024). The Mobile Gender Gap Report 2024.

4. Use cases delivering impact



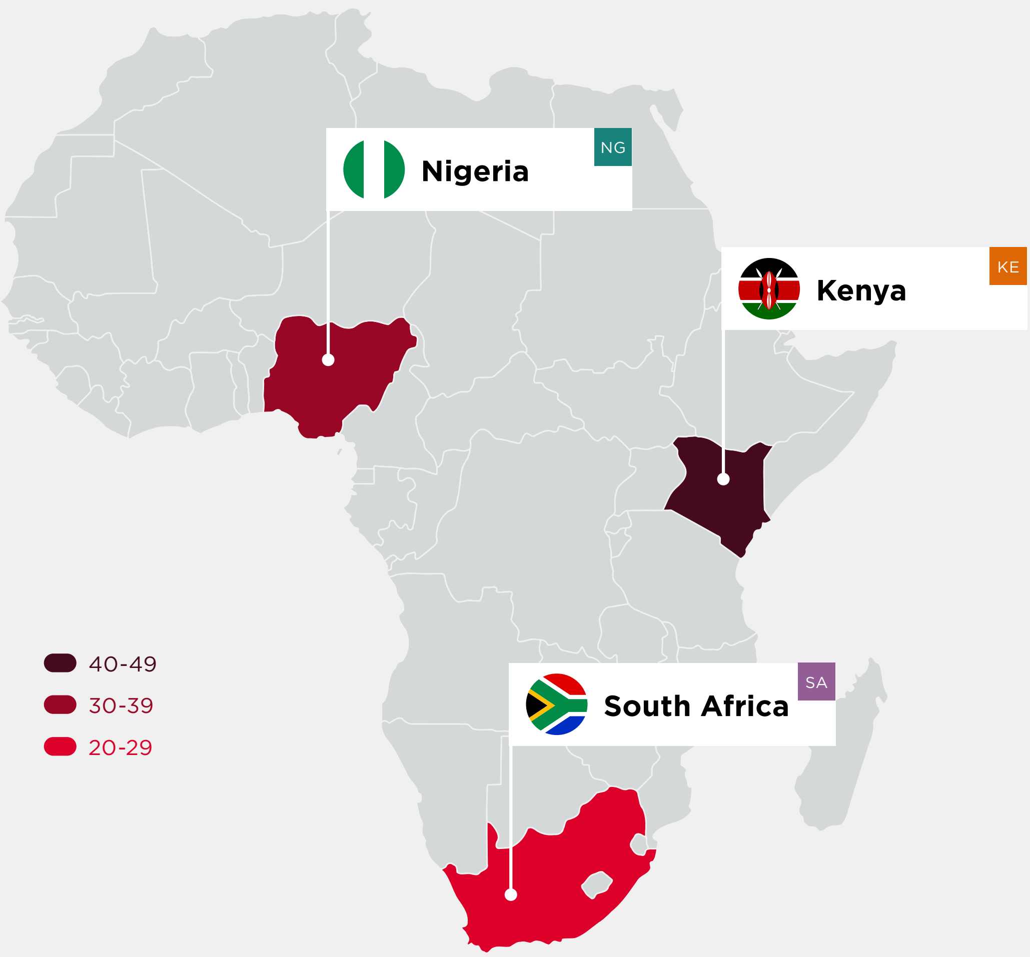
Key trends across use cases

We identified over 90 use case applications across Kenya, Nigeria and South Africa. The distribution of solutions shows the dominance of Kenya, followed by Nigeria, in the deployment of AI use cases for development. While both countries have a thriving and diverse tech ecosystem, they also face considerable development challenges with less mature economies, compared to South Africa, which has more AI applications in non-development sectors. Our analysis shows that the use case applications have diverse characteristics across multiple dimensions: sector, type of AI, type of organisation, ownership, and type of solution.

Figure 13

Distribution of use case applications by country

(number of applications identified in agriculture and food security, energy and climate)



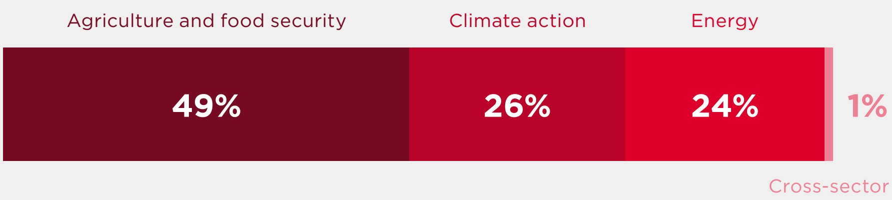
Sector

Almost half of the AI applications featured are in the agriculture sector, followed by energy and climate action. AI applications for agriculture are particularly dominant in Kenya and Nigeria, accounting for around half of the solutions in both countries. This reflects the significant role that agriculture continues to play in Kenya and Nigeria, in contrast to South Africa, which benefits from a more industrialised economy. Energy is the second most represented sector in Nigeria, reflective of the considerable challenges the country faces in terms of infrastructure gaps and power reliability and the potential for off-grid energy solutions. South Africa and Kenya have multiple climate-related AI applications and fewer energy solutions, compared to Nigeria where most climate solutions are related to agriculture or energy. There is also one cross-sector solution, Viamo, which enables digital inclusion for those traditionally left behind (Box 3).

Figure 14a

Allocation of use cases by sector

(% of total use case applications)



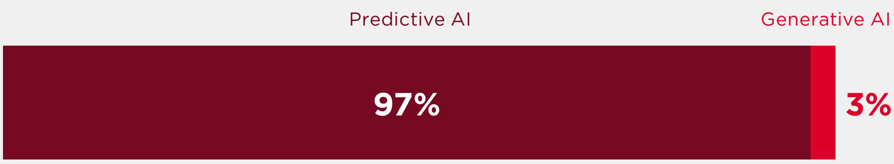
Type of AI

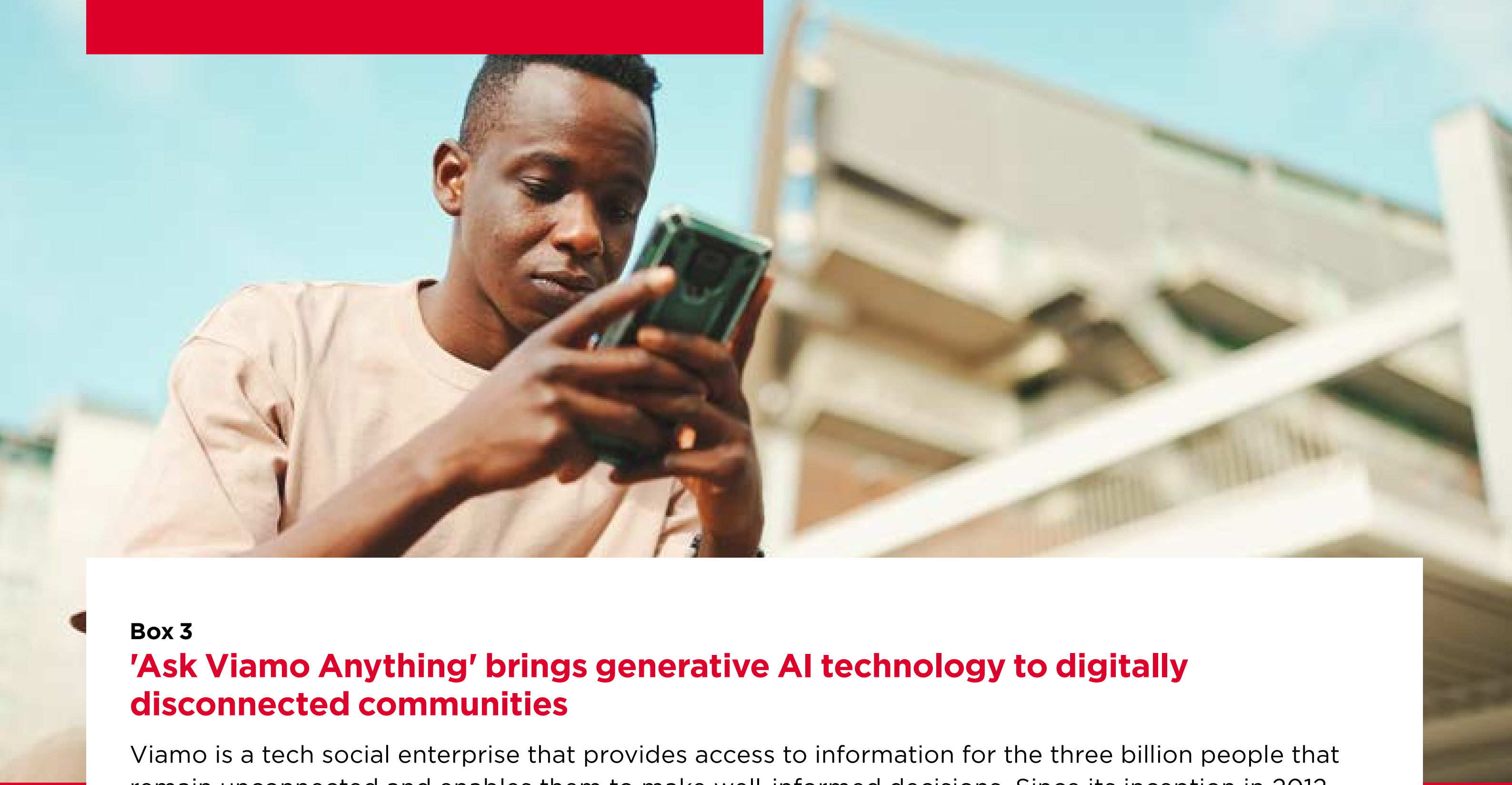
An overwhelming majority of use case applications fall under predictive AI. The dominance of predictive AI from the sample may relate to several factors, including the availability of historical datasets, ease of applicability and lower computational requirements compared to generative AI models. Predictive AI models are widely used for tasks such as forecasting, risk assessment, and anomaly detection such as forecasting weather patterns, optimising crop yields, predicting food supply and demand dynamics, and optimising energy consumption and production. We identified only three generative AI solutions: Viamo, Digital Green (→ ***Spotlight in Kenya report***) and Crop2Cash (→ ***Spotlight in Nigeria report***). This is likely to reflect trends in the region given how nascent generative AI is, but its applicability across sectors means that further investment could lead to significant advancements spanning a range of areas.

Figure 14b

Allocation of use cases by type of AI

(% of total use case applications)





Box 3

'Ask Viamo Anything' brings generative AI technology to digitally disconnected communities

Viamo is a tech social enterprise that provides access to information for the three billion people that remain unconnected and enables them to make well-informed decisions. Since its inception in 2012, Viamo has been developing a platform to allow anyone with a feature phone to receive and interact with information through Interactive Voice Response (IVR), by leveraging partnerships with MNOs.

In 2023, Viamo launched a generative AI voice assistant called Ask Viamo Anything on its existing platform in Zambia. Ask Viamo Anything provides free access to crucial information via the latest AI technology for the digitally disconnected. The technology works on feature phones without internet access, and can be used by people with low literacy, leapfrogging text-based and internet-dependent approaches and democratising access among those traditionally left behind, such as women or persons with disabilities, many of whom have limited smartphone and mobile internet access.[54,55]

Viamo expanded the pilot to Nigeria,[56] and as of March 2024, the service is available to about 1,500 Viamo users in Nigeria.[57] The potential for scale is large, as Viamo already has 1.35 million users on its Nigeria platform, representing 20% of its platform users globally.[58] Results from the two pilots revealed that women are particularly active users, asking about 50% and 30% more questions than men in Zambia and Nigeria respectively.[59] Ask Viamo Anything allows users to leverage generative AI for their own self-efficacy, leading to significant behaviour change and improved decision-making among vulnerable populations. Viamo already pilots Ask Viamo Anything on its platforms in DRC and Pakistan and will ultimately make the service available in the 25 countries it currently operates in. Viamo is also developing a specialised version of the service to provide expertly vetted answers, such as agricultural questions posed by farmers.

The availability of domain-specific and local language data is critical to the functionality of the voice solution to ensure it can provide contextually relevant information in users' local languages. To achieve this, Viamo collaborates with international development partners such as UNICEF, USAID and Mercy Corps to develop content that addresses various topics, including HIV, tropical diseases, nutrition, and water and sanitation, among others. Remaining barriers lie in obtaining sufficient language data, as most knowledge bases are currently available in English and French, and some in Swahili. Viamo is exploring the creation of multi-language knowledge bases and advocating to build momentum around the creation of open-source language datasets to democratise access to information.

54 Ask Viamo Anything.
55 The Africa Report. (2024). Viamo to offer free ChatGPT-driven information for Africans with basic phones.
56 YouTube. (2024). AI-backed phones offer solutions in Nigeria | World of Africa.
57 The Africa Report, (2024). Viamo to offer free ChatGPT-driven information to Africans with basic phones.
58 Viamo. CEO Annual Letter: Breaking barriers in digital inclusion with GenAI.
59 See: Viamo's "Ask Viamo Anything" User Interviews'.

Type of organisation

A vast majority of use case applications are developed by for-profit organisations, largely startups. This is especially the case in Nigeria, where almost all solutions are led by for-profit organisations, as well as Kenya to some extent. However, in Kenya, other types of stakeholders have also deployed solutions, including social enterprises and non-profit organisations such as NGOs and foundations. These trends are reflective of the tech ecosystem, as Kenya benefits from a thriving and diverse ecosystem, characterised by the presence of startups as well as large tech players such as the Microsoft AI for Good Lab, considered here as a non-profit initiative. In South Africa, the deployment of AI use case applications is led by various types of players, including academia, reflecting its more advanced and diverse research ecosystem.

Figure 14c

Allocation of use cases by type of organisation

(% of total use case applications)

Ownership

Around 60% of use case applications are led by local organisations, with the rest led by international organisations.[60] This may seem surprising, given the challenges that local developers and AI researchers face in terms of access to high-quality data and computing resources. However, many of the local organisations we identified have received some initial financing in the form of grants from international donor organisations and development partners, helping them secure essential resources. Domestic investment and venture capital is rarer, posing a barrier for those local organisations that cannot comply with donor requirements. The ability of local organisations to engage in valuable partnerships to access the right resources or expertise also acts as a key enabler for the successful development and deployment of their solutions.

Figure 14d
Allocation of use cases by ownership
(% of total use case applications)

Type of solution

Most AI solutions are products and services, largely commercial solutions developed by private sector organisations. This is reflective of trends around the type of stakeholders developing and implementing AI solutions. Many of these products and services are developed for agriculture, which is also the most represented sector, as well as energy. By contrast, projects and programmes, which represent around 20% of AI use case applications, commonly address climate challenges. They are mostly led by non-profit organisations and social enterprises, or as side programmes led by for-profit organisations. A few pilots were also identified but represent a minority of use case applications.

Figure 14e
Allocation of use cases by type of solution
(% of total use case applications)

60 Ownership is determined by the location of the headquarters of the organisation.

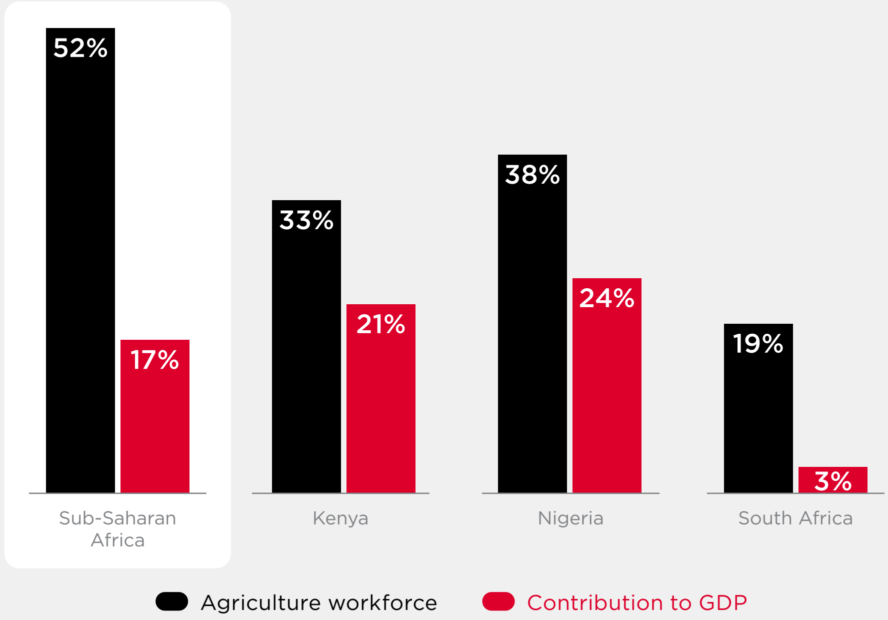
Agriculture and food security

Agriculture forms the backbone of many African economies, employing 52% of the workforce and contributing to 17% of GDP on average. Agriculture is a key contributor to the economy of the focus markets, contributing almost one-quarter of Nigeria's GDP. As the most industrialised country of the three, agriculture's contribution is much lower in South Africa, but still employs one-fifth of the population.

Figure 15

Agriculture's contribution to GDP and labour force by country

(2022)



Source: World Bank

In Sub-Saharan Africa, up to 80% of the food consumed is produced by smallholder farmers cultivating less than two hectares of agricultural land.[61] Despite the vital role of agriculture for the economy, smallholder farmers account for the majority of those living on less than two dollars a day and are most likely to go hungry.[62,63] The average income of smallholder farmers is not enough to support a decent standard of living, and women farmers generally produce and earn even less.[64] Smallholder farmers are often trapped in poverty due to systemic challenges, which lowers their productivity and incomes, and reduces food supply.[65]

Smallholder farmers tend to rely on outdated farming techniques and lack access to critical information that could help them plan their farming activities, improve on-farm practices, reduce inefficiencies, and increase per-hectare yields. They lack access to quality inputs and assets due to their limited access to formal financial services. Insufficient collateral and absence of identification documents prevent them from qualifying for loans, while data gaps around their financial history make it difficult to assess creditworthiness. These challenges disproportionately affect women, who account for 50% of the workforce in agriculture in many eastern and southern African countries, leading to gender gaps in agricultural productivity.[66] Women also face challenges due to social norms and lack of land ownership.

In addition, input and distribution markets are highly volatile and unstructured, leading to unpredictable fluctuations in pricing, supply chain inefficiencies, and unreliable and inconsistent access to food. Smallholder farmers are also under growing pressure from climate change, given their reliance on natural resources and lack of access to appropriate risk-coping mechanisms, which further undermines food security. The increased frequency and intensity of extreme weather events, rising temperatures and changing precipitation patterns all threaten agricultural production. Unpredictable rainfall and recurring droughts contribute to the disruption of crops and the erosion of soils.[67]

These inefficiencies in the agriculture supply chain contribute to food insecurity, which is exacerbated by economic and climate shocks, as well as political instability. Around 50% of the population in Nigeria has insufficient food consumption, driven by high rates of food insecurity in the northern and eastern parts of the country where conflict and insecurity are prevalent.[68] In Kenya, 26% of the population does not have sufficient food consumption, with higher levels in the east.[69] These trends are reflected in the Global Hunger Index Score, where Nigeria and Kenya both have serious levels of hunger.[70]

Table 2

Hunger assessment by country

(2023)

	GHI score (out of 100)	GHI rank (out of 125 countries)	Severity scale
Sub-Saharan Africa	27	-	Serious
Kenya	22	90	Serious
Nigeria	28	109	Serious
South Africa	13	58	Moderate

Source: Global Hunger Index

61 Ricciardi, V. et al. (2018). How much of the world's food do smallholders produce? Global Food Security, Vol 17, 64-72.
62 Abumhadi, N., et al. (2012). Agricultural Research in 21st Century: Challenges facing the food security under the -impacts of climate change. Bulgarian Journal of Agricultural Science, 18 (No 6), 801-818.
63 World Bank. (2015). Ending Poverty and Hunger by 2030: An Agenda for the Global Food System. Second edition.
64 Oxfam. (2018). A living income for small-scale farmers: Tackling unequal risks and market power.
65 The agricultural cycle is comprised of four key stages: input and planning, crop management and production, harvest and post-harvest, market access and distribution.
66 AUDA-NEPAD. (2021). Gendering Agriculture: Empowering African Women Farmers Using Modern Technologies.
67 GSMA. (2023). Improving Farmer Livelihoods Through Digitised Agricultural Value Chains : Results and lessons from the GSMA Innovation Fund.
68 World Food Programme HungerMap.
69 Ibid.
70 The Global Hunger Index (GHI) is a tool for comprehensively measuring and tracking hunger at global, regional and national levels. GHI scores are based on the values of four component indicators: undernourishment, child stunting, child wasting and child mortality.

The role of digital and AI

Digital technologies can unlock access to agricultural services, markets and assets to help agricultural value chains function better and mitigate the challenges and barriers smallholder farmers face.[71] Access to markets improves linkages to formal crop buyers, allowing farmers to bypass multiple intermediaries and making procurement more equitable. Access to assets, particularly farm assets and equipment, increases productivity and farmers' incomes. Access to services strengthens farmers' access to relevant information and digital financial services (DFS), supporting their resilience to unexpected shocks. Mobile-enabled dissemination of agronomic advice, market prices, and weather forecasts help farmers make decisions about farming practices. Access to credit enables them to access quality inputs and insurance protects their incomes in case of adverse weather events.[72,73]

Incorporating AI to these digital services has the potential to significantly enhance their effectiveness and amplify their impact (Figure 16). AI tools can source real-time data, perform predictive analysis, and run algorithms to optimise farming practices to improve crop yields, strengthen product quality, market and credit access, and reduce production costs. Expansion of AI in African agriculture is anticipated. For example, the agribot sector—comprising AI-driven robots performing agricultural tasks—is projected to reach around $337 million by 2030, marking a 21% compound annual growth rate from 2023 to 2030.[74]

Many of the use case applications identified fall under digital advisory, where AI is used to provide more relevant and contextualised information and advice for farmers. For example, precision agriculture brings advisory services to the farm level by integrating farm-specific agronomic data with remote sensing data, climate and weather data and domain-specific data (Box 4). The growing availability of data and ML capabilities makes it possible to provide farmers with customised information based on field-level conditions. Examples of organisations using precision agriculture include ThirdEye in Kenya, Kitovu in Nigeria and Aerobotics in South Africa.

AI can also enable innovative agri DFS like credit and insurance. By applying AI and ML to data sources such as satellite imagery of farms, climate data, and other farm-level information, organisations like Apollo Agriculture and mfarmPay in Kenya can generate a credit score that smallholder farmers can use as collateral. AI can also strengthen supply chain management, for example by monitoring and ensuring optimal storage conditions to reduce waste, streamline distribution and ensure market and price transparency. In Nigeria, companies like ColdHubs and Koolboks provide AI-driven solutions that maintain optimal storage conditions for perishable products. Notably, many organisations offer a bundle of services, for example including digital advisory and DFS, typically aimed at digitising value chain activities to provide holistic support to smallholder farmers.

Figure 16

Overview of use cases in agriculture and food security

Access to inputs

Access to services | Access to markets

Data-driven agri advisory	Agri DFS	Smart farming	Supply chain management	Market linkages	Food security monitoring and forecasting
Customised advisory for climate-smart agricultural practices at the farm level (i.e. precision agriculture)	Access to financial services, creditworthiness assessment for input or labour financing, and insurance	Crop and livestock management and mechanisation equipment	Optimisation of processing, storage, and distribution to reduce post-harvest loss	Digital marketplaces and analysis of market trends, demand-supply dynamics and price fluctuations	Real time monitoring and forecasting of food security trends

Note: Non-exhaustive examples based on research findings.

71 GSMA. (2020). The GSMA AgriTech Toolkit for the Digitisation of Agricultural Value Chains.
72 GSMA. (2021). Digital Innovation for Climate-Resistant Agriculture: Using Rainfall data from mobile networks for localised and scalable services.
73 GSMA. (2023). Improving Farmer Livelihoods Through Digitised Agricultural Value Chains : Results and lessons from the GSMA Innovation Fund.
74 Next Move Strategy Consulting. (2023). Africa Agriculture Robots Market is expected to reach USD 336.83 million by 2030. .

Box 4

Use case deep dive: Precision agriculture

Precision agriculture refers to the use of technologies such as sensors, drones and satellite data to generate accurate and data-driven farming insights, with the aim to improve the efficiency of resources, enhance crop yields, and reduce the environmental impact of fertiliser, pesticide and water use. Precision agriculture leverages ML, IoT and big data analytics to analyse extensive datasets such as soil composition and weather patterns. ML algorithms process these datasets to provide actionable insights for farmers, optimising crop management decisions.

End users: Smallholder farmers, extension agents.

Delivery channels: SMS notifications, mobile applications.

Key use case requirements

Data	Satellite imagery, geospatial data, weather and climate data, farm records and farm-level agronomic and environmental data (e.g. soil composition).
Infrastructure and hardware	Smart sensors, high-resolution remote sensing infrastructure (e.g. drones), cloud and edge computing devices.

Potential for impact and scale

- **Increased farmer income:** Precision agriculture can boost crop yields, resulting in a potential income surge for farmers, improving their livelihoods.
- **Climate resilience:** Farmers can access critical information to anticipate climate shocks and implement climate-smart agriculture practices, building resilience to climate change.
- **Market potential:** Around 250 million Africans are engaged in smallholder agriculture, representing a significant market for technologies that enhance productivity and livelihoods.[75]
- **Increased mobile penetration:** The number of unique mobile subscribers is expected to rise to 614 million people in Sub-Saharan Africa by 2025, opening up opportunities to increase digital inclusion among smallholder farmers.

Ecosystem constraints and risks

- **Affordability of precision agriculture technologies:** High costs of hardware such as IoT sensors or drones and their ongoing maintenance is a major barrier to uptake at the farm level.
- **Low levels of digital inclusion:** AI-enabled agri services risk exacerbating existing digital divides among less digitally literate farmers, especially women, persons with disabilities and older people.

Use case applications

ThirdEye: Uses flying sensors to monitor soil needs and identify pests/diseases in crops at an early stage.

UjuziKilimo: Utilises AI to analyse soil and provide farmers with tailored advice on fertilisation, watering, and crop rotation to optimise yields.

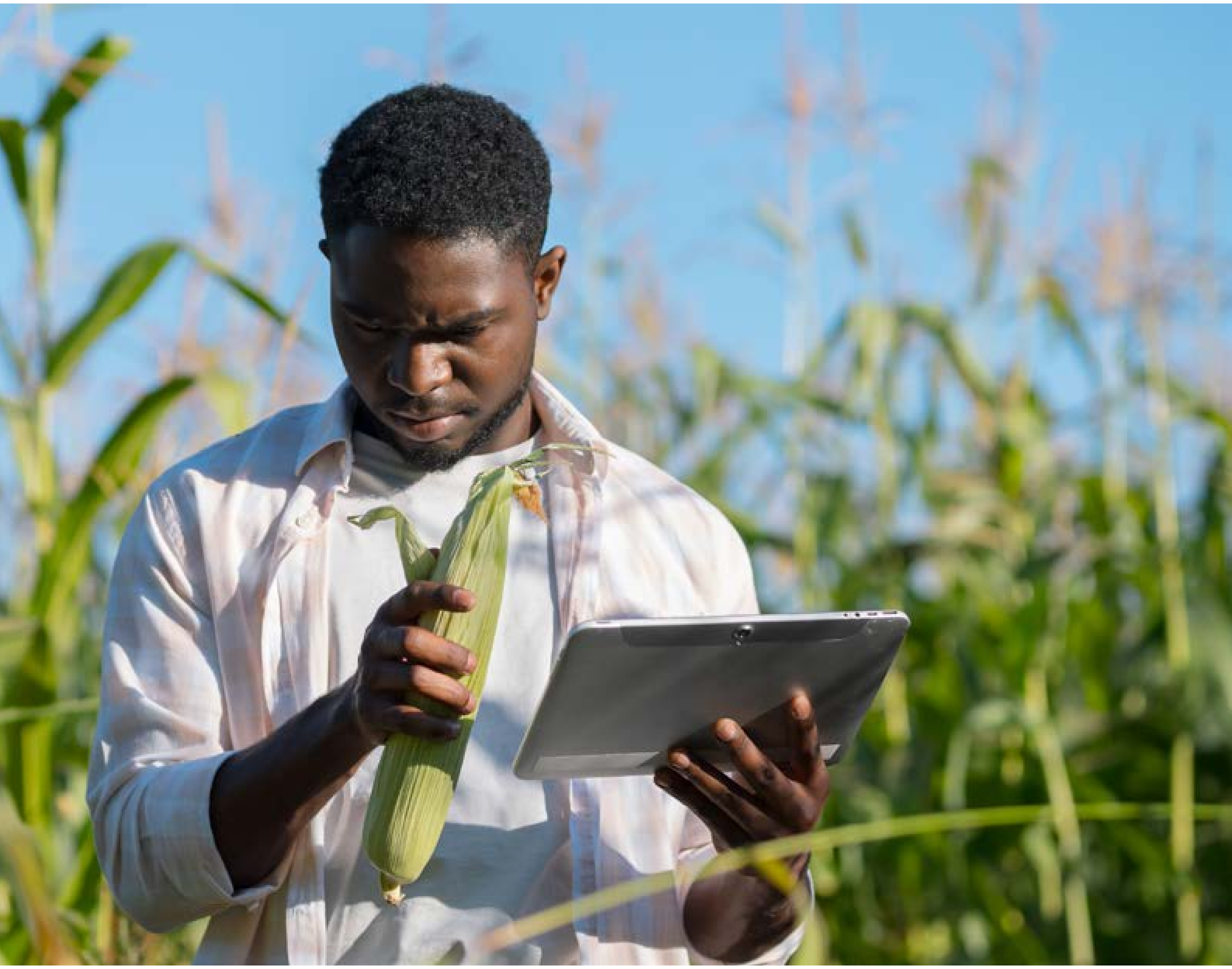
Riwe Technologies: Uses satellite imagery and ML to monitor crop health and provide personalised recommendations for crop management.

Kitovu: Combines spatial and satellite data to deliver precise agronomic advice, recommend optimal inputs, and ensure ongoing monitoring of crop health.

Aerobotics: Uses AI to provide pest/disease detection, drone imagery services, orchard management, and yield management (→ *Spotlight in South Africa report*).

75 World Bank. (2023). Scaling agriculture science and innovation for a climate-resilient future in Africa.

By strengthening agricultural value chains and supply chain management, digital technologies and AI ultimately also impact food security outcomes. Enhancing productivity and yields through data-driven digital advisory, agri DFS, and smart farming can boost food production, while better supply chain management and market linkages help ensure efficient food distribution and minimise waste. Together, these solutions play a significant role in improving food availability and access, reducing household food insecurity. In addition, predictive analytics and ML algorithms can be used to analyse real-time data on weather patterns, crop yields, market prices and food distribution to enable detection of food shortages and barriers to access. In Nigeria, the World Food Programme (WFP) piloted a new methodology to predict food insecurity up to 30 days in advance (→ ***Spotlight in Nigeria report***).[76] In Kenya, the Microsoft AI for Good Lab developed a spatiotemporal ML model to detect malnutrition hotspots.[77] These initiatives aim to enable timely interventions and targeted assistance, mitigating the impact of malnutrition and fostering food security for vulnerable populations.



76 Foini, P., et al. (2023). On the forecastability of food insecurity. Nature, Scientific Reports, 13, 2793.
77 Microsoft. (2024). AI in Africa Meeting the Opportunity.

Box 5

Use case deep dive: Food security forecasting

Food security forecasts are predictive models used to anticipate and manage disruptions within global food supply chains to address food insecurity. These forecasts are crucial for timely intervention and resource allocation to mitigate hunger and malnutrition, particularly in vulnerable populations. AI, including ML algorithms, can be integrated to analyse vast amounts of data from various sources and identify patterns and correlations related to food security outcomes. AI enables the development of predictive models that can forecast food security indicators based on socioeconomic and environmental factors, improving the accuracy and timeliness of forecasts.

End users: Governments, humanitarian organisations, agricultural agencies and policymakers involved in addressing food insecurity.

Delivery channels: Desktop-based tools and platforms (e.g. data visualisation dashboards, interactive maps), reports and publications, workshops and training sessions for targeted assistance.

Key use case requirements

Data	Socioeconomic data, environmental data, agricultural data, supply chain and market data, macroeconomic data and conflict data.
Infrastructure and hardware	Cloud or edge computing devices.

Potential for impact and scale

- **Food insecurity alleviation:** Access to reliable predictions of food insecurity levels allows governments and humanitarian organisations to identify which areas should be monitored closely and to take timely decisions on resource allocation.
- **Market potential:** Forecasting models can be used to provide rapidly available forecasts for several places at the same time by automatically feeding near real-time data to algorithms.

Ecosystem constraints and risks

- **Data availability and quality:** There may be limitations in the availability of reliable and highly granular data across time and at sub-national levels.
- **Access to computing resources and skills:** Lack of access to advanced computing infrastructure or expertise in AI and big data analytics could pose barriers to developing complex forecasting models, limiting the use of such solutions to international organisations and large tech companies.

Use case applications

Microsoft AI for Good Lab: Developed a spatiotemporal ML model to detect malnutrition hotspots.

WFP: Forecasting models to predict insufficient food consumption up to 30 days in advance. (→ *Spotlight in Nigeria report*).

ITIKI Project: Leverages indigenous environmental knowledge with AI to predict droughts, providing alerts to farmers using mobile phones. (→ *Spotlight in South Africa report*).

Key takeaways and considerations for AI deployment in agriculture and food security

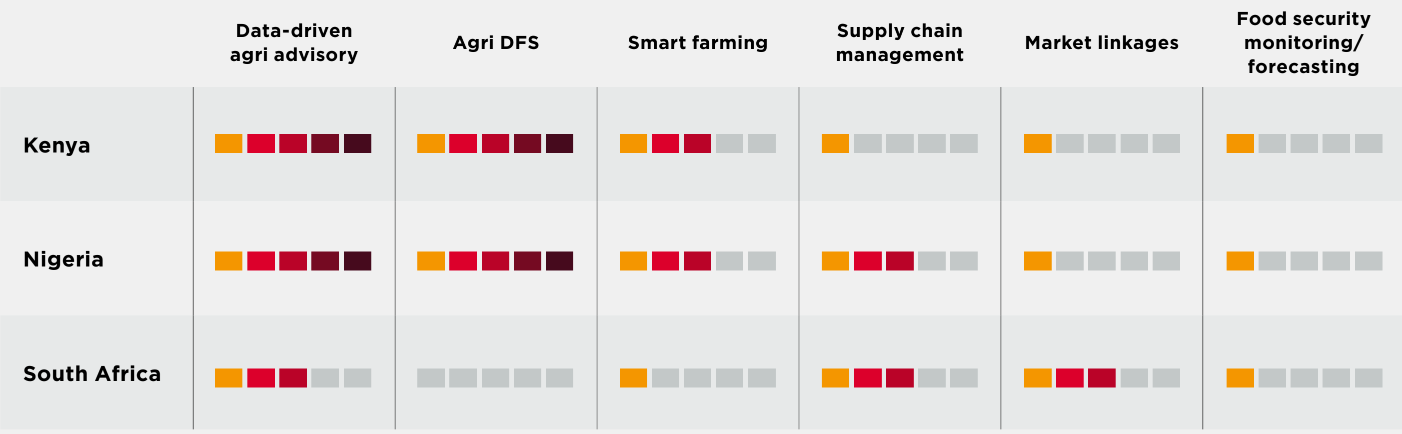
Most of the use case applications identified in agriculture and food security fall under data-driven agri advisory and agri DFS, especially in Kenya and Nigeria. These maturing use cases have the most potential for impact and scale in the short term, but their continued expansion will require facilitating access to technologies such as IoT sensors and drones to generate farm-level data. In South Africa, use cases are concentrated around post-harvest activities including supply chain management and market linkages, reflective of its more advanced agriculture sector.

Overall, the development and deployment of AI across agriculture and food security depends on the availability and accessibility of a wide range of data sources such as agronomic data, weather data, and geospatial data. Data-driven advisory services also heavily rely on domain-specific secondary data and local language data, which will be increasingly important with the gradual emergence of generative AI in Africa. However, barriers such as data quality and representativeness issues can lead to biases and limitations of AI-enabled services. For example, the lack of gender-disaggregated data may result in services that overlook the needs and circumstances of women in decision-making processes. Similarly, if research data predominantly reflects large-scale commercial farming practices, it will neglect the needs of smallholder farmers engaged in subsistence farming.

As mobile devices often constitute the primary channel through which end users access AI-enabled services, there is a risk of exacerbating inequalities for non-mobile owners and illiterate farmers, among which many are women, thus widening productivity gaps. Fostering access to mobile phones, promoting digital skills and literacy and enhancing the user friendliness of apps is essential for the adoption and active usage of AI-enabled services. In the short term, leveraging low-tech delivery channels will continue to play an important role in reaching smallholder farmers. For example, TomorrowNow prioritises SMS notifications to deliver information, while Amini primarily partners with farmer cooperatives.

Figure 17

Heatmap of use cases in agriculture and food security by country



Factors considered

Number of use case applications, data availability, hardware and software requirements/availability, partnership opportunities.

Note: Authors' assessment based on the sample of use case applications included in this research. See Annex 1.1 for more details about use cases requirements.

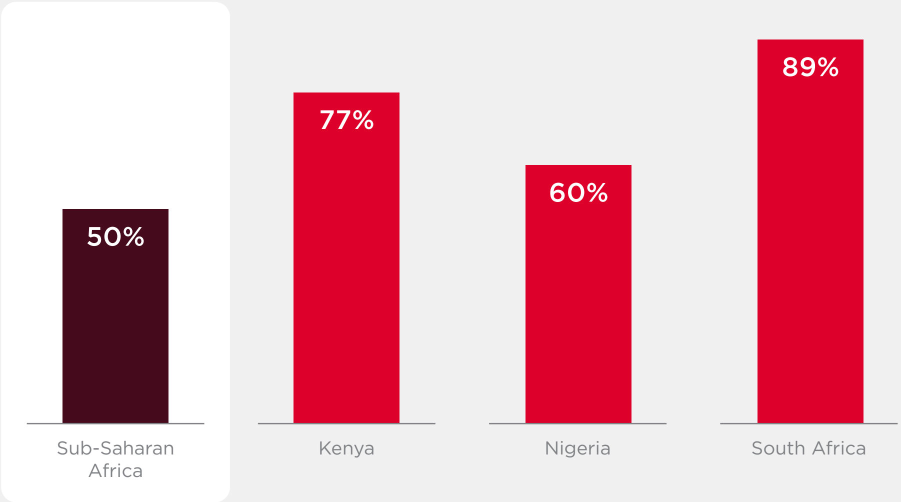
Energy

Sub-Saharan Africa still faces major challenges in terms of energy access and energy reliability. While there has been some progress over the past decade, the lack of access to electricity and clean cooking facilities remains one of the biggest energy-related challenges in the region. In 2021, around 590 million people in Sub-Saharan Africa—approximately half of the population—lacked access to electricity.[78] This means that 85% of those without access to electricity live in Sub-Saharan Africa, despite the region representing only around 15% of the overall global population. In both Kenya and South Africa, over 75% of the population has access to electricity, compared to 60% in Nigeria. There are important disparities within countries, however, as a large majority of those who do not have access to electricity live in rural areas.

Figure 18

Access to electricity by country

(% of population, 2021)



Source: World Bank

78 IEA. (2022). Africa Energy Outlook 2022.

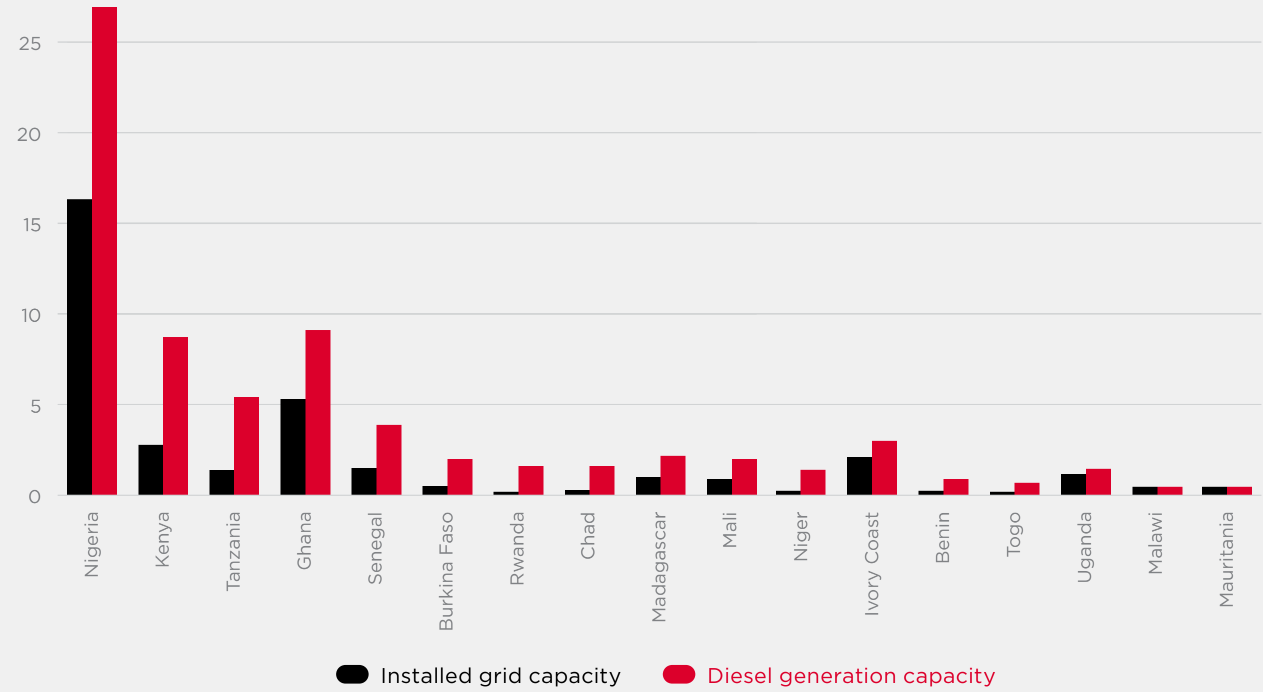
Even for those who are connected to the grid, electricity supply remains unreliable. Fewer than half of Africans enjoy a supply of electricity that works most or all of the time.[79] Nigeria has the world's largest absolute electricity access deficit.[80] Chronic grid outages, estimated to amount to 4,600 hours per year (over half the year), have made power unreliable to those connected to the national grid, and are costing the country two per cent of its GDP.[81] Lack of access to energy also has an adverse impact on the environmental sustainability of the country, since one of its results is an increase in deforestation for charcoal to use for cooking and heating.

Unreliable access to electricity particularly impacts the productivity of households, small businesses and public services like education and healthcare, also impacting the economic development of the continent. In the absence of reliable grid connectivity, people are dependent on mini-grids and standalone systems, mostly powered by diesel-powered generators or batteries, for access to electricity. Nigeria and Kenya's diesel generator capacity far exceeds their grid capacity (Figure 19). In addition to being highly polluting, these solutions are not sustainable due to high capital costs and rising prices of diesel.

Figure 19

African countries with more diesel generator capacity than grid capacity

(Gigawatt)



Source: Energy Monitor

Many factors contribute to low access rates and the unreliability of power supply. Expanding grid infrastructure in rural areas is costly, while rapid population growth is outpacing electrification efforts. Poor regulatory frameworks and financial constraints of utilities are hindering investments in the sector. As a result of low tariffs, reflective of high poverty rates and low electricity demand, utilities in the region struggle to recover their costs, which increases the risk of blackouts and rationing. Even with subsidies, many Sub-Saharan African households pay higher rates for electricity (adjusted for purchasing power parity) than households in many OECD countries.[82]

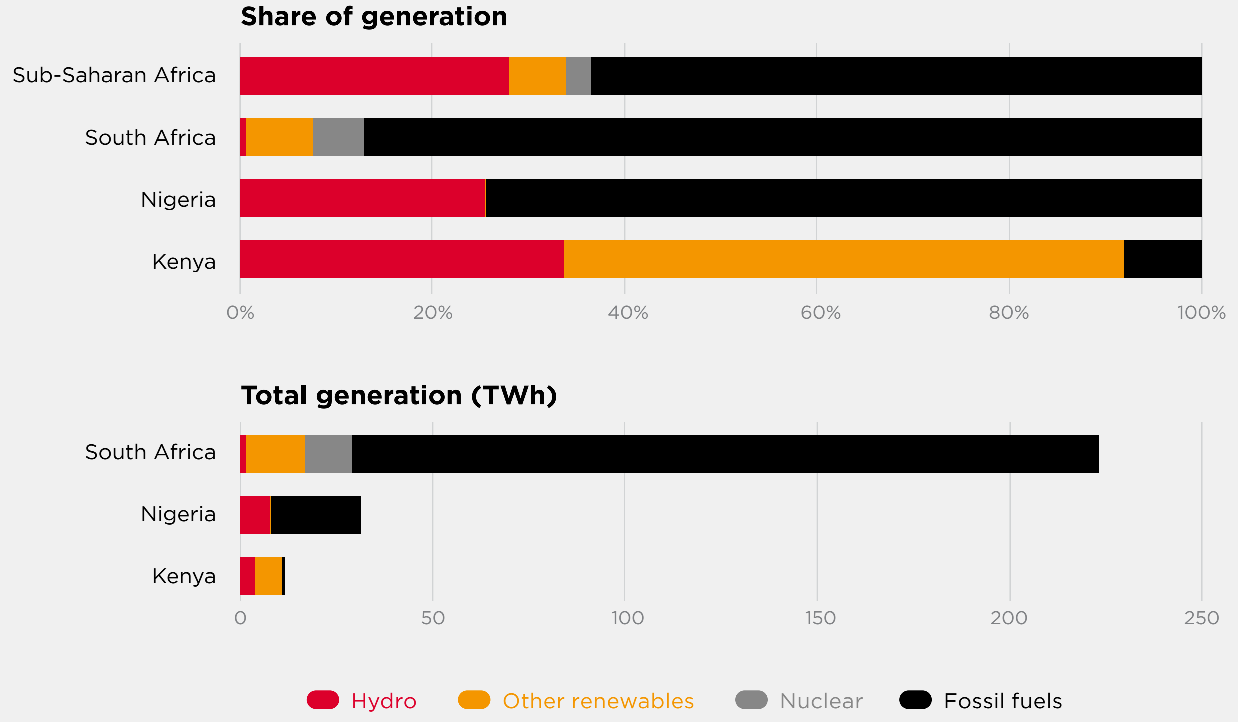
79 Afro Barometer. (2022). Still lacking reliable electricity from the grid, many Africans turn to other sources.
80 IRENA. (2021). Tracking SDG 7: The Energy Progress Report (2021).
81 GSMA. (2023). Innovator Spotlight Series: Tackling the urban energy challenge through digital innovation.
82 GSMA. (2023). Energy Challenges for Mobile Networks in Sub-Saharan Africa: The need for clean and reliable energy for universal connectivity and digital transformation.

Around two-thirds of the region's energy is generated from fossil fuel sources. Coal accounted for nearly half of the electricity mix in 2020, mostly driven by South Africa, while natural gas accounted for just over 10%. There are differences between countries, however. While more than 85% of electricity is generated from coal in South Africa, Kenya and Nigeria have more diversity in their generation mix. Over 90% of Kenya's energy is generated from clean sources, mostly geothermal, and around 25% of Nigeria's energy comes from hydropower. Generation from wind and solar have more than tripled in the region in the past decade, but account for less than five per cent of total generation.[83]

Figure 20

Electricity grid mix in Sub-Saharan Africa

(2023)



Note: Other renewables include solar, wind, geothermal and biomass. Total generation in Sub-Saharan Africa was approximately 460 TWh.
Source: US EIA

Despite being home to considerable solar resources, Africa holds just one per cent of the world's installed solar photovoltaic (PV) capacity. Substantial investments in infrastructure financing, innovative technology development and effective multi-regional partnerships are required to unlock the potential of renewable energy sources such as solar, wind and hydropower. Access to financing remains one of the biggest barriers to adopting solar PV systems for African consumers. To achieve Africa's development goals, as well as energy access and climate objectives, energy spending on the continent needs to more than double by 2030, representing an annual investment of $32-40 billion, with more than two-thirds going to clean energy.[84,85] South Africa and Nigeria, along with Egypt, account for about one-third of Africa's climate financing gap in energy.[86]

83 Ibid.
84 International Energy Agency: Energy system of Africa.
85 Africa Renewal. (2022). Energy: Africa's stand at COP27.
86 African Development Bank Group. (2022). African Economic Outlook 2022.

The role of digital and AI

Digital and mobile-enabled solutions play a key role in supporting access to affordable and reliable energy services in Sub-Saharan Africa.[87] In the grid sector, solutions like smart grids, supported by smart meters and sensors, have helped manage energy storage and supply, enabling the real-time monitoring of energy usage. AI can play a key role in supporting African utilities to enhance the impact of existing digital tools to reduce inefficiencies and technical losses in the grid infrastructure.[88] Using real-time and historical data, AI can perform predictive analysis and run algorithms to optimise grid and energy distribution systems to improve grid management, resource allocation, and sustainability in the energy sector. AI is being used to increase efficiency in transmission and distribution of energy, and private sector companies are using AI to upgrade aging infrastructure and efficiently integrate renewable energy sources. In Nigeria, Beacon Power Services uses AI to support utilities to pre-empt outages and identify network losses to distribute electricity more efficiently. In South Africa, where the energy sector is largely state-owned, Eskom is exploring the use of AI for predictive maintenance and demand forecasting in power generation.[89]

Digital technologies have also been transformative for off-grid populations by bringing decentralised solutions to the unconnected. Mini-grids are independent power networks that can function apart from the national grid. They can be a preferred option when deploying national grid extensions is not economically viable, but where the energy needs of the community may exceed the generation capacity of standalone systems like Solar Home Systems (SHS). Solar mini-grids can be the most effective way to bring power to underserved populations without access to electricity in Sub-Saharan Africa.[90] Mobile and digital solutions, such as prepaid smart metering, make access to mini-grids more affordable to low-income customers and provide mini-grid developers with vital information to improve efficiency. The use of smart meters can help operators make decisions to increase usage and reliability, such as whether to connect new customers, increase or decrease consumption at certain times of day, or to add new generation or energy storage.[91] However, estimates suggest that deploying mini-grids to meet current needs in Sub-Saharan Africa would require an investment of $91 billion, which is unlikely to be met.[92] Leveraging AI for cost-efficiency could help deploy mini-grids and bring electricity to the unconnected. In Nigeria, mini-grid developer Husk Power uses predictive AI to support service extension and forecast supply and demand, thereby increasing its operational efficiency and enhancing its sustainability (→ ***Spotlight in Nigeria report***).

Digital technologies have also been instrumental in the growth of SHS. Pay-As-You-Go (PAYG) technologies combined with mobile payments have enabled a new wave of consumer asset financing for low-income customers. PAYG solar energy in particular has emerged as one of the strongest use cases for this technology and the sector has matured from a handful of pilots to a global industry in under a decade.[93] Well-established companies include M-KOPA, Lumos and Mobisol.[94] PAYG models are being replicated in adjacent sectors, such as irrigation (SunCulture), clean cooking (M-Gas and SimGas), cooling (Koolboks) and water (CityTaps).[95] AI can be further incorporated into these solutions to predict energy demand and consumption. Nigeria-based startup Koolboks uses AI for the predictive maintenance of its solar-powered refrigerators and early-detection of payment defaults.[96]

87 GSMA Mobile for Development: Digital Utilities.
88 Global Data. (2024). Africa Energy Transition Market Trends and Analysis by Sectors and Companies Driving Development.
89 Power Engineers. (2023). POWER Partners with Eskom in South African Transmission Grid Transformation Project.
90 World Bank. (2023). Solar Mini Grids Could Sustainably Power 380 million People in Africa by 2030 – if Action is Taken Now.
91 GSMA. (2019). Mini-grids, macro impact?
92 World Bank. (2023). Solar Mini Grids Could Sustainably Power 380 million People in Africa by 2030 – if Action is Taken Now.
93 GSMA. (2022). The Value of Pay-As-You-Go Solar for Mobile Operators: Insights from Customer Journeys in Benin and Côte d'Ivoire.
94 Mobisol was acquired by Engie in 2019.
95 GSMA. (2023). IoT and Essential Utility Services: Kenya market case study.
96 GSMA. (2024). AI for Impact and Climate Action: Highlights from MWC Barcelona 2024.

Figure 21

Overview of use cases in energy

On-grid solutions

Off-grid solutions

Predictive maintenance	Smart energy management	Energy access/ demand assessment	Productive use asset financing
Forecasting of equipment failures, optimisation of maintenance schedules and minimisation of downtime	Optimisation and real-time monitoring of energy production, distribution and consumption	Mapping and monitoring of energy-scarce areas for targeted and tailored service extension	Digitised innovative finance mechanisms to enable asset financing (e.g. off-grid solar and clean cooking appliances) and increase access to energy

Note: Non-exhaustive examples based on research findings.

There has been an acceleration in the use of innovative data sources, such as remote sensing and geospatial data, to predict energy demand and inform energy planning efforts (Box 6). In areas with existing electricity access, ML models that leverage meter data, high-resolution satellite imagery, internet speed data, building footprints and land use data can help estimate future patterns of energy needs. This data also helps identify disparities in electricity consumption, highlighting affordability and reliability challenges that may impede energy access despite infrastructure availability.[97] Satellite data and GIS systems also help identify and map areas that lack access to electricity and determine the least cost and most suitable electrification options between grid extension, mini-grids or SHS. Fraym, which has conducted projects in Nigeria and Kenya, uses ML-enabled geospatial modelling to identify areas with high energy needs.

Digitised innovative finance mechanisms can also act as a catalyst to reduce gaps in energy access and reach those at the last mile. Nithio, which operates in Kenya and Nigeria, uses AI and blended-finance to provide a sustainable, risk-informed approach to finance aggregated receivables for the off-grid solar sector (→ ***Spotlight in Kenya report***). It also uses AI to assess customer creditworthiness for off-grid solar energy solutions. This helps decision-making about the type of capital that is most suited to their needs, such as commercial capital for low-risk customers and grants or results-based financing tools for high-risk customers like low-income and last mile communities or those living in informal settlements.[98] AI can also support uptake of off-grid solar among rural and low-income populations through smart subsidies.[99] Subsidies traditionally prioritise on-grid customers, but innovative data sources can improve targeting by identifying service gaps that require subsidy.[100]

97 IEA. (2024). Africa's electricity access planners turn to geospatial mapping.
98 Techpoint Africa. (2022). 592 million Africans do not have electricity, but this company has an AI solution.
99 GSMA. (2021). Smarter subsidies and digital innovation: Implications for utility services.
100 Ibid.

Box 6

Use case deep dive: Energy access and demand assessment

AI and ML can be used for energy access and demand assessment to identify energy-scarce areas for evidence-based and targeted energy planning strategies. Innovative data, such as remote sensing data, and more traditional data sources, such as household survey data, help identify and map areas that lack access to electricity and determine the least-cost and most suitable electrification options between grid extension, mini-grids or SHS. In areas with existing services, ML models can help estimate future patterns of energy needs. They can also help identify disparities in electricity consumption, highlighting affordability and reliability challenges that may impede energy access despite infrastructure availability.

End users: Energy utilities and off-grid energy providers, government agencies, industry associations (e.g. GOGLA, SEforALL) and international development organisations.

Delivery channels: Data visualisation dashboards, reports and policy briefs, workshops and training sessions.

Key use case requirements

Data (sources)	Utility data, weather and climate data, geospatial data, socioeconomic data, population and demographic data.
Infrastructure and hardware	IoT sensors, smart meters, drones with high-resolution cameras and satellites.

Potential for impact and scale

- **Improved access for underserved areas:** AI and ML algorithms help identify and prioritise underserved areas for service extension and subsidies, reducing energy poverty by providing clean, reliable and affordable energy where it is most needed.
- **Evidence-based policy development:** AI-driven insights can help policymakers and development partners formulate more effective policies and investment strategies to address energy access issues and promote sustainable energy development in underserved areas.
- **Market potential:** Tailored deployment of energy solutions, supported by AI, presents significant opportunities for energy providers to tap into new markets, given current infrastructure gaps and population growth, resulting in growing energy needs.

Ecosystem constraints and risks

- **Availability of quality data:** Access to reliable and comprehensive data can be limited, in part due to the high costs of hardware such as smart meters and IoT sensors.
- **Access inequalities:** Despite the potential to improve energy access for underserved communities, there is a risk that they may exacerbate existing inequalities in access, if energy providers prioritise investments in wealthier or more densely populated areas with higher potential for ROI.
- **Policy and regulatory frameworks:** Policies that prioritise universal energy access, promote renewable energy deployment, and incentivise private sector investment are essential to create an enabling environment.

Use case applications

ENGIE Energy Access: Using AI for a pilot project seeking to identify areas with potential future demand for solar appliances.

VIDA: Uses satellite imagery and big data to estimate optimal locations for mini-grid deployments.

Husk Power Systems: Uses AI to scale up mini-grid installations and to forecast supply and demand, optimising electricity delivery and minimising costs for customers.

Key takeaways and considerations for AI deployment in energy

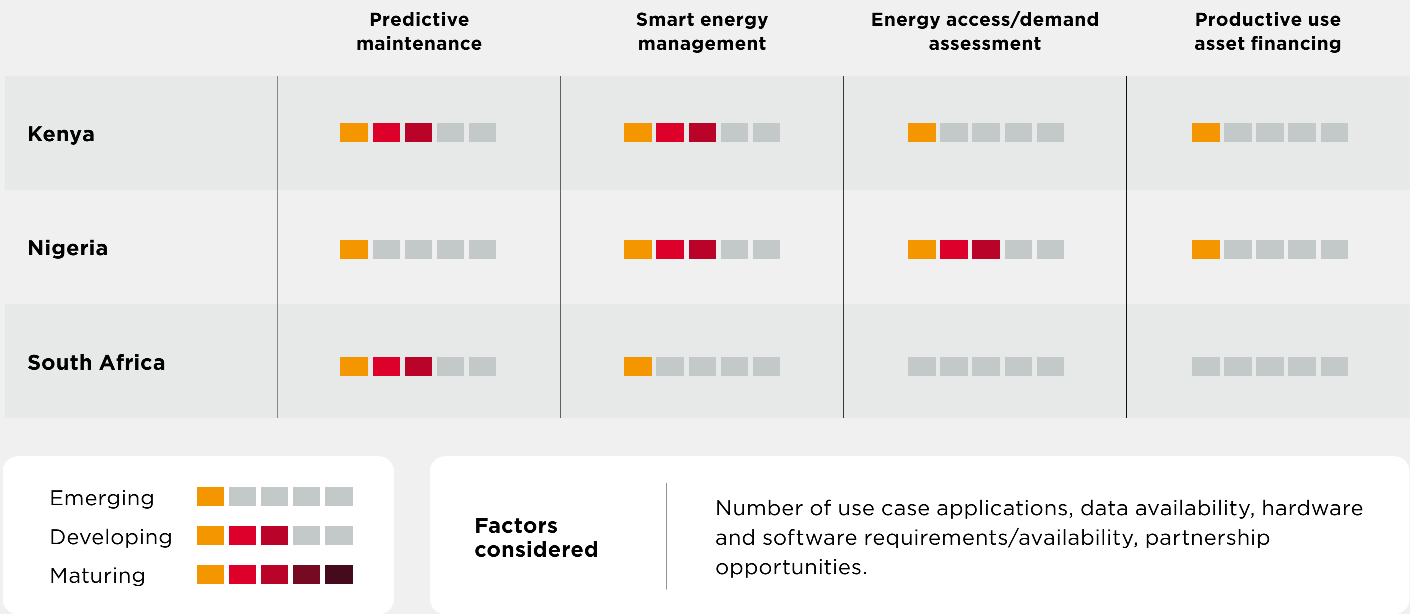
Across countries, the development and deployment of AI in energy is at a nascent or developing stage, for both on-grid infrastructure and off-grid systems. In Kenya and Nigeria, digital technologies already play an important role in smart energy management and technologies like IoT can act as an entry point for advanced data analytics and predictive AI. In both countries, there is huge potential to bridge the access gap and reduce energy poverty with use cases such as energy access monitoring and productive use asset financing, developed by companies like Nithio. In South Africa, where access to the grid infrastructure is relatively high but characterised by poor reliability, using AI for predictive maintenance and smart energy management can have significant impact on access to energy.

Scaling AI-enabled solutions in the energy sector will entail overcoming several challenges. Energy use cases largely depend on digital and emerging technologies such as smart meters and IoT sensors for data collection. Yet the deployment of hardware requires significant investment and constitutes a major barrier for financially constrained public utilities and startups providing off-grid energy solutions. Other important datasets, such as energy demand, willingness and ability of households to pay, the location and energy needs of public institutions, and productive uses remain unreliable, outdated or incomplete in how representative they are. In addition, regulatory reforms and sector liberalisation could unlock private sector investment and fill in the climate financing gap in energy. Enabling more private off-grid energy providers to operate on the continent will reduce dependence on state-owned utilities and drive competition to the benefit of customers.

Improving energy access and operational efficiency also has wider implications for the digital transformation of the continent. Lack of access to electricity is linked to limited access and usage of the internet and digital tools, as well as cellular networks and broadband. Improving generation, transmission and distribution is critical for the deployment of data centres, which form the backbone of AI compute capabilities but require significant energy resources. Given Kenya and Nigeria's low reliance on fossil fuels, there is huge potential to build on this competitive advantage and invest in renewable energy and develop sustainable compute technologies.[101]

Figure 22

Heatmap of use cases in energy by country



Note: Authors' assessment based on the sample of use case applications included in this research. See Annex 1.2 for more details about use cases requirements

101 Tony Blair Institute for Global Change. (2023). State of Compute Access: How to Bridge the New Digital Divide.

Climate action

Africa holds a significant proportion of the world's biodiversity hotspots and natural resources. The continent is rich in resources such as arable land, water, minerals, forests and wildlife. In many countries, natural capital accounts for 30-50% of overall wealth and more than 70% of the population in Sub-Saharan Africa depend on natural resources for their livelihoods.[102] Yet the interconnected biodiversity and climate crises are putting considerable pressure on these resources and exacerbating inequalities for vulnerable communities by reducing their access to essential natural resources, livelihood opportunities and resilience to environmental challenges. Indigenous Peoples and Local Communities (IP&LCs), which have long been the custodians of biodiverse ecosystems, bear the brunt of these impacts.[103] Similarly, vulnerable populations, such as rural communities dependant on smallholder farming or people living in informal settlements, are particularly vulnerable to extreme events such as droughts or floods. Climate-related events, which have already caused substantial damage and loss to ecosystems and human lives, are expected to increase in frequency and become harder to manage.[104]

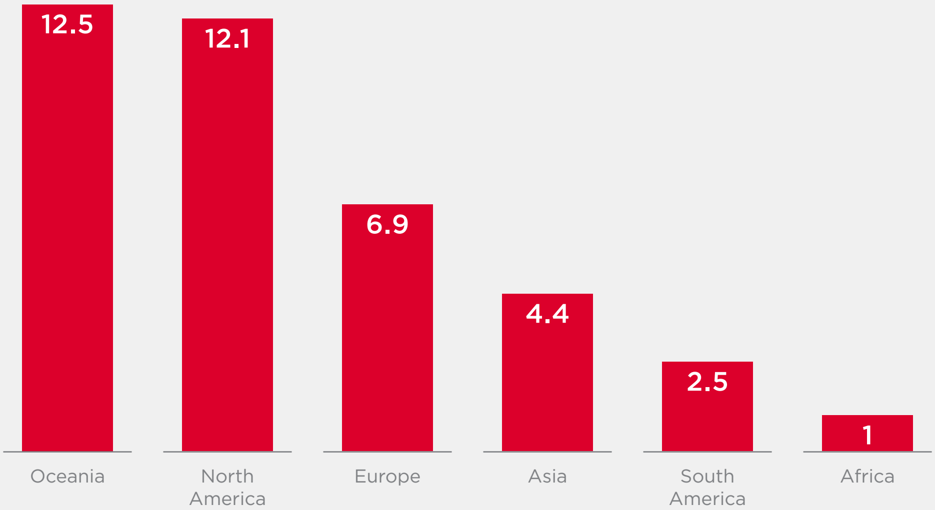
Africa is already facing more severe consequences due to the effects of climate change than other parts of the world, despite bearing the least responsibility for the problem. With nearly one-fifth of the world's population, Africa accounts for just four per cent of the world's energy-related carbon dioxide (CO2) emissions to date and has the lowest emissions per capita of any region.[105] Yet Africans are already disproportionately experiencing the negative effects of climate change, including water stress, reduced food production, increased frequency of extreme weather events and lower economic growth, all of which are fuelling regional instability. Estimates suggest that climate change such as temperature rises would reduce African GDP by eight per cent by 2050, with losses of around 15% in some regions such as East Africa.[106]

102 United Nations Environment Programme: Our work in Africa.
103 GSMA. (2024). The Nature Tech Nexus: Bridging biodiversity and business.
104 United Nations. (2023). The Sustainable Development Goals Report: Special Edition.
105 International Energy Agency. (2022). Africa Energy Outlook 2022: Key findings.
106 Ibid.

Figure 23

CO_2 emissions by region

(tonnes per capita, 2022)



Source: Global Carbon Budget

Despite being a minor contributor to global emissions, Africa needs to do far more to adapt to climate risks than the rest of the world. Current levels of climate finance[107] in Africa fall short of needs as the region receives only a small fraction of financing for climate resilience and adaptation. Africa requires on average $250 billion each year to meet the $2.5 trillion of climate finance needed between 2020 and 2030. In 2020, total annual climate finance flows accounted for around 12% of the amount needed.[108] Given Africa's vulnerability to climate change and its historically low levels of greenhouse gas emissions, there is a need to unlock climate finance for adaptation.[109] Kenya and Nigeria are particularly vulnerable to climate change but, along with South Africa, fall behind in terms of readiness to leverage investments and convert them into climate action.

Table 3

Vulnerability to climate change and readiness to improve resilience

(Rank out of 185 countries, 2021)

	Country Index Rank	Vulnerability Rank	Readiness Rank
Kenya	150	41	152
Nigeria	154	53	179
South Africa	95	111	120

Vulnerability measures a country's exposure, sensitivity and ability to adapt to the negative impact of climate change.
Readiness measures a country's ability to leverage investments and convert them to adaptation action.
Source: ND-GAIN Country Index

107 Climate finance is conventionally described as the flow of financing towards climate change adaptation and mitigation activities.
108 Climate Policy Initiative. (2022). The State of Climate Finance in Africa: Climate Finance Needs of African Countries.
109 Brookings Institution. (2024). Finance for climate adaptation in Africa still insufficient and losing ground.

The role of digital and AI

Digital and mobile-enabled solutions play a key role in supporting climate action.[110] Digital solutions can mitigate the primary driver of climate change by reducing greenhouse gas emissions, building resilience[111] towards the impacts of climate change for the most vulnerable communities, and drive sustainable use, management and protection of natural resources and the environment in areas exposed to climate sensors. Key areas of impact include agriculture, clean energy, energy efficiency, transport and mobility, waste management, disaster preparedness and response, and natural resources management (NRM).[112] For example, mobile-based early warning systems (EWS) provide timely alerts for disasters and climate-related events such as heatwaves and flooding, while enhancing post-disaster resilience by gathering information on unfolding disasters and improving rapid response.[113]

AI tools can further enhance these solutions, making them more relevant, cost-efficient, and amplifying their impact. ML models can significantly improve flood-forecasting for countries where flood-related data is scarce,[114] thereby strengthening EWS and disaster preparedness. In Nigeria, Google generated flood alerts based on flood forecasts (→ ***Spotlight in Nigeria report***). Similarly, AI can support disaster responses by processing images captured by satellite and drones. This can be particularly effective in areas where it is more difficult to operate on the ground. In South Africa, the WFP used SKAI, an open-sourced tool that uses satellite imagery and AI to automatically assess building damage to speed up humanitarian assistance after flooding and landslides in 2022 (→ ***Spotlight in South Africa report***).

AI is increasingly being used in combination with other tech solutions for environmental mapping and monitoring, biodiversity conservation and restoration, wildlife protection and Human-Wildlife Conflict (HWC) prevention. In Kenya, the Microsoft AI for Good Lab has leveraged high-resolution satellite imagery and ML to address HWC (→ ***Spotlight in Kenya report***). When trained and applied to images generated from camera traps, AI can also be used to identify rare species. This can reduce human labour hours and effort, maximising potential for data collection and analysis.[115] Similarly, AI-enabled recognition of acoustics can help identify and protect species in an area. Rainforest Connection, which uses AI to listen to the sounds of illegal logging and poaching, has been testing the technology in South Africa to help remote communities in their efforts to halt illegal activities.[116]

Digital technologies can also be leveraged to strengthen access and delivery of climate finance by catalysing lending, credit modelling, and the development of bankable climate projects for the benefit of communities that need it the most. Although the use of mobile and technology in climate finance is still nascent, it has huge potential to serve as an intermediary between financial sources and vulnerable communities, a medium of establishing transparent and traceable systems, a tool for collecting precise data, and an enabler for vulnerable communities to participate in the carbon market.[117] Low-tech solutions and mobile money solutions, such as DigiFarm in Kenya, already play a key role in supporting climate finance delivery. There is considerable potential for AI to support carbon credit initiatives and leverage alternative data to enable digital lending and insurance for climate-vulnerable customers.[118] In Kenya for example, Boomitra uses remote sensing and AI to monitor soil carbon and generate certified carbon removal credits.

110 GSMA Mobile for Development: Climate Tech.
111 Climate resilience is defined as supporting communities and vulnerable groups to adapt to multiple, long term and evolving climate change risks, anticipate climate variability and risks from extreme climate events, thus supporting preparedness and planning, and absorb adverse conditions, emergencies or disasters.
112 GSMA. (2021). The Role of Digital and Mobile-Enabled Solutions in Addressing Climate Change.
113 GSMA. (2021). The Climate Crisis: Mobile-enabled solutions in humanitarian emergencies.
114 Nearing, G., et al., (2024). Global prediction of extreme floods in ungauged watersheds. Nature, 627, 559-563.
115 GSMA. (2024). The Nature Tech Nexus: Bridging biodiversity and business.
116 Atlas of the Future. Saving the rainforests with AI: Rainforest Connection.
117 GSMA. (2023). Digitally Enabled Climate Finance: Access and delivery through mobile and digital technologies in low- and middle-income countries.
118 Ibid.

Figure 24

Overview of use cases in climate action

Resilience, adaptation and mitigation			Natural Resources Management	
Weather services and climate modelling	**Disaster preparedness and EWS**	**Carbon credits**	**Biodiversity monitoring**	**Wildlife protection and HWC prevention**
Hyperlocal weather forecasts and climate modelling for climate change anticipation and adaptation	Automated warning systems triggered by predictive analytics, and real-time disaster assessment and monitoring to mitigate impacts	Monitoring, analysis, and optimisation of carbon trading activities to facilitate compliance, trading decisions and carbon footprint reduction strategies	Assessment and tracking of changes in ecosystems, species distribution, and habitat health	Monitoring of wildlife habitats, detection of illegal activities (e.g. poaching) and support towards conservation efforts

Note: Non-exhaustive examples based on research findings. Additional climate-related use cases, such as climate-smart agriculture and clean energy, are covered in previous sections.

Box 7

Use case deep dive: Biodiversity monitoring

AI can support biodiversity monitoring by analysing a wide range of environmental, climate, and geospatial data to assess and track changes in ecosystems, species distributions, and habitat health, informing conservation and restoration efforts. Technologies like remote sensing offer high-resolution data for biodiversity assessments, while ML enhances the efficiency, scalability, and accuracy of ecosystem mapping and monitoring. This enables the timely detection of environmental changes and facilitates predictive modelling, allowing conservationists to anticipate future trends and take adaptive measures.

End users: Governments, environmental organisations, conservationists and local communities.

Delivery channels: Mobile apps, desktop-based tools and platforms (e.g. data visualisation dashboards, interactive maps), community workshops and training sessions.

Key use case requirements

Data	Geospatial and remote sensing data, environmental and climate data, habitat health data
Infrastructure and hardware	Smart sensors, high-resolution remote sensing infrastructure, cloud and edge computing devices.

Potential for impact and scale

- **Effective conservation strategies:** The use of AI can facilitate better-informed decision-making via improvement of species monitoring, conservation efforts, and ecosystem management through more efficient and accurate data analysis. The potential for impact is significant given Africa's vast conservation areas.
- **Enhancing community empowerment and livelihoods:** AI-driven biodiversity management in Africa holds promise for empowering local communities through equitable involvement, recognition, and potential compensation for their crucial role in environmental stewardship, thereby fostering improved livelihoods.
- **Biodiversity gaining recognition as a tradable commodity:** Biodiversity management has the potential to scale as biodiversity becomes a tradable commodity in the market, with global demand projected to surge to $2 billion by 2030 and a substantial $69 billion by 2050.[119]

Ecosystem constraints and risks

- **Limitations in data availability:** These include disparities in data availability among regions, species and habitats, the delicate balance between collecting relevant data and respecting the data rights of local communities, limited awareness and capacity in AI technologies, and a prevailing lack of trust in AI systems.
- **Access to hardware components:** Limited infrastructure and logistical constraints pose obstacles to the deployment of advanced technologies like drone sensing and data collection in these challenging terrains.
- **Risk of disempowering local communities:** Poorly designed solutions may reinforce inequalities by neglecting social and cultural norms and lead to unintended consequences. Excluding communities from the design and implementation of digital technology represents missed opportunities to leverage traditional knowledge for NRM and to empower communities to assert their rights.

Use case applications

EarthAcre: Uses AI-driven tools for carbon and biodiversity credit generation to compensate IP&LCs for their crucial role in biodiversity stewardship.

Connected Conservation Foundation: Uses high-resolution satellite imagery with local geospatial and conservation expertise to monitor wildlife, habitat and landscape changes over space and time.

FruitPunch AI: Developed an edge computer vision model to detect poachers on thermal video streams via a fixed-wing drone.

119 World Economic Forum. (2023). Biodiversity Credits: Demand Drivers and Guidance on Early Use.

Many of the climate-related use cases focus on NRM, using AI for biodiversity management and wildlife protection, with several other focusing on disaster preparedness and EWS. The increasing availability of remote sensing data has been a key driver of the acceleration of climate action use cases, especially in Kenya where Big Tech players—who have the requisite resources—are leading NRM projects to support local partners with climate-related issues.

For example, the integration of high-resolution remote sensing data with GIS has enabled the precise mapping of deforested areas. Combining satellite data with information on soil quality, topography and climate enables a comprehensive understanding of affected areas and helps monitor reforestation efforts, tracking tree growth, health and survival rates.

Figure 25

Remote sensing as a tool to support climate action

Use cases

- **Understanding environmental changes:** Remote sensing enables the monitoring of changes in ecosystems, weather patterns, and land use.
- **Disaster management:** Aids prediction and assessment of natural disasters like floods, earthquakes, and wildfires.
- **NRM:** Through accurate data collection, remote sensing helps manage natural resources, reduce waste, and minimise environmental impact.

Technologies used in remote sensing

- **Satellite imagery:** Satellites capture images of the Earth's surface, providing detailed information about terrain, vegetation and water bodies.
- **Aerial photography:** Drones and aircrafts equipped with cameras offer high-resolution images for detailed analysis.
- **Sensors:** Sensors measure environmental parameters like temperature, humidity and radiation, providing real-time data.

Methods and techniques

- **GIS:** GIS technology assists in visualising and analysing spatial data, creating multi-layered maps that depict different environmental aspects.
- **LiDAR (Light Detection and Ranging):** LiDAR uses laser technology to create detailed three-dimensional representations of the surface.
- **NDVI (Normalised Difference Vegetation Index):** Similar to crop monitoring, NDVI is used to assess vegetation health in various ecosystems.

Source: Amini

Key considerations for the development and deployment of AI in climate action

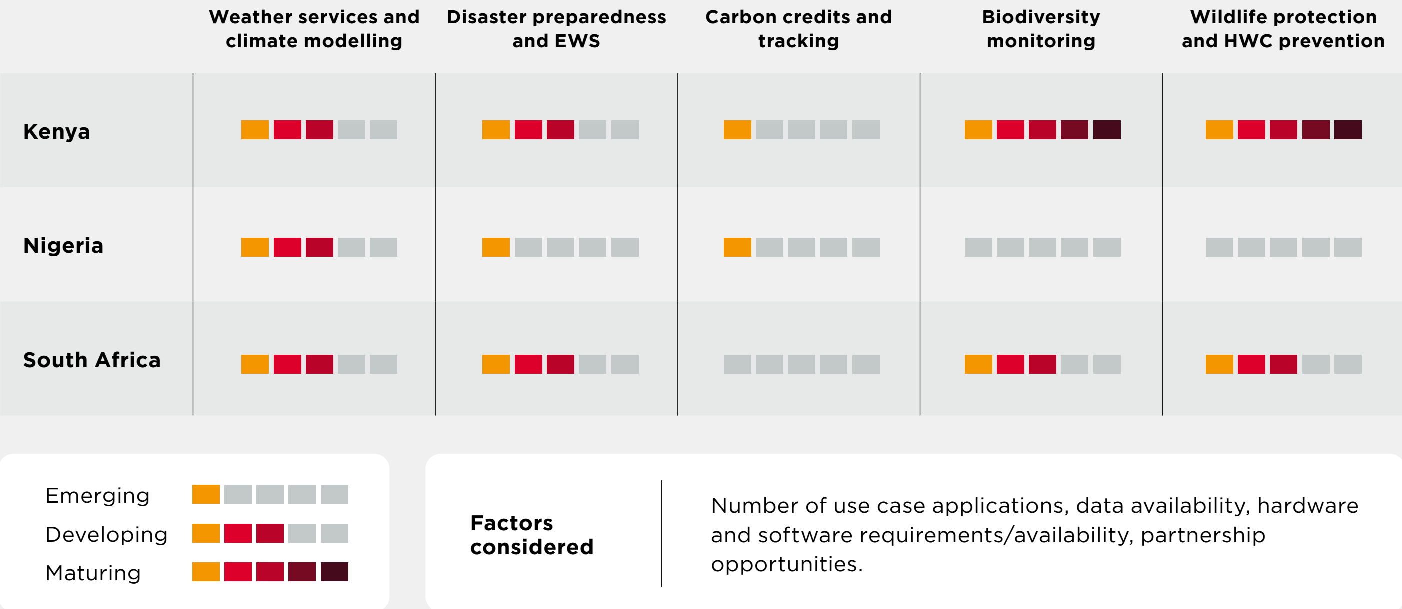
AI is already being deployed to support climate action, with varying levels of deployment across use cases and countries. AI-enabled weather services are used in the agriculture sector to support farmers in adopting climate-smart farming practices in Kenya and Nigeria, while various initiatives use AI for climate modelling in South Africa. Kenya seems to be taking the lead in NRM, with various examples of AI deployment for biodiversity monitoring as well as wildlife protection and HWC prevention. This has mostly been enabled by the increasing availability of geospatial data, which supports a range of NRM use cases, and the presence of large tech companies with the required expertise and computing resources to process such data.

Mobile devices tend to constitute the primary delivery channels for AI-enabled services such as weather services, disaster preparedness and EWS, as well as carbon credits for small-scale and community-based projects. Fostering access to mobile phones, promoting digital skills and literacy, and enhancing the user friendliness of apps is essential for the adoption and active usage of AI-enabled services. Leveraging low-tech delivery channels such as USSD and SMS notifications is also critical to reduce digital exclusion in local and rural communities. Similarly, while the use of AI-enabled services in NRM enables the participation of marginalised groups and facilitates the sharing of information, it can also reinforce inequalities if designed following a top-down approach. When decision-making is guided by high-level officials, it may not account for the social and cultural contexts of local communities or for power asymmetries among different stakeholders.

Even when these considerations are factored into programming, there can be unintended consequences. For example, the use of remote sensing to track and protect wildlife can bring valuable data to the hands of local communities, but this data can also inadvertently help poachers if it gets into the wrong hands. There are also instances where surveillance devices can affect community interaction within this space, such as women no longer travelling to these areas or modifying their behaviour due to the discomfort of being captured on camera. Without contextually sensitive approaches, driven by local demand and the inclusion of IP&LCs, digital solutions risk negatively impacting communities. Including communities in the design and implementation of digital technology for NRM can also unleash the potential and use of traditional knowledge to sustainably manage natural resource use and empower communities to assert their rights in natural resource governance.

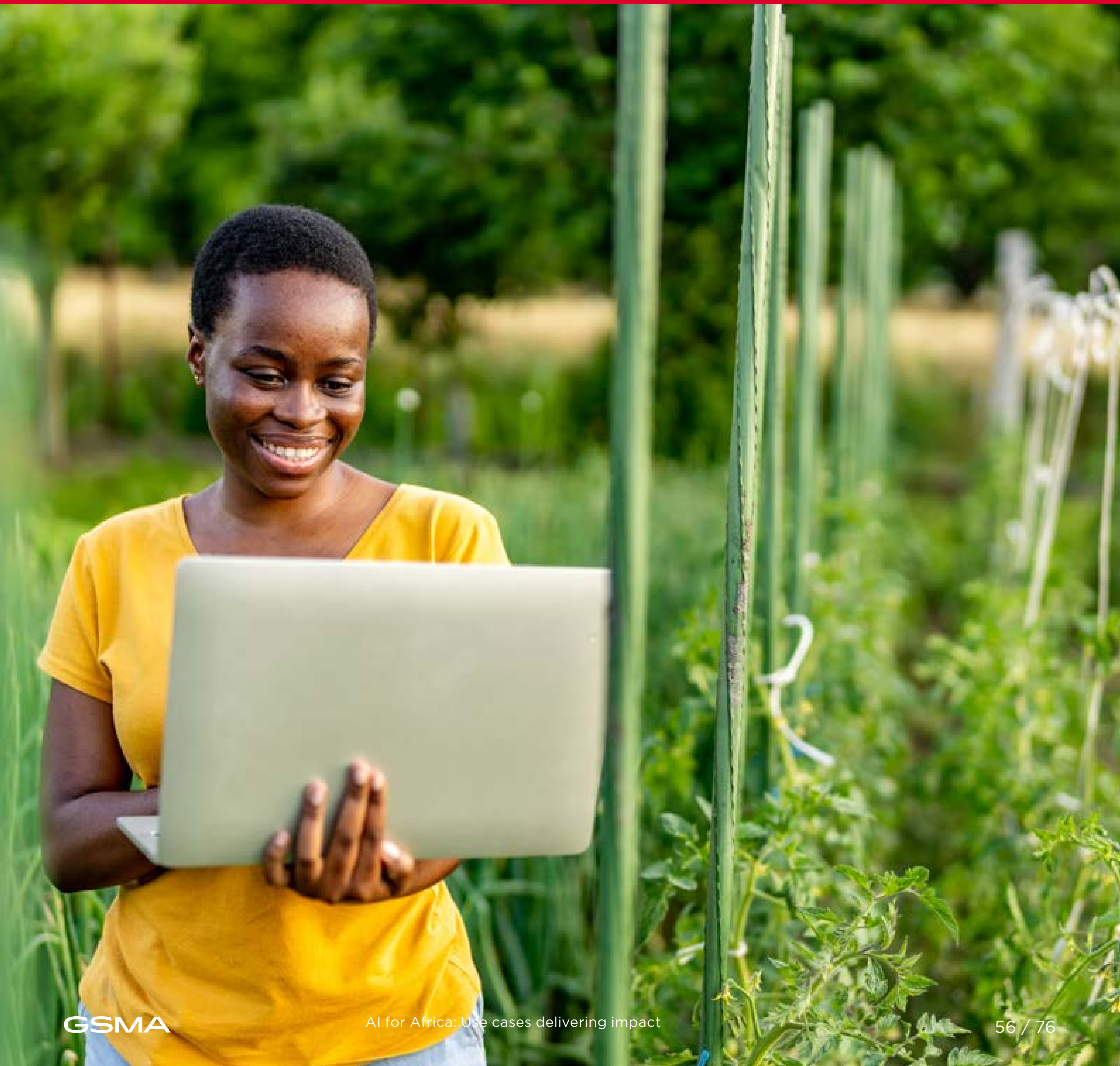
Figure 26

Heatmap of use cases in climate action



Note: Authors' assessment based on the sample of use case applications included in this research. See Annex 1.3 for more details about use cases requirements.

5. Towards a thriving ecosystem



Creating a conducive policy environment

AI policy and governance play a crucial role in shaping the development and implementation of AI-enabled use cases applications in Africa by providing policy frameworks and regulations that govern the ethical, responsible and safe use, deployment, and management of AI technologies and the data they use. These policies promote responsible innovation and contribute to ensuring inclusivity and building trust in AI technologies, driving their adoption and impact across the continent.

Domestic initiatives for AI governance

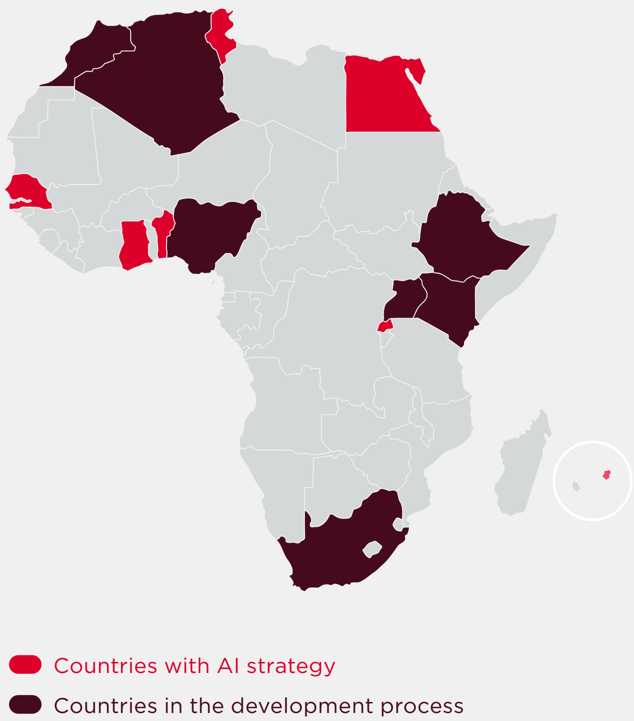
A handful of African countries have made significant strides in AI governance. Mauritius was the first country in Africa to publish its national strategy in 2018, setting out a vision for AI to become the cornerstone of its development model. Egypt launched its national AI strategy in 2021, after establishing the National Council for AI in 2019. In the past year, there have also been significant developments in Sub-Saharan Africa. Rwanda,[120] Senegal[121] and Benin[122] published the first national AI strategies in mainland Sub-Saharan Africa. It is worth noting that that these countries are considered low income (Rwanda) or lower middle income (Senegal and Benin),[123] unlike Mauritius, which classifies as upper middle income. This goes against the trend seen in other regions across the globe, where the most developed or largest economies in a region are the first to create national AI strategies.[124]

Kenya, Nigeria and South Africa do not currently have a published national AI strategy but have taken steps towards improving AI governance. Nigeria is in the process of finalising a draft of its national strategy, which is expected to be completed in the second half of 2024. Similarly, the Ministry of Information, Communications and The Digital Economy in Kenya recently started a process for the development of a national AI strategy. Both countries have taken a multi-stakeholder engagement approach, providing opportunities for key ecosystem actors to contribute to the formulation of the strategies. Existing policies have also supported the growth of their respective tech ecosystems and acknowledge the role of emerging technologies for socioeconomic growth. South Africa has recently started the process of formulating a national AI strategy, and has published a draft discussion document for stakeholders to engage with. South Africa ranks second in Sub-Saharan Africa on the Oxford Insights Government AI Readiness Index, while Kenya and Nigeria are both in the top 10.[125]

Figure 27

AI policy development in Africa

(As of May 2024)



Sources: Brookings, Diplo

120 Republic of Rwanda Ministry of ICT and Innovation. (2022). The National AI Policy.
121 D4D Hub. (2023). Implementing a national AI policy: Key lessons from Rwanda.
122 Ministère du Numérique et de la Digitalisation République du Bénin. (2023). National Artificial Intelligence and Big Data Strategy 2023-2027.
123 World Bank: World Bank Country and Lending Groups.
124 Oxford Insights (2023). Government Readiness Index 2023.
125 Ibid.

Regional initiatives for AI governance

Regional and international organisations are taking the lead in establishing pan-African guidelines. The African Union, Smart Africa and GIZ published a Blueprint on AI for Africa in 2021, a strategic framework developed to guide the application and governance of AI technologies in Africa. The initiative was introduced by the South African government and included a working group with experts from the private sector, international organisations, academia and entrepreneurs.[126] In addition, the African Union convened experts from across the continent to develop a comprehensive AI Continental Strategy, which it is reportedly finalising, aiming to establish policy frameworks for responsible and safe AI adoption across African countries.

Regional and international organisations are also taking the lead in establishing the principles that will ensure ethical development and usage of AI. The African Commission on Human and People's Rights (ACHPR) has been advocating for legal and regulatory frameworks to ensure human-centric AI, emphasising international human rights law and standards, while UNESCO published a global standard on AI ethics in 2021 (Box 8).[127] Experts from African countries, including Cameroon, Egypt, Ghana, Morocco, Rwanda, and South Africa, were consulted during the formulation process. Nigeria also contributed to the draft and advocated for UNESCO to endorse a recommendation supporting the adoption of legislation to ensure ethical oversight and accountability in the application of AI to human activities.[128]

Several donor organisations have also committed to deepening their support towards the region. In 2023, the FCDO started co-funding the AI for Development (AI4D) in Africa programme initially launched by the International Development Research Centre (IDRC). One of the pillars of the programme is to support policy research think tanks to establish responsible AI and support local policy networks. International organisations and development partners have supported recent AI strategies in Rwanda (GIZ FAIR Forward, the World Economic Forum, and the Future Society) and Senegal (African Union and the AU-EU Digital for Development Hub). Some of these organisations are supporting other countries, including Ghana and Tunisia, in the development of their own national AI strategies.[129]

Key considerations for strategy formulation and implementation

Although there has been significant progress towards AI governance, most policy frameworks remain in their infancy, leaving AI deployment largely unregulated. This is especially true for countries who do not yet have overarching national AI strategies and where a lack of clear ownership undermines effective AI governance. While the focus is on the drafting of strategies and policies around AI, it is also essential to establish robust accountability mechanisms to ensure that AI strategies are effectively implemented. In addition, finding the right balance between regulating a rapidly changing ecosystem to mitigate risks without stifling innovation will be critical and entail building capacity at the policy level.

Continued collaboration among local stakeholders such as public bodies, CSOs, academia, developers, researchers and local communities will be important to ensure that AI solutions are compatible with local development priorities. Developing ethical AI frameworks that reflect African cultural values and account for the continent's diverse populations will be essential to mitigate biases and uphold principles of accountability and transparency. Addressing critical challenges such as data bias and breaches will also help develop ethical AI frameworks that uphold principles of fairness, transparency and inclusivity. As countries progressively draft AI strategies, there is a need to involve more women at the forefront of policymaking to ensure strategies include gender-inclusive considerations and contribute to addressing gender equality issues rather than exacerbating them.[130]

126 Smart Africa. (2021). Artificial Intelligence for Africa.
127 UNESCO: Ethics of Artificial Intelligence.
128 Teleanu S. & Kurbalija J., (2022). Stronger digital voices from Africa: Building African digital foreign policy and diplomacy Diplo.
129 Microsoft white paper (2024). AI in Africa: Meeting the Opportunity.
130 OECD. (2024). Deliberate, inclusive AI policies to empower women in Africa.

Box 8

UNESCO's human rights-centred approach to the ethics of AI

UNESCO produced 'Recommendation of the Ethics of Artificial Intelligence,' the first-ever global standard on AI ethics, in November 2021. The framework was adopted by all 193 Member States. It is applicable to multiple policy action areas, ranging from data governance, environment and ecosystems, gender, education and research, among others. The protection of human rights and dignity forms the cornerstone of the Recommendation, based on the advancement of fundamental principles such as transparency and fairness. Ten core principles lay out a human rights-centred approach to the ethics of AI:

1. **Proportionality and do no harm:** The use of AI systems must not go beyond what is necessary to achieve a legitimate aim. Risk assessment should be used to prevent harm which may result from such use.
2. **Safety and security:** Unwanted harm (safety risks) as well as vulnerabilities to attack (security risks) should be avoided and addressed by AI actors.
3. **Right to privacy and data protection:** Privacy must be protected and promoted throughout the AI lifecycle. Adequate data protection frameworks should also be established.
4. **Multi-stakeholder and adaptive governance and collaboration:** International law and national sovereignty must be respected in the use of data. Additionally, participation of diverse stakeholders is necessary for inclusive approaches to AI governance.
5. **Responsibility and accountability:** AI systems should be auditable and traceable. There should be oversight, impact assessment, audit and due diligence mechanisms in place to avoid conflicts with human rights norms and threats to environmental wellbeing.
6. **Transparency and explainability:** The ethical deployment of AI systems depends on their transparency and explainability (T&E). The level of T&E should be appropriate to the content, as there may be tensions between T&E and other principles such as privacy, safety and security.
7. **Human oversight and determination:** Member States should ensure that AI systems do not displace ultimate human responsibility and accountability.
8. **Sustainability:** AI technologies should be assessed against their impacts on sustainability, understood as a set of constantly evolving goals including those set out in the SDGs.
9. **Awareness and literacy:** Public understanding of AI and data should be promoted through open and accessible education, civic engagement, digital skills and AI ethics training, media and information literacy.
10. **Fairness and non-discrimination:** AI actors should promote social justice, fairness and non-discrimination while taking an inclusive approach to ensure AI's benefits are accessible to all.

UNESCO developed two methodologies to provide Member States with actionable resources that ensure the effective implementation of the Recommendation: the Readiness Assessment Methodology, to help Member States assess whether they are prepared to effectively implement the Recommendation, and the Ethical Impact Assessment, to help project teams and communities identify and assess the impact an AI system may have.

Source: UNESCO

Fostering partnerships

Given the complexity of developing AI use cases delivering impact at the local level, partnerships are critical to ensure adequate sharing of resources, knowledge and expertise. Different stakeholders bring different assets and capacities, defining their roles within these partnerships. Five primary types of stakeholders play particularly important roles and functions in the context of AI for development: data holders, hardware and software providers, technical partners, domain experts and financial partners. Various organisations can contribute to these partnerships, sometimes with overlapping roles. For example, large tech companies can be both data holders and hardware providers while NGOs can contribute as domain experts and financial partners. Ultimately, it is the collaborative efforts and synergies among these diverse stakeholders that drive the successful implementation of AI solutions.

Figure 28

Types of actors involved in partnerships for AI

Data holders

Organisations gathering data, including not only big data, i.e. high-volume and high-speed data from ICT companies (e.g. MNOs, large tech players, remote sensing companies, companies offering services through digital apps) but also population and demographic data from government agencies or domain-specific data from civil society organisations, academia and research institutions.

Hardware/software providers

Organisations with the hardware and software resources required for compute (e.g. large tech companies such as NVIDIA, IBM or Microsoft) who can provide the necessary resources for processing and training data.

Technical partners

Tech companies that specialise in the provision of data science services, including hands-on data management, from data collection to dissemination and consumption of insights, and data strategy (e.g. data analytics companies such as Fraym and Atlas AI).

Domain experts

Organisations that possess sector-specific knowledge and work at the local level, such as NGOs, CSOs, academia and specialised research institutions. They provide valuable insights into industry-specific challenges and opportunities, facilitating the customisation of AI to address sectoral and contextual challenges.

Financial partners

Institutions like development finance institutions (DFIs), governments, NGOs and foundations that provide financial support to establish and sustain partnerships. In some cases, they also provide technical support, such as capacity building.

Partnerships supporting AI use cases

Many of the use case applications identified in this research are contingent on private sector data and infrastructure partnerships between large tech companies, startups and domain experts. Private sector partners often bring specialised knowledge and resources and can complement the strengths of other private entities. In Kenya for example, Digital Green partnered with OpenAI to access and fine-tune its GPT-4 model with local data, and with CGIAR to incorporate domain expertise into its existing database to complement the development of advisory content. For its pilot in Nigeria, Viamo partnered with domain experts like UNICEF and Mercy Corps to leverage their data and fine-tune pre-trained LLMs. In addition, their pre-established partnerships with MNOs allowed Viamo to use free airtime to onboard users, including in last-mile communities. So far, Viamo has signed exclusive national agreements with telecom operators and will be looking to sign multiple telecoms agreements in its countries of operations, thereby scaling up the initiative.[131]

Private sector players also play a key role in supporting the public sector through public-private partnerships (PPPs). In Kenya, IBM signed a Memorandum of Understanding with the Kenyan government to support the National Tree Growing and Restoration Campaign through a new 'adopt-a-water-tower' initiative.[132] In PPPs, public actors can also bring valuable assets such as established networks, broad geographic coverage, and trust among local communities. TomorrowNow partnered with the public initiative Kenya Agricultural and Livestock Research Organisation (KALRO) to provide AI-enabled climate-smart digital advisory to farmers through government extension agents. This allows TomorrowNow to leverage existing networks, thereby reaching out to a broader audience.

Partnerships for the AI fundamentals

There has been an acceleration of multi-stakeholder partnerships that support the development of the AI ecosystem at both the domestic and regional level. These are often led by international actors, including multilateral and donor organisations. The Lacuna Fund, a multi-donor initiative, seeks to address data gaps by providing local data scientists, researchers, and social entrepreneurs with the resources they need to produce datasets that can be used to address local problems. It has specifically worked on agriculture, health and language datasets.[133] Similarly, the Rockefeller Foundation is collaborating with the Electricity Growth and Use in Developing Economies (e-GUIDE) initiative and Atlas AI, a predictive analytics company, to build a digital platform leveraging satellite data and ML capabilities. The digital platform will build on the latest research and publicly available data covering the nexus of agriculture, energy, and transportation sector development to improve decision-making for policymakers and investors.[134] Many of these initiatives focus on building open-source data platforms to improve accessibility. While essential, there is also a need to develop infrastructure-sharing partnerships to improve access to compute across countries, and to bridge the AI skills gap across the region.

131 The Africa Report. (2024). Viamo to offer free ChatGPT-driven information for Africans with basic phones.
132 IBM. (2023). IBM Advances Geospatial AI to Address Climate Challenges..
133 Lacuna Fund: Filling in the International Data Map.
134 Rockefeller Foundation. (2022). The Rockefeller Foundation Invests in Satellite Data & AI to Accelerate Economic Development and Climate Resilience in Africa.

Making partnerships work

There are multiple considerations that impact the relevance and efficiency of partnerships for AI use cases. A key consideration is that partnerships should be formed with the purpose of using AI to tackle local challenges and leverage the resources that can best address the challenges at hand. In Kenya, the Microsoft AI for Good Lab works primarily on projects that emerge from a demand from local partners to address specific pain points. This serves as the basis for project scoping and helps identify the types of data that need to be leveraged. However, such problem-centric approaches are not always guaranteed. Several experts mentioned that partnerships led by international partners tend to leverage pre-established relationships or existing datasets used as proxies. While it may be adequate in some cases, it can also exacerbate the risk of developing solutions that are not always entirely tailored to the needs of users. There is a need to focus on exploring a range of solutions to critical challenges rather than searching for potential problems that AI can solve.

Identifying the right partners is critical to ensure relevant and adequate sharing of resources. In PPPs, public and private sector actors can take advantage of mutually beneficial synergies. While governments can access more cost-effective, timely and accurate data sources, private companies have the potential to extend their reach, increase brand recognition and meet their impact-driven strategic objectives. While these benefits and incentives help initiate partnerships, they are not enough to successfully conduct or sustain them. For example, for data-sharing partnerships to be effective, they need to rely on clear frameworks for data collection, sharing and analysis to ensure the reliability and integrity of the data. Data sharing agreements need to outline limitations and intended purposes for data use, ensuring compliance with regulatory requirements and ethical standards.

> "Cultivating successful partnerships begins with demonstrating value. We managed to engage with the government and leverage their extensive agent network because we demonstrated how we could address their needs and pain points."
>
> **– Agritech Startup in Kenya**

Sustainability and financial considerations also influence the success of partnerships. While initial financial support is often available for piloting AI use cases delivering impact, securing funding for long-term maintenance and sustainability remains challenging. Nascent AI use cases, such as those based on LLMs, require patient financial backing and adaptable engagement models. Access to long-term funding sources remains a challenge. Private capital sees AI in Africa as a risky investment and is wary of unproven use cases while philanthropic capital and grant funding cycles are not tailored to the needs of the industry.

Unlocking financing at scale

With advances in Africa's technology ecosystem and talent pool in the last decade, there has been an influx of financing for technology startups and initiatives. In 2023, African tech startups received investments of about $4 billion, with Kenya, South Africa, Nigeria, and Egypt accounting for the bulk of the funding.[135] However, investments towards AI still represent a minority of total tech investments. Private sector investors are wary of investing in a technology that they are unfamiliar with and prefer to invest in well-established sectors like fintech. This disproportionately affects female African AI founders, for whom raising capital is often the single most important barrier.

Table 4

Venture capital investments in tech by country

($ million, 2023)

KE	Kenya	806
NG	Nigeria	575
SA	South Africa	565

Source: Briter Bridges

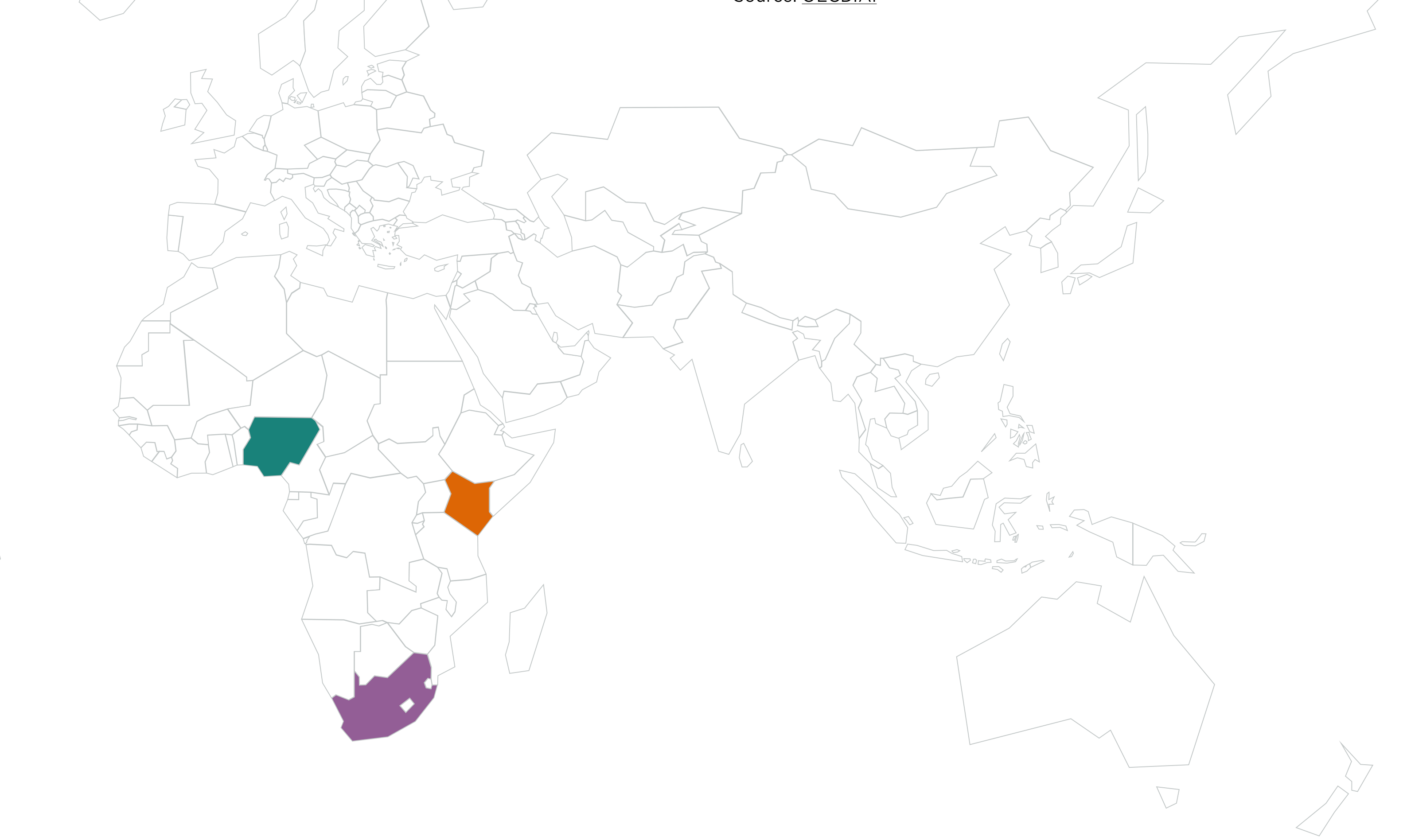
Table 5

Venture capital investments in AI by country

($ million, 2023)

KE	Kenya	15
NG	Nigeria	2.9
SA	South Africa	123

Source: OECD.AI



135 Briter Bridges. (2023). Africa Investment Report 2023.

“Risk-aversion is related to how AI in Africa is perceived by investors. Despite thriving tech ecosystems on the continent, African people are still seen as consumers of technology and AI rather than drivers of innovation. Funders need to be careful about not replicating their investment thesis from the Global North in Africa.”
– AI Startup Founder

The development of AI-enabled solutions across Africa has mostly been enabled by donor funding and philanthropic capital. However, many of these solutions are either created as part of pilot schemes or research programmes without clear sustainable pathways. There is a need for dedicated funding that can help startups and pilot projects expand their scope and become commercially viable and financially sustainable. Blending commercial capital with development funds from donors or philanthropic organisations may be an effective way of de-risking investments in AI. Development funds can be used by technology companies to innovate, test, and fine-tune their AI solutions, making them market-ready and therefore attractive for commercial investors. This would also be an effective way for more standalone donor-funded AI programmes to grow out of the pilot phase. The Global Innovation Fund, which invested in Viamo, follows such a model. It invests in innovations for social impact at scale, through grants, loans, and equity investments across all development stages from starting up and piloting projects to full-scale implementation.

Beyond supporting the development of impact-driven AI solutions, international donors and philanthropies also play a significant role in supporting the wider AI ecosystem in Africa. Initiatives include funding activities such as research on responsible and ethical AI, building local language datasets, and fostering local talent through AI skill building. Some of the key players active in financing AI include Mozilla Foundation,[136] BMGF,[137] FCDO,[138] GIZ,[139] USAID, IDRC,[140] and SIDA. Many are also involved in different partnerships such as the AI4D in Africa programme and the Lacuna Fund. While positive, these initiatives remain limited in scope given the extent of gaps. For example, creating LLMs to support use cases involves considerable resources and time, but initiatives that support dataset building tend to be underfunded with inadequate funding cycles.

Supporting research and development

Research and development (R&D) is a key pillar of building an inclusive and sustainable AI ecosystem and fully leveraging the potential of AI to create impact. Investing in research around AI can help build a workforce of local experts, enhancing the current level of representation of African AI experts in the global ecosystem. Building research capabilities, including robust datasets, compute infrastructure, and academic facilities, will also help improve the affordability and access of AI innovations for local communities.[141] Across Sub-Saharan Africa, spending on research and ICT has traditionally been insufficient and the sector is characterised by low levels of collaboration between industry and academia, undermining the ecosystem as whole.

136 Mozilla Foundation: Africa Innovation Mradi Research Grants.
137 Forbes. (2023). Gates Foundation Allocates $30 Million Towards Advancing AI in Africa.
138 FCDO. (2023). UK unites with global partners to accelerate development using AI.
139 GIZ: Fair Forward - Artificial Intelligence for All.
140 IDRC. (2023). Combining forces for a new phase of AI for development: Africa and beyond.
141 UNDP. (2023). Positioning Africa’s youth to win by harnessing AI for development.

Table 6

Country ranks for R&D capabilities

(rank out of 132 countries, 2023)

	R&D	University-Industry R&D collaboration
Kenya	119	64
Nigeria	119	122*
South Africa	53	36**

*indicates an area of weakness relative to income group
**indicates an area of strength relative to income group
Source: Global Innovation Index

South Africa appears as an outlier as it established itself as a regional leader in patents and publications, and benefits from government investment.[142] Several academic institutions have research centres dedicated to AI and other emerging technologies.[143] While Kenya and Nigeria have a less advanced ecosystem, there has been momentum in research efforts. In Kenya, private sector players and local research institutions play a key role in building R&D capabilities. Large tech companies such as Microsoft and IBM have set up local offices with research departments in the country and provide research opportunities for local researchers to work on pressing challenges for the region. There is also growing momentum in academic institutions, but more investment is needed.[144] Nigeria has seen recent government investment in the local research ecosystem through the National AI Research Scheme and partnerships, as illustrated by the launch of the AI4Dev Reference Group, a multi-stakeholder initiative.

Significant challenges will have to be addressed however, including the scarcity of local AI researchers and a resulting skills gap, especially in advanced technical and AI skills. There is also a need to increase representativeness in the sector. Across Sub-Saharan Africa, women constitute less than one-third of the R&D workforce, in large part because of the gender divide in access to training, skills and infrastructure for digital technologies.[145] Addressing these disparities and actively involving more women in research and development endeavours will be crucial for fostering a diverse and inclusive AI ecosystem.

At the regional level, international donors and private sector foundations have taken the lead in supporting research initiatives and building a research and evidence base around the use of AI on the continent. GIZ, BMGF, and the Mozilla Foundation are undertaking research projects on the use of AI for impact, funding grant programmes to explore the potential of AI to address social inequalities and justice issues and developing research guides for other stakeholders in the ecosystem to build their understanding of AI. The Mradi research grants offered by the Mozilla Foundation support research conducted by local communities in Africa around the intersections of AI with human rights, social and economic justice, gender and minorities, including people with disabilities and the LGBTQIA+ community.[146]

As advancements around AI models and applications across sectors grow rapidly, it will be important to continue exploring not just the development potential of the technology but also related areas such as the ethical, social and economic risks associated with AI. Research efforts can help AI practitioners as well as other stakeholders understand critical issues such as the responsible and ethical use of AI, ensuring accountability and oversight in its applications, the privacy and security of individuals, and gaps in implementation at the last mile, especially for women and other minorities.[147]

142 WIPO. (2023). Global Innovation Index 2023.
143 Republic of South Africa. (2022). Minister Khumbudzo Ntshavheni launches Artificial Intelligence Institute of South Africa and AI hubs, 30 Nov.
144 Tuko. (2023). AI Hackathon 2023: MKU Set to Build First Artificial Intelligence Research Center in Kenya.
145 UNESCO/OECD/IDB. (2022). The effects of AI on the working lives of women.
146 Mozilla Foundation: Africa Innovation Mradi Research Grants.
147 IRCAI. (2021). Responsible Artificial Intelligence in Sub-Saharan Africa: Landscape and General State of Play.

6. Conclusion and recommendations

This report has shown that AI is being deployed to support a range of use cases for development, albeit at varying levels. In many cases, AI is still deployed in pilots and proofs of concept, but a number of commercially viable solutions have also emerged. Development partners and other stakeholders looking to boost the ecosystem must balance their support between more mature use cases and emerging ones that have high potential for impact. Mature use cases need support with developing sustainable business models to scale, while emerging use cases require foundational support, such as unlocking access to data and testing proofs of concept. In addition, ensuring adoption and active usage of AI-enabled services requires addressing key barriers such as access to mobile devices and AI-optimised hardware, and digital skills and literacy, especially for those traditionally left behind such as low-income and rural communities, women, and persons with disabilities. As technology continues to advance, it will be critical to ensure that AI-enabled services remain available on low-tech channels to foster inclusivity.

Different stakeholders across the public and private sectors, development partners and multilateral organisations can take a number of actions and collaborate to ensure that impactful innovations in Africa can be deployed and scaled. Table 7 explores key priority actions to support various components of the AI ecosystem, including AI fundamentals and the broader enabling environment, which are crucial for developing scalable use cases and fostering adoption and usage by end users.

Table 7

Key recommendations to support AI deployment and adoption

Pillar	Recommendation	Description	Relevant stakeholders
Data	**Standardise and regularly update government datasets**	To maintain the relevance and accuracy of government datasets, it is essential to establish protocols and allocate resources for regular updates. Implementing standard data formats will facilitate easier integration into AI models and further analysis. Adhering to internationally recognised standards like the FAIR Principles[148] can further enhance the quality and accessibility of data. This entails upskilling government staff to engage in data curation activities. In addition, improving access to government data platforms, especially for local startups and researchers, will support innovation and research efforts.	Government agencies, development partners
	Invest in and increase access to local domain-specific data	There is a need to increase the availability of domain-specific datasets. This includes sector-specific primary data, such as data collected from remote sensing technology (e.g. geospatial data and agronomic data), as well as secondary data that can be integrated into AI models, such as existing domain-specific research outputs and natural language data from published papers. It is essential to address barriers such as affordability to ensure that governments, businesses and households can access hardware and devices for data collection and make it easier for entrepreneurs and researchers to access secondary data.	Development partners, domain experts (e.g. specialised research institutions)
	Support local language data development	The development of generative AI solutions and LLMs requires considerable resources. Initiatives that support dataset building tend to be underfunded with short funding cycles that often overlook the unique requirements of building local language datasets. Raising awareness about the value of language data for AI development and the requirements of building language models is essential to ensure that funding is well-tailored. Dedicated funding should go to initiatives and entities (e.g. non-for profit, universities) specialising in building such models, including those leveraging community-driven data collection methods, such as voice journaling, to gather diverse language data that reflects local dialects and usage.	DFIs, development partners, NGOs and CSOs
	Encourage participatory approaches to data collection	Encouraging participatory approaches to data collection, by leveraging community-based processes to collect, analyse and use data, can be an effective way to collect locally relevant data. This entails including community leaders in the design process and providing communities with the required digital devices and digital literacy trainings to enable them to capture data digitally.	Development partners, NGOS and CSOs
	Unlock access to existing sources of data	There are untapped opportunities to leverage existing data sources from the private sector. For example, sources such as CDR from mobile operators can significantly enhance the availability of local language NLP data. Making anonymised CDR data available to AI entrepreneurs and researchers could address significant gaps in the ecosystem. Realising this opportunity requires greater awareness, alignment of incentives and demonstration of best practices for effective engagement with mobile operators.	MNOs, Big Tech, industry associations
	Ensure data privacy and security	Ensuring data protection and privacy, particularly for personal and identifiable data, is essential for the safe and responsible development of AI solutions. For example, training language models must carefully consider and adhere to data privacy and protection regulations, including obtaining informed consent, anonymising data, ensuring robust security measures, limiting data usage to specific purposes, implementing appropriate data retention policies, and complying with relevant legal requirements.	Private sector, government agencies, development partners

148 See: FAIR Principles.

Pillar	Recommendation	Description	Relevant stakeholders
Compute	**Strengthen baseline infrastructure and promote renewable energy**	There is a need to address challenges such as power outages and to conduct energy audits in data centres to help enhance operational efficiency and foster long-term infrastructure resilience. Countries in the region are less reliant on fossil fuel than many others globally, and have a distinctive opportunity to champion innovative, green data-centre infrastructure and pioneer new approaches to clean computing. This will be essential to balance growing energy demands of the population with the energy requirements of data centres.	Government agencies, development partners, DFIs, Big Tech
	Provide credits and donate hardware	Addressing barriers to access, such as affordability, involves providing cloud credits to local startups, universities and research institutions, and students. Greater access to laptops, desktops and GPUs is needed for students, businesses and research labs. There is an opportunity to promote sustained access to credits and hardware through partnerships with the private sector. Incentives structures, such as tax benefits, brand recognition, and opportunities for collaborative research with academia, can encourage private sector participation.	Big Tech and cloud providers, government agencies, DFIs, development partners
	Increase opportunities for funding and resource sharing	For nascent compute ecosystems, collaboration is key to unlocking resources. Governments could consider creating consortiums or regional frameworks for the sharing of compute. Initiatives to attract local and foreign investments, such as investor events, could help in attracting financing. This should be coupled with an enabling regulatory environment of tax incentives and subsidies to drive investment in boosting local data centre capacity and improving access to cloud services.[149]	Government agencies, development partners
	Enhance edge computing capabilities	As the compute ecosystem develops, growing smartphone penetration means that Sub-Saharan Africa has an opportunity to leverage distributed-edge computing, reducing reliance on high-energy consumption data centres, especially where infrastructure gaps remain significant. This entails supporting device financing to increase access to smartphones and funding local initiatives building ML capabilities on edge devices, including lower-end smartphones.	Development partners, government agencies, MNOs
	Build institutional capacity	There is a need to conduct an assessment of a country's compute needs to establish roadmaps for targeted investment in infrastructure that balances funding of short-term compute assets (cloud computing) and longer-term resources (quantum computing and sustainable compute). Governments could consider establishing dedicated agencies with a mandate to coordinate and align the work of different entities engaged in compute-related activities, as well as initiating regional and international collaboration.[150]	Government, development partners

149 Tony Blair Institute for Global Change. (2023). State of Compute Access: How to Bridge the New Digital Divide.
150 Ibid.

Pillar	Recommendation	Description	Relevant stakeholders
Skills	**Enhance academic-industry collaboration**	Fostering collaboration between universities and industry to align curricula with evolving industry requirements is critical to bridge the skills gap. AI-related courses should cover both theoretical foundations and practical learning and incorporate hands-on projects to enable students to gain real-world AI experiences. For example, universities could seek partnerships with AI companies to enable students to conduct research projects that address real-world challenges identified by industry partners. Establishing mentorship schemes and inviting industry experts as guest lecturers can also increase exposure to industry practices and needs.	Government, academic institutions, development partners
	Provide financial support for skill-building initiatives	Allocating dedicated funding to support skill-building initiatives such as workshops, seminars and bootcamps can enhance AI education and capacity building. Funding should be allocated to regional initiatives and networks focused on enhancing gender equality, such as Women in AI Africa or Women in Voice Africa. Establishing scholarship programmes to support students pursuing AI-related fields and promoting gender representation in STEM subjects can help skills building while promoting diversity and inclusion. Increasing opportunities for AI scholarships at international universities can also provide students with exposure to global expertise and practices.	Government agencies, development partners
	Strengthen data curation capabilities in the public sector	There is a need to invest in building the capacity of government agencies' staff to effectively curate and manage domain-specific data and census data, which are critical resources to build AI solutions. This includes providing training and resources to government staff on data collection, storage, analysis and usage. By improving data management practices, governments can harness the full potential of their data assets to inform evidence-based decision-making and policy formulation.	Government agencies, development partners
	Build AI skills and awareness for policymakers	It is crucial to increase awareness and understanding of AI among government officials. Upskilling efforts are key to securing buy-in and fostering informed decision-making. Development partners and industry organisations can update existing training and capacity building programmes to educate policymakers about the basics of AI, its applications, and its implications for various sectors of society, including SDG fields. There is also a need to raise awareness and build knowledge on both the opportunities and risks associated with AI adoption and deployment. Empowering policymakers with this comprehensive understanding will enable them to develop policies that promote innovation while ensuring the responsible and inclusive deployment of AI technologies.	Development partners, private sector, industry associations
	Promote digital skills and literacy	Mobile is the primary delivery channel for AI-enabled services, and a key tool for generating data. Improving literacy and digital skills, which continue to be key barriers to both mobile ownership and mobile internet adoption, is essential to foster adoption and active usage of AI-enabled services. Leveraging tools such as the GSMA Mobile Internet Skills Training Toolkit can facilitate the acquisition of essential digital skills, empowering individuals to confidently navigate AI-driven technologies and fully utilise the potential of mobile platforms.	Development partners, NGOs and CSOs, industry associations
	Raise awareness on prompt-engineering	While generative AI models remain nascent in Africa, they offer significant potential to democratise access to AI-enabled services across sectors. Raising awareness and offering training on prompt-engineering will be critical to ensure users can learn how to formulate effective prompts that yield desired outcomes, in turn building trust and confidence in AI technologies. Prompt-engineering training can be incorporated into existing digital literacy and skills programmes to empower users with the skills and knowledge needed to interact effectively with generative AI applications.	Development partners, NGOs and CSOs, industry associations
	Prioritise voice-based solutions	Recognising the importance of inclusivity and accessibility, using voice-based channels for service delivery (e.g. IVR) can be a way to engage users with varying level of literacy and digital proficiency with AI applications. Voice channels can enable seamless interaction with AI systems through natural language commands. By prioritising the development and deployment of voice-based solutions, organisations can ensure that AI technologies are accessible to a broader spectrum of users, including those with limited digital skills. As technology continues to advance, it will be also critical to ensure that AI-enabled services remain available on low-tech channels (e.g. feature phones) to foster inclusivity.	Development partners, solution providers (e.g. startups, research institutions, Big Tech)

Pillar	Recommendation	Description	Relevant stakeholders
Partnerships	**Encourage public-private partnerships to strengthen AI fundamentals**	There is a need to establish PPPs to accelerate access to critical datasets and compute capacity, as well as to reduce the skills gap. For instance, companies that collect and generate data through their services can partner with public actors to improve access to domain-specific data. Capacity building of stakeholders involved in these partnerships can help mobilise and monetise these datasets, thereby improving incentives for engaging in data-sharing partnerships. Similarly, public and private sector actors can engage in consortiums to accelerate the development of infrastructure and unlock access to compute resources. Implementing incentive structures such as tax benefits and collaborative research opportunities can encourage hardware and software companies to provide essential compute resources to local actors.	Development partners, Big Tech, MNOs, IT infrastructure companies, DFIs, government agencies
	Identify and implement best practices in partnership building	When initiating partnerships, identifying best practices can help ensure that collaborations are structured effectively and achieve their intended objectives. This includes defining clear roles and responsibilities for each stakeholder within partnerships and aligning on outcomes and success measures. It also entails establishing transparent frameworks for various activities, such as data collection and sharing to ensure reliability and ethical use of data and clear guidelines for allocating compute resources. Development partners and multilateral organisations can leverage their convening power to facilitate the formation of these partnerships and provide funding and technical assistance. Importantly, partnerships must be rooted in local challenges and demands and project-scoping should always be guided by context-specific needs and pain points.	Development partners, industry associations

Pillar	Recommendation	Description	Relevant stakeholders
Financing	**Adopt a consortium-based approach to support the AI ecosystem**	A consortium-based financing approach – such as the AI4D programme[151] – can play a key role by pooling resources, given the substantial investments needed to support the ecosystem, in particular to enable greater access to the AI fundamentals. Once established, the consortium can identify shared objectives, investment areas, metrics to measure impact, and align on funding timelines and funding vehicles – whether grants, equity, blended finance tools. This approach can reduce fragmentation and duplication of efforts among development partners and multilateral organisations, ensuring better allocation of resources and fostering sustainable growth in AI innovation.	DFIs, development partners, impact investors, private sector investors
	Explore innovative finance tools to derisk investments in AI use cases	Blended finance tools that combine early-loss patient capital with commercial capital can help startups build foundational AI capabilities and test solutions before attracting commercial and long-term capital.[152] Tailoring the type of capital based on different customer segments – as seen in the case of Nithio – can reduce risk and allow for optimised resource allocation, ensuring that funding mechanisms cater to various risk profiles. Grant funders can also align reporting metrics with those used by potential commercial follow-on funders and investors to streamline requirements across players and reduce the burden for investees. To reduce inequalities and ensure equitable access to resources and opportunities, it is also important to create dedicated funding rounds for women founders.	Development partners, DFIs, private sector investors
	Provide technical assistance and go-to-market support	The provision of technical assistance and go-to-market support alongside funding represents a holistic approach to empowering startups developing AI solutions. Technical assistance includes training in AI technologies, training in data management and ML capabilities, as well as guidance on ethical AI practices while go-to-market support focuses on assisting startups in effectively bringing their AI solutions to market. It involves conducting market research, refining products based on feedback, developing sustainable business models, facilitating networking and partnerships, and ensuring regulatory compliance.	Development partners, impact investors, tech hubs, incubators and accelerators

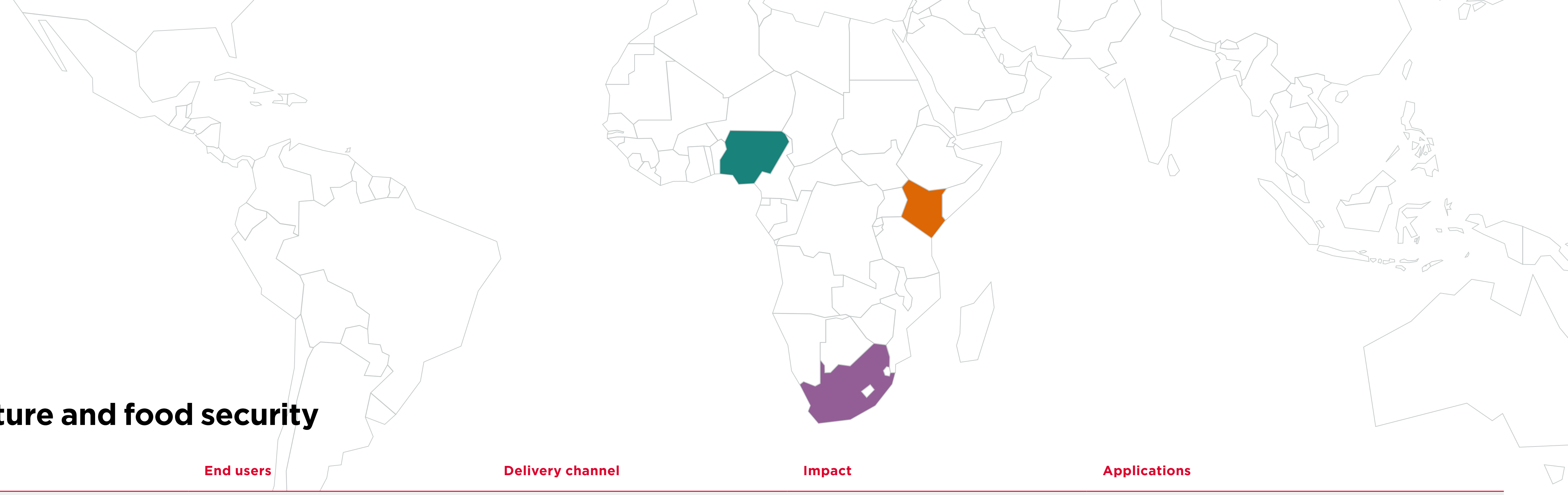
151 AI4D Africa.
152 Examples of blended finance tools being leveraged include the Agri-Business Capital Fund by the International Fund for Agricultural Development (IFAD) to provide financing for SMEs, and the USAID Power Africa Nigeria Power Sector Programme, for the installation of solar home systems in Nigeria.

Pillar	Recommendation	Description	Relevant stakeholders
Policy	**Establish an inclusive and representative policymaking process**	Having an inclusive and representative policymaking process that brings in perspectives from different stakeholders is essential to ensure that AI development benefits everyone. In addition, ensuring that marginalised groups are included in the process can help identify key priority areas for AI policies and strategies in line with the needs of various segments of society. Similarly, it is crucial to develop policies that are specifically tailored to the continent's distinctive needs and challenges rather than simply replicating strategies from other regions.	Government agencies, policy think tanks, NGOs and CSOs, industry associations, development partners
	Ensure responsible and ethical use of AI	Several institutions, including international organisations such as UNESCO[153], Mozilla Foundation[154] and the GSMA[155], have developed guidelines for trustworthy and ethical approaches to AI. When developing national AI strategies and policies, stakeholders must ensure that fairness, transparency, and accountability are integrated as the underlying principles in the development, deployment and adoption of AI.	Research organisations, NGOs and CSOs, Big Tech
	Establish a clear roadmap for policy implementation	As countries work on advancing their AI strategies, it is important that they establish a clear roadmap for implementation. This involves identifying appropriate implementation agencies within local and national governments that oversee roles and responsibilities of different stakeholders. It also entails establishing timelines for implementation and regular updates to ensure that the strategies remain relevant, as well as earmarking a portion of the national budget to support these initiatives. In addition, establishing mechanisms for continuous monitoring and evaluation of AI initiatives is essential to assess progress, identify challenges, and make necessary adjustments.	Government agencies, policy think tanks
	Introduce phased regulations to allow for AI innovation	Policymakers and regulators should encourage innovation by taking a test-and learn approach. Phasing in regulations as emerging AI use cases grow and mature, and adopting regulatory sandboxes for novel innovations, can foster an environment where innovation flourishes. This approach enables the development of evidence about new use cases, addressing regulatory concerns while allowing impactful innovations to scale and reach the marketplace. It is equally important for policymakers to continuously engage with stakeholders through joint forums and working groups to better understand what interventions could be the most effective in creating an enabling environment for AI-driven innovations. This collaboration helps to strike a balance between necessary regulation and the flexibility needed for innovation to thrive, ultimately maximising the developmental benefits of AI technologies.	Government agencies, development partners, CSOs, private sector

Pillar	Recommendation	Description	Relevant stakeholders
Research & Development	**Increase R&D funding**	Allocating more funding towards R&D for AI is essential to support the development of AI use cases. Development partners and NGOs can raise awareness on the role of R&D and build a body of evidence on the AI opportunity to encourage public investment. Dedicated grants and funding programmes can be established to support AI research projects with a focus on local challenges and solutions (e.g. research funding provided by Data Science Africa and Deep Learning Indaba). Funding may also be earmarked for women and other gender minorities, and persons with disabilities, to ensure inclusivity.	Development partners, government agencies, research and academic institutions
	Facilitate global knowledge exchanges	Research partnerships between African research and academic institutions and between local and global universities can drive momentum in R&D. Development partners are well-placed to initiate such partnerships, ensure knowledge sharing and identify best practices in building R&D capabilities, digital infrastructure requirements, and avenues for industry-academia collaboration. These partnerships can also be used to showcase African use cases to global institutions and raise awareness about local innovation.	Academic and research institutions, development partners
	Build R&D capacity to address local challenges	Events such as AI hackathons, coding competitions, and AI innovation challenges can help create a robust local research ecosystem. These programmes can include bootcamps or workshops specifically for girls and young women to reduce the gender gap in digital talent. These programmes can also focus on innovating for challenges faced by groups such as disabled and differently abled persons so that emerging AI solutions can encompass their unique needs.	NGOs and CSOs, academic and research institutions, industry associations, incubators and accelerators

153 UNESCO. Ethics of Artificial Intelligence.
154 Mozilla Foundation. Trustworthy artificial intelligence.
155 GSMA. Digital toolkit.

Annexes

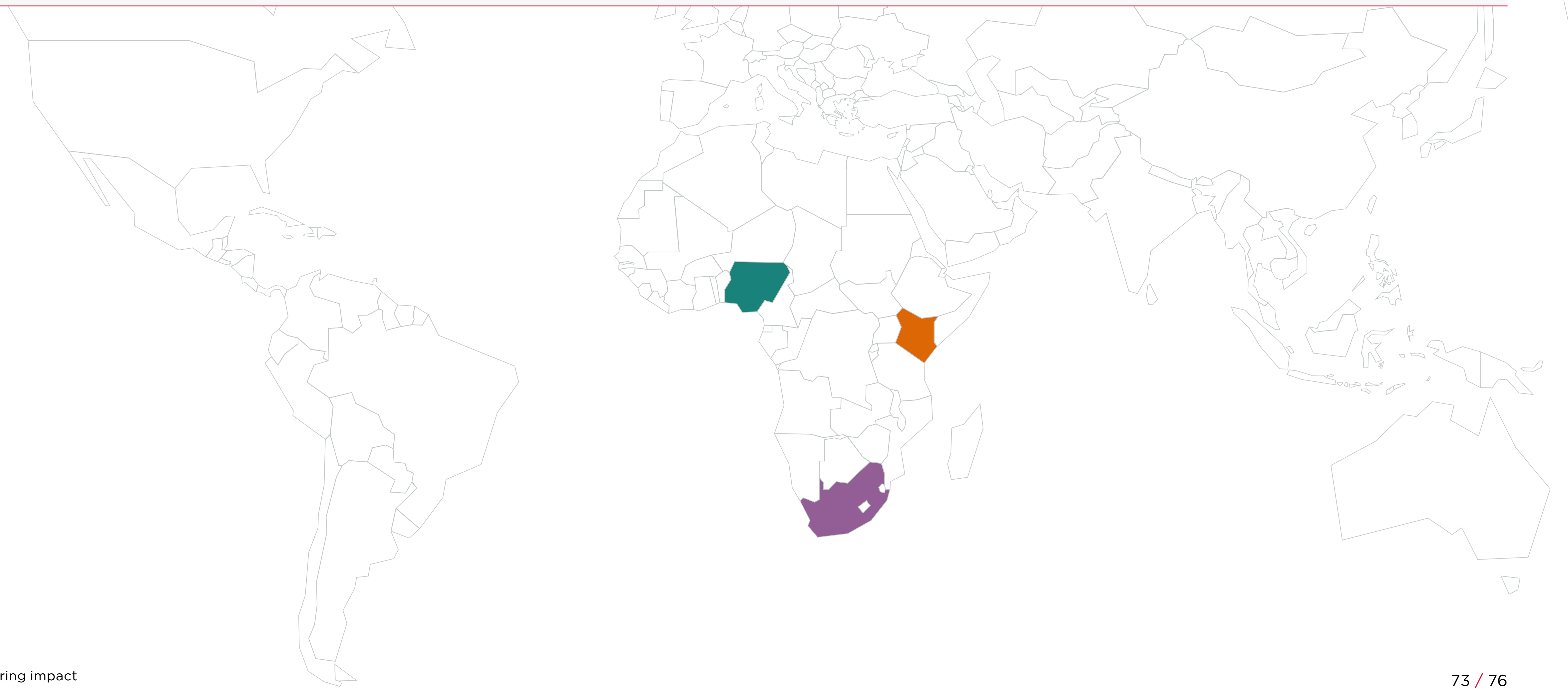


Annex 1.1: Mapping of use cases in agriculture and food security

Use case	Description	Data	End users	Delivery channel	Impact	Applications
Data-driven agri advisory	Customised advisory for climate-smart agricultural practices at the farm level (i.e. precision agriculture)	Weather data, climate data, remote sensing data, agronomic data, environmental data, domain-specific data, local language data	Smallholder farmers, extension agents, farmers cooperatives	Mobile apps, SMS alerts, face-to-face	Informed decision making, optimised resource allocation, increased yields, improved livelihoods and resilience to climate change	KE Apollo Agriculture, Amini, Aquarech, Digital Green, Kuzi, SunCulture, Synnefa, ThirdEye, TomorrowNow, UjuziKilimo NG Agroxchange Technology, Babban Gona, Crop2Cash, IAPrecision, Ignitia, Kitovu, Riwe Technologies, ThriveAgric, Zenvus SA Aerobotics, Donkerhoek Data, Southern African Agri Initiative
Agri DFS	Access to financial services, creditworthiness assessment for input or labour financing, and insurance	Farm data, geospatial data, socioeconomic data, behavioural data	Agritech startups, farmers, cooperatives, financial institutions	Mobile banking apps, online portals	Economic empowerment, digital financial inclusion, access to resources and risk-coping mechanisms	KE Apollo Agriculture, mfarmPay, One Acre Fund, Twiga Foods NG Crop2Cash, Riwe Technologies, ThriveAgric, TradeBuza
Smart farming	Crop and livestock management and mechanisation equipment	Weather patterns, crop types, agricultural activity, socioeconomic data	Farmers, community-based agents	Digital marketplaces	Optimised use of farm inputs, increase in productivity and incomes	NG FarmSpeak, Gwin Technologies KE NG Cropnuts KE NG SA Hello Tractor
Supply chain management	Optimisation of processing, storage, and distribution to reduce post-harvest loss	Crop production, yields, livestock data, market prices and trends, logistics data, weather data, quality standards data	Farmers, farmers cooperatives, agribusinesses	Mobile apps, online portals	Improved market access and competitiveness, reduction of production costs, improved quality standards	KE Baridi NG ColdHubs, Figorr, TradeBuza
Market linkages	Digital marketplaces and analysis of market trends, demand-supply dynamics and price fluctuations	Production data, market demand and supply data, market price data, geospatial data, logistics and inventory data	Smallholder farmers, farmer cooperatives, agribusinesses	Mobile apps, SMS alerts	Supply chain optimisation, market and price transparency	KE Aquarech, Twiga Foods NG Farmcrowdy, ThriveAgric SA KHULA!, The Awareness Company
Food security monitoring and forecasting	Real-time monitoring and forecasting of food security trends	Food consumption data, health records data, socio-demographic data, climate and environmental data, satellite data, political stability data, insecurity data	Humanitarian organisations, NGOs, government agencies, community-based organisations	Desktop-based data visualisation dashboards, workshops and trainings	Timely and targeted interventions, improved response strategies and resource allocation	KE Microsoft AI for Good Lab KE NG WFP KE SA ITIKI project

Annex 1.2: Mapping of use cases in energy

Use case	Description	Data	End users	Delivery channel	Impact	Applications
Predictive maintenance	Forecasting of equipment failures, optimisation of maintenance schedules and minimisation of downtime	Energy generation data, equipment performance data, maintenance logs, sensor data	Power plant operators, maintenance teams, energy generation companies	Monitoring alerts via mobile applications, web-based platforms	Enhanced energy infrastructure reliability and efficiency, optimised maintenance schedules, improved customer service	KE KenGen, Safaricom NG Beacon Power Services SA Eskom, The Sun Exchange
Smart energy management	Optimisation and real-time monitoring of energy production, distribution and consumption	Energy consumption figures, temperature readings, humidity levels, user behaviours, equipment status	Households and commercial energy consumers, facility managers, energy service providers	Mobile apps	Reduced energy waste, optimised energy consumption, cost savings, increased sustainability	KE Circle Gas, Green Innovation Ventures, KOKO Networks SunCulture NG Arnergy, Azuri Technologies, Husk Power Systems, Inq, ICE Solar, Koolboks, Odyssey Energy, OneWattSolar SA Enel Green Power
Energy access/ demand assessment	Mapping and monitoring of energy-scarce areas for targeted and tailored service extension	Socioeconomic data, household survey data, population and demographic data, geospatial data, climate data	Renewable energy companies, government agencies, international development organisations	Web-based dashboards	Evidence-based energy planning, improved access for underserved areas	KE Engie Energy Access NG Fraym, Husk Power Systems, ICE Solar, Omdena, VIDA
Productive use asset financing	Digitised innovative finance mechanisms to enable asset financing (e.g. off-grid solar and clean cooking appliances) and increase access to energy	Socioeconomic data, geographic information, repayment history, energy consumption	Off-grid communities, solar energy providers, financial institutions	Mobile apps, online platforms	Increased access to clean energy, improved livelihoods, economic empowerment of underserved communities	KE NG Nithio



Annex 1.3: Mapping of use cases in climate action

Use case	Description	Data	End users	Delivery channel	Impact	Applications
Weather services and climate modelling	Hyperlocal weather forecasts and climate modelling for climate change anticipation and adaptation	Weather data, historical climate data, remote sensing data	Smallholder farmers, agricultural communities, environmental organisations, governments	USSD, SMS, mobile apps, data visualisation dashboards	Enhanced resilience and adaptation to climate change	KE Amini, TomorrowNow SA IBM Green Horizon Initiative, Tshwane Institute of Technology, Microsoft/eThekwini Municipality, SpekTech
Disaster preparedness and EWS	Predictive analytics and real-time disaster assessment and monitoring to mitigate impacts	Disaster data, environmental data, geospatial and remote sensing data, sensor data, social media and crowdsourced data, infrastructure data, population and demographic data, MNO data	Local communities, disaster response agencies, humanitarian organisations	Online platforms, mobile applications, feature phone alerts, radio	Enhanced preparedness and response to climate disasters, timely and targeted interventions to reduce loss of life	KE Humanitarian OpenStreetMap Team, Ushahidi SA WFP KE NG SA Google Floods
Carbon credits and tracking	Monitoring, analysis, and optimisation of carbon trading activities to facilitate compliance, trading decisions and carbon footprint reduction strategies	Carbon emissions and pricing data, market activity data, data on emissions reduction projects, financial data, supply chain data	Businesses, corporations, carbon offset projects	Online platforms or mobile applications for trading carbon credits	Reduction of greenhouse gas emissions, incentives for carbon sequestration projects	KE Boomitra, Verst Carbon NG Chemotronix
Biodiversity monitoring	Assessment and tracking of changes in ecosystems, species distribution, and habitat health	Geospatial and remote sensing data, habitat health indicators, historical data, climate data, species distribution data	Environmental agencies, conservation organisations, government bodies	Interactive maps, web-based platforms, community workshops	Conservation of biodiversity hotspots, sustainable land management, ecosystem restoration	KE Amini, AstraZeneca/Earthbanc, EarthAcre, National Tree Growing and Restoration Campaign, Microsoft AI for Good Lab KE SA Connected Conservation Foundation
Wildlife protection/ HWC prevention	Monitoring of wildlife habitats, detection of illegal activities (e.g. poaching) and support towards conservation efforts	Camera data, sensor and acoustic data, remote sensing data, population and species distribution data	Wildlife conservationists, park rangers, environmental researchers	SMS alerts, online dashboards	Reduced illegal wildlife trade, preservation of endangered species habitats	KE Microsoft AI for Good Lab, Safaricom/ Vodafone SA FruitPunch AI, Rainforest Connection

Annex 1.4: Example of a cross-sector use case

Use case	Description	Data	End users	Delivery channel	Impact	Applications
Cross-sector/ digital inclusion	Access to information through generative AI technology operating on user prompts and NLP	Domain-specific data, local language data	Individuals and households	IVR, SMS, mobile apps	Improved access to essential information and customised advisory services, reduced digital divide	NG Viamo

Annex 2: List of organisations consulted

Global/Regional

- Centre for the Fourth Industrial Revolution (C4IR)
- Carnegie Mellon University
- Data.org
- Digital Umuganda
- FAO
- GIZ (FAIR Forward)
- Global Innovation Fund
- Global Partnership for Sustainable Development Data
- IDRC
- Mozilla Foundation
- Smart Africa Alliance
- Tony Blair Institute for Global Change
- Viamo
- WFP
- World Bank

Kenya

- Briter Bridges
- Dedan Kimathi University of Technology
- Development Gateway
- Digital Green
- DoveTail
- EarthAcre
- Fastagger
- Founders Factory Africa
- GIZ (FAIR Forward)
- Global Partnership for Sustainable Development Data
- IBM Research Africa
- IDRC
- IDX Africa
- Centre for Africa Epistemic Justice
- Kenya National Innovation Agency
- Kenya's Special Envoy for Technology
- Local Development Research Institute
- Microsoft AI for Good Lab
- Microsoft Africa Research Institute
- Qhala
- Science for Africa Foundation
- Strathmore University (CIPIT)
- SunCulture
- Tech Innovators Network (THiNK)
- TomorrowNow
- Verst Carbon
- WFP

Nigeria

- AI in Nigeria
- Autogon AI
- Awarri
- Chevron
- ColdHubs
- CoAmana
- Crop2Cash
- Data Science Nigeria
- Federal Ministry of Communications, Innovation and Digital Economy
- Fedironics
- FarmSpeak
- Farmz2u
- Fraym
- Gwin Technologies
- Itana
- Koolboks
- Lagos Business School
- National Information Technology Development Agency
- Renewable Energy Association of Nigeria
- Riwe Technologies
- Rise Networks
- Tech Hive Advisory
- ThriveAgric
- University of Lagos
- Wootlab Foundation

South Africa

- 22 on Sloane
- African Union
- Data Economy Policy Hub
- Dimagi
- Discovery Health
- Geekulcha
- Genesis Analytics
- GIZ (FAIR Forward)
- Human Sciences Research Council
- Innovation Matters
- Innovate UK
- Institute for the Future of Work
- mDoc
- MomConnect: Ada Health
- Mozilla Foundation
- Tshwane University of Technology
- University of Pretoria
- Vambo AI
- Veluka Platform

GSMA Head Office
1 Angel Lane
London
EC4R 3AB
United Kingdom
Tel: +44 (0)20 7356 0600