GSMA

AI for Africa: Use cases delivering impact

Kenya deep dive

July 2024

GSMA

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries challenges, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

We invite you to find out more at www.gsma.com

Follow the GSMA on Twitter/X: @GSMA

UK International Development
Partnership | Progress | Prosperity

This initiative has been funded by UK Aid from the UK Government and is supported by the GSMA and its members. The views expressed do not necessarily reflect the UK Government's official policies.

GSMA Central Insights Unit

The Central Insights Unit (CIU) sits at the core of GSMA Mobile for Development (M4D) and produces in-depth research on the role and impact of mobile and digital technologies in advancing sustainable and inclusive development. The CIU engages with public and private sector practitioners to generate unique insights and analysis on emerging innovations in technology for development. Through our insights, we support international donors to build expertise and capacity as they seek to implement digitisation initiatives in low- and middle-income countries through partnerships within the digital ecosystem.

Contact us by email: centralinsights@gsma.com

AXUM

Axum is an Afrocentric impact company dedicated to fostering climate-positive, digitally innovative, inclusive growth across Africa, the Middle East and around the world. The company works with locally and globally influential leaders that seek to drive sustainable development, inclusion and prosperity.

Through strategic leadership and the ability to transform ideas into reality, Axum partners with diverse stakeholders to drive positive change. Boasting over 150 years of collective leadership experience, and a team of nearly 100 across 10 offices in Africa and the Middle East, Axum leverages a wealth of multisectoral and multicultural expertise to help clients navigate pressing global challenges and realise Africa and the Middle East's immense potential.

Author and contributors

Author: Eugénie Humeau

Contributors: Tanvi Deshpande and Daniele Tricarico

Acknowledgements
This report draws on research conducted for the GSMA by Axum. We would like to thank Gathoni Kang'ethe, Jamila Raji, Jonathan Munge, Salma Ait Hssayene, Isis Nyong'o Madison and Robin Miller for their contribution.

We would like to thank the many individuals and organisations that contributed to the research. A full list of organisations consulted for the research in Kenya is listed in Annex 3. We are particularly grateful to Dr Angella Ndaka (Centre for Africa Epistemic Justice), Antony Sure (Verst Carbon), Brian Omwenga (Tech Innovators Network), Dr Jacki O'Neill (Microsoft Africa Research Institute), Jason Njoroge Kabi (Dedan Kimathi University of Technology), Leonida Mutuku (Local Development Research Institute), Linet Kwamboka (Global Partnership for Sustainable Development Data), Loise Ochanda (IDRC), Mark Gachara (GIZ – FAIR Forward), Dr Melissa Omino (Centre for Intellectual Property and Information Technology Law), Mutembei Kariuki (Fastagger), Sarah Spencer (Independent Consultant), and Dr Watu Wamae (Africa Oxford Initiative) for their participation in our focus group discussion in Nairobi.

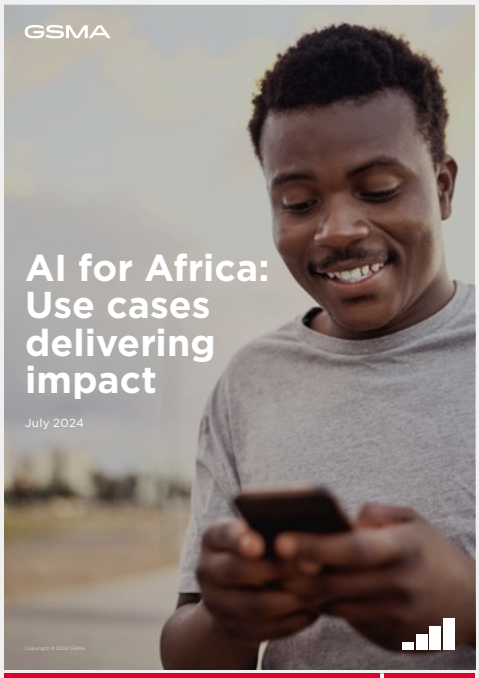
Contents

1. Introduction

Kenya is a lower-middle income country with a population of around 55 million people. The country has made significant political and economic reforms that have contributed to sustained economic growth, social development, and political stability gains over the past decade. Kenya continues to show resilience in the face of recent shocks and its growth is projected to reach 5.2% between 2024-2026. However, the country still faces considerable development challenges, including poverty, inequality, youth unemployment, governance and accountability issues, climate change, weak private sector investment, and economic vulnerability to internal and external shocks.[1]

Despite these challenges, Kenya has emerged as a technology leader in Africa, with a dynamic tech ecosystem and pioneering mobile money through M-Pesa. Several global tech giants have opened local offices in Nairobi, underscoring the country's growing role in the global tech landscape. Mobile broadband coverage is near universal and a large majority of the population (92% of men and 91% of women) own a mobile device.[2] Smartphone penetration is currently at 50% in Kenya and projected to reach 81% by 2030.[3] However, the usage gap remains high, especially in rural areas.[4] The high cost of devices and mobile internet, as well as limited knowledge and skills, still constitute key barriers to access and usage. Addressing these foundational challenges will be key to harness the potential of AI in Kenya without leaving anyone behind.

While there are key gaps that need to be addressed, there is huge potential for Kenya to build on its thriving tech ecosystem and solid digital foundations to unlock the potential of AI and accelerate its development trajectory. This report showcases existing and emerging AI-enabled use cases and solutions that can address development challenges related to agriculture and food security, energy and climate action in Kenya. It explores the key requirements for the development of use cases and provides an overview of the AI ecosystem to identify gaps and opportunities to leverage AI for development. The report is one of three detailed country-level reports examining the potential of AI for development in Kenya, Nigeria and South Africa. It complements the primary report, 'AI for Africa: Use cases delivering impact', which introduces key concepts around AI and includes regional and sectoral insights.



Download here

1 See: World Bank Kenya Overview.
2 GSMA. (2024). The Mobile Gender Gap Report 2024.
3 GSMA. (2023). The Mobile Economy Sub-Saharan Africa 2023.
4 The usage gap refers to the proportion of the population that lives within the footprint of a mobile broadband network but does not use mobile internet. Typical barriers include affordability, literacy and digital skills, relevance, safety and security, and access. See: GSMA. (2024). The Mobile Gender Gap Report 2024.

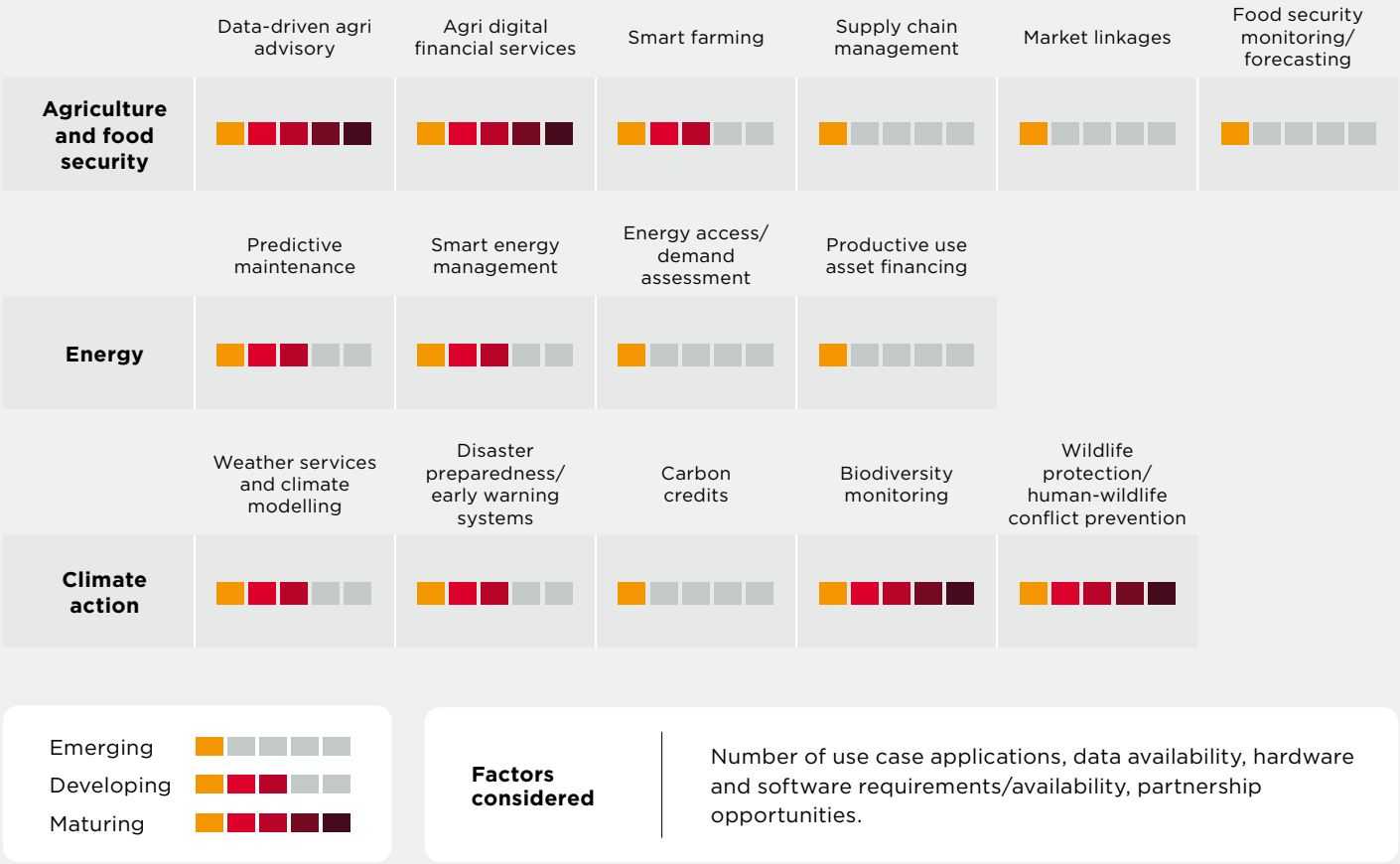
2. Use cases delivering impact

Kenya's Bottom-Up Economic Transformation Agenda (2022-2027) aims to deliver on five core pillars, including agriculture and the digital economy. The agenda prioritises economic empowerment at the grassroots level, aiming to enhance the productivity and income of small-scale farmers, informal sector workers, and micro, small, and medium enterprises (MSMEs). It also reasserts the country's ambition to achieve universal access to electricity and the potential to leverage renewable sources of energy.[5] The government's commitment to green growth, highlighted by initiatives such as the Nairobi Declaration from the Africa Climate Summit, fosters development, integration and investment in AI technologies for climate action.[6]

AI can be transformative in advancing sustainable development efforts in Kenya and the technology is already being used to develop solutions across sectors and use cases (Figure 1). This section explores the potential of AI in agriculture and food security, energy and climate action in Kenya. It includes spotlights on specific use case applications, with additional examples provided in Annex 1. The full list of use case applications considered for the analysis in Kenya is provided in Annex 2.

Figure 1

Heatmap of AI use cases in Kenya



Note: author's assessment based on the sample of use case applications included in this research.

5 Kenya Kwanza UDA. (2022). The Bottom-Up Economic Transformation Agenda 2022 – 2027.
6 African Union. (2023). The African Leaders Nairobi Declaration on Climate Change and Call to Action.

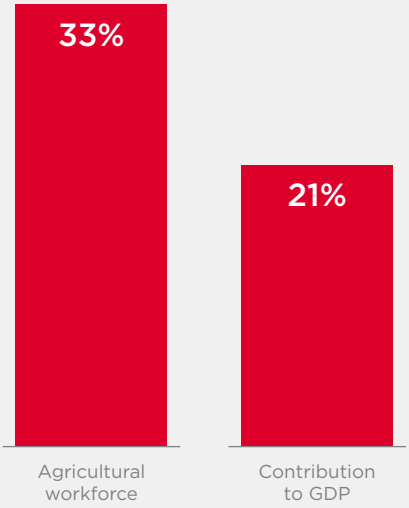
Agriculture and food security

Kenya's agricultural sector is critical to the national economy, employing around one-third of the workforce, contributing to one-fifth of gross domestic product (GDP) and accounting for more than 65% of exports.[7] A large majority of the agricultural labour force is engaged in smallholder rural farming, yet smallholder farmers are exposed to a number of systemic challenges that lower their productivity and incomes and reduce food supply. Limited access to formal financial services and identification documents prevents them from qualifying for loans, resulting in poor access to quality agricultural inputs such as seeds and fertilisers. Similarly, limited access to information means farm management decisions are made without knowledge of the weather forecast, market demand and prices, and other essential farm-specific data.[8] Input and distribution markets are unstructured and volatile, leading to unpredictable fluctuations in pricing and supply chain inefficiencies.[9]

Figure 2

Agricultural contribution to labour force and GDP in Kenya

(2022)



Source: World Bank

In addition, smallholder farmers are under growing pressure from climate change, given their reliance on natural resources and lack of access to appropriate risk-coping mechanisms. The majority of Kenyan agriculture relies on seasonal rains for production and the projected changes in precipitation patterns are expected to directly increase the likelihood of short-term crop failures and long-term production declines. Rain-fed agriculture remains the predominant source of staple food production and accounts for the livelihoods of the majority of the rural poor in Kenya.[10] High variability in annual precipitation has devastating consequences on rural livelihoods, leading to frequent droughts and floods in arid, semi-arid, and agricultural regions. Moreover, indirect effects like runoff, soil erosion, and crop damage from wildlife, insects, diseases and weeds compound production losses.[11]

Inefficiencies in food systems, combined with growing pressure from climate change, exacerbates food insecurity. Access to adequate quantities of food remains a challenge for many, especially in arid and semi-arid regions[12] which make up 80% of the country's land area, and for the urban poor. Around 26% of the population does not have sufficient food consumption. In 2023, approximately 4.4 million people faced high levels of acute food insecurity, with 774,000 people considered in emergency.[13]

Table 1

Hunger assessment in Kenya

(2023)

	GHI score (out of 100)	GHI rank (out of 125)	Severity scale
Kenya	22	90	Serious
Sub-Saharan Africa	27	-	Serious

Source: Global Hunger Index

7 World Bank. (2021). Climate Risk Country Profile Kenya.
8 FAO. (2021). Digital Agriculture Profile Kenya.
9 See: Digital Agriculture Profile Kenya.
10 World Bank. (2021). Climate Risk Country Profile Kenya - CGIAR.
11 Ibid.
12 Food insecurity is especially prevalent in eight arid and semi-arid counties: Turkana, Marsabit, Samburu, Isiolo, Wajir, Mandera, Garissa and Tana River.
13 ReliefWeb. (2023). Kenya: IPC Acute Food Insecurity and Acute Malnutrition Analysis. 'People in Emergency' refers to the penultimate Phase 4 of the Integrated Food Security Phase Classification (IPC). Phase 5 indicates a state of catastrophe where famine has occurred.

The role of digital and AI

The use of digital technologies can mitigate the challenges Kenyan smallholder farmers face, and help agricultural value chains function better, especially at the last mile. Weather and climate services offer farmers vital information to adjust their practices based on anticipated conditions or respond to impending extreme weather events. Digital advisory services support farmers' decision-making, while agricultural digital financial services (agri DFS) enable access to inputs and assets for climate-smart practices.[14,15] Kenya's efforts to digitalise the wider economy have had significant spillover effects for agritech companies targeting smallholder farmers. Kenya has one of the largest agritech and agribusiness ecosystems in Africa with established companies such as Apollo Agriculture, iProcure, and SunCulture.

Incorporating AI to these digital services has the potential to significantly enhance their effectiveness and amplify their impact. Machine learning (ML) algorithms can support use cases such as crop management and precision agriculture, bringing digital advisory to the farm-level and enabling real-time monitoring, predictive analytics and resource optimisation. For example, Amini and TomorrowNow (Spotlight in Annex 1) are utilising high-resolution remote sensing data and farm-specific agronomic data to train AI models. These models play a crucial role in translating complex data into actionable and customised recommendations on planting times, irrigation schedules and fertiliser usage. Digital Green launched an AI-powered assistant for tailored agricultural advisory services by leveraging the emergence of large language models (LLMs) and generative AI (Spotlight 1).

AI can also facilitate access to inputs and equipment through smart-sharing platforms and AI-powered credit scoring models leveraging alternative sources of data. Hello Tractor, a tech platform that has created a digital marketplace for agricultural mechanisation, worked with Atlas AI to build a predictive demand model for tractor utilisation in Kenya and Nigeria.[16] Agritech companies such as Apollo Agriculture (Spotlight in Annex 1) and mfarmPay have developed new AI-enabled credit scoring models to expand rural access to finance, using satellite imagery data of farms and AI to rate the creditworthiness of farmers.[17] Companies like Baridi enhance supply chain management by maintaining optimal storage conditions for perishable products to reduce waste through IoT and AI technologies. It is worth noting that many organisations offer a bundle of services aimed at digitising value chain activities to provide holistic support to smallholder farmers.

AI can also play a role in addressing food security challenges, helping estimate the number of food insecure individuals and identifying malnutrition hotspots. For example, the World Food Programme (WFP) piloted a project in a Kenyan county to digitise nutrition records in remote health clinics (Spotlight 2), while the Microsoft AI for Good Lab developed a spatiotemporal ML model to detect malnutrition hotspots.[18] These initiatives aim to enable timely interventions and targeted assistance, mitigating the impact of malnutrition and fostering food security for vulnerable populations.

14 GSMA. (2021). Digital Innovation for Climate-Resilient Agriculture: Using rainfall data from mobile networks for localised and scalable services.
15 GSMA. (2023). Improving Farmer Livelihoods Through Digitised Agricultural Value Chains: Results and lessons from the GSMA Innovation Fund.
16 See: Atlas AI Case Study.
17 Financial Times. (2023). AI and space technology boost smallholders' access to finance.
18 Microsoft. (2024). AI in Africa: Meeting the Opportunity.

Spotlight 1
Digital Green enhances agricultural advisory services with generative AI

Digital Green has been supporting the transformation of extension systems in Kenya since 2019, when the company first introduced its signature community video programme to equip farmers with timely and actionable information to combat crop pests and diseases effectively. Digital Green's approach involves collaborative efforts with farmers, governments, community organisations and private partners who are the key stakeholders in ensuring the sustainability and scalability of its initiatives in Kenya's extension ecosystem. Using this approach, Digital Green launched Farmer.Chat in Kenya in September 2023.

Farmer.Chat is an AI-powered chatbot designed to provide tailored assistance to extension workers, thereby enhancing the efficiency and effectiveness of agricultural advisory services to farmers. The domain-specific chatbot draws insights from various curated sources, including advisory videos, call centre logs and vetted factsheets developed in collaboration with Kenya's extension systems. This enables extension agents to view upcoming tasks, log feedback, and retrieve advisory information to answer queries from farmers. Farmer.Chat facilitates speedy and efficient agroecology-specific agricultural extension content for farmers.

Farmer.Chat is being rolled out in collaboration with the Kenya Agriculture and Livestock Research Organization (KALRO) and eight county governments of Nyeri, Meru, Nakuru, Uasin Gishu, Nandu, Kirinyaga, and Murang'a. So far, these collaborations have onboarded over 6,000 extension agents, who have exchanged over 134,000 messages in two languages (Swahili and English). It is being rolled out in additional value chains, including cabbage and poultry, in addition to the initial dairy, coffee, and potato value chains.

By concentrating on a select range of commodities and geographical areas, Digital Green aims to refine Farmer.Chat's model, gather user feedback and familiarise extension agents with the chatbot. Farmer.Chat's adaptable architecture allows for the inclusion of additional features, commodities and practices covered by Digital Green's repository of video advisories across various locations. For example, Farmer.Chat is designed to seamlessly integrate with diverse systems, including government-managed Interactive Voice Response (IVR) systems. This integration enables farmers with limited access to smartphones to access and receive advisory recommendations, thereby promoting inclusivity and accessibility in agricultural information dissemination. Moving forward, Digital Green plans to expand Farmer.Chat's coverage to encompass a wider array of commodities, geographies and practices.

Food security monitoring/forecasting

Spotlight 2
WFP's Meza app empowers remote health workers

WFP and Charitable Analytics International collaborated to develop the Meza app, an AI-powered tool that enables community health workers in remote and low-resource clinics to rapidly collect nutrition and related health data. Currently implemented in 58 health clinics in Turkana County, it helps the WFP and government to have the information they need to provide high-quality, context-specific and timely nutrition support.[19]

The Meza app uses Optical Character Recognition (OCR), a sub-field of computer vision which enables the digitisation of handwritten health records by reading text inside photographs and extracting data from photographs and logbooks. Health clinic workers take a picture of log-book entries with low-end smartphones and send it via Meza to the AI engine which extracts the data. The data is instantly accessible to analysts in regional or international offices and to local governments.[20,21]

Results revealed that health workers are able to spend 20% less time reporting, giving them more time to focus on providing healthcare services. Having access to the data has enabled government officials to tailor interventions, such as providing efficient procurement of medication and supplements for target populations. This has resulted in improved health outcomes and in turn improved economic productivity. Initially launched in Kenya in 2021 after a pilot in the Republic of Congo, the project is currently in a scale-up phase to expand to other remote facilities in the arid and semi-arid regions of Kenya.

19 See: WFP Innovation Accelerator – Meza.
20 See: Charitable Analytics International – Meza.
21 See: AI for Good – WFP.

Key takeaways and considerations for AI deployment

In Kenya, agriculture is seeing a rise in AI innovation, driven by a thriving agritech ecosystem. AI solutions in agriculture represent around half of the total use cases identified in Kenya across sectors. Most use case applications fall under data-driven agri advisory and agri DFS (Table 2). 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 precision agriculture technologies such as IoT sensors or drones. These technologies are critical enablers to collect data at the farm-level, such as soil moisture or crop health, but remain expensive and out of reach for many smallholder farmers. AI applications that provide access to markets and inputs appear at a more nascent stage, with only a few examples identified in supply chain management and market linkages. The availability of data such as real-time market dynamics and the interoperability of data management systems may constitute a barrier to their development.

Most of the identified use case applications rely on predictive AI, using existing data to make predictions and provide tailored information and advisory services. While nascent, there is immense potential for generative AI solutions based on text or speech recognition. In addition to Digital Green, organisations like TomorrowNow are exploring the integration of generative AI in their digital advisory services, but face constraints in terms of computational capacity and access to data. Promoting the development of generative AI, especially voice-based solutions, can reduce the risks of exacerbating digital divides for farmers with low literacy or with disabilities. According to the 2023 GSMA Consumer Survey, around one-third of Kenyans still reported reading and writing difficulties as a barrier to mobile internet adoption.[22] Promoting digital skills and literacy and ensuring that services are available on lower-end mobile devices will be critical to ensure adoption across marginalised groups, such as women farmers.

22 GSMA. (2024). The Mobile Gender Gap Report 2024.

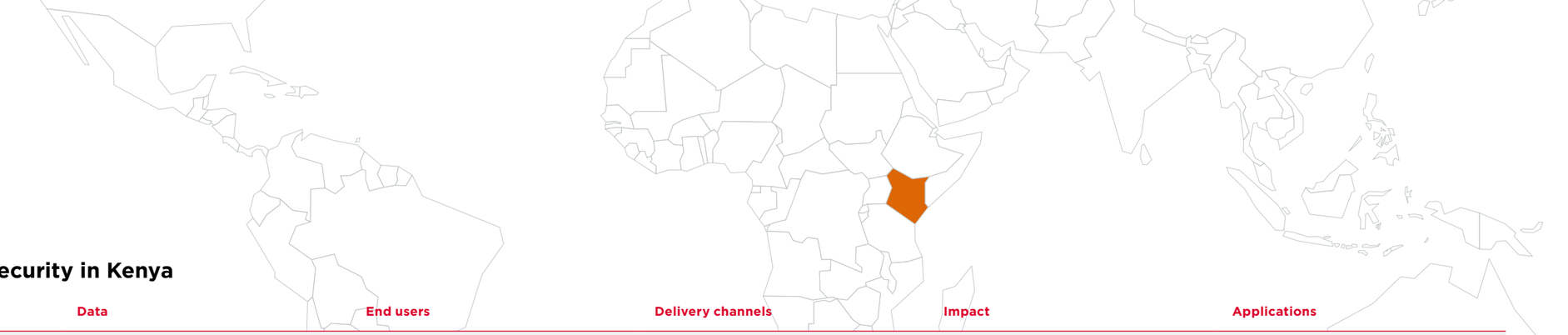


Table 2

Mapping of use cases in agriculture and food security in Kenya

Use case	Description	Data	End users	Delivery channels	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, farmer cooperatives	USSD, SMS, apps, extension agents	Informed decision making, optimised resource allocation, increased yields, improved livelihoods and resilience to climate change	Apollo Agriculture, Amini, Aquarech, Digital Green, Kuzi, SunCulture, Synnefa, ThirdEye, TomorrowNow, UjuziKilimo
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 credit and financial services, improved financial inclusion, risk management	Apollo Agriculture, mfarmPay, One Acre Fund, Twiga Foods
Smart farming	Crop and livestock management and mechanisation equipment	Weather patterns, crop types, agricultural activity, socioeconomic data	Farmers, community-based agents	Mobile apps, digital marketplaces	Optimised use of farm inputs, increase in productivity and incomes	Cropnuts, Hello Tractor
Supply chain management	Optimisation of processing, storage, and distribution to reduce post-harvest loss	Storage and logistics data, market prices and trends, weather information	Farmers, cooperatives, agribusinesses	Mobile apps, online portals	Reduced food waste, better quality standards, improved market access	Baridi
Market linkages	Digital marketplaces and analysis of market trends, demand-supply dynamics and price fluctuations	Production data, market supply and demand data, market price data, geospatial data, logistics and inventory data	Smallholder farmers, farmer cooperatives, agribusinesses	Mobile apps, SMS notifications	Supply chain optimisation, market and price transparency	Aquarech, Twiga Foods
Food security monitoring/ 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/conflict 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	ITIKI project, Microsoft AI for Good Lab, WFP

Energy

Energy plays a pivotal role in Kenya's development agenda and continued efforts to improve the population's standard of living. Kenya was one of the first countries in Sub-Saharan Africa to institute market-oriented reforms, supported by the World Bank, which separated key sector functions.[23] The main players in the sector include KenGen (Kenya Electricity Generating Company), responsible for energy generation, KETRACO (Kenya Electricity Transmission Company), responsible for electricity transmission, and KPLC (Kenya Power and Lighting Company), the main distribution company.[24]

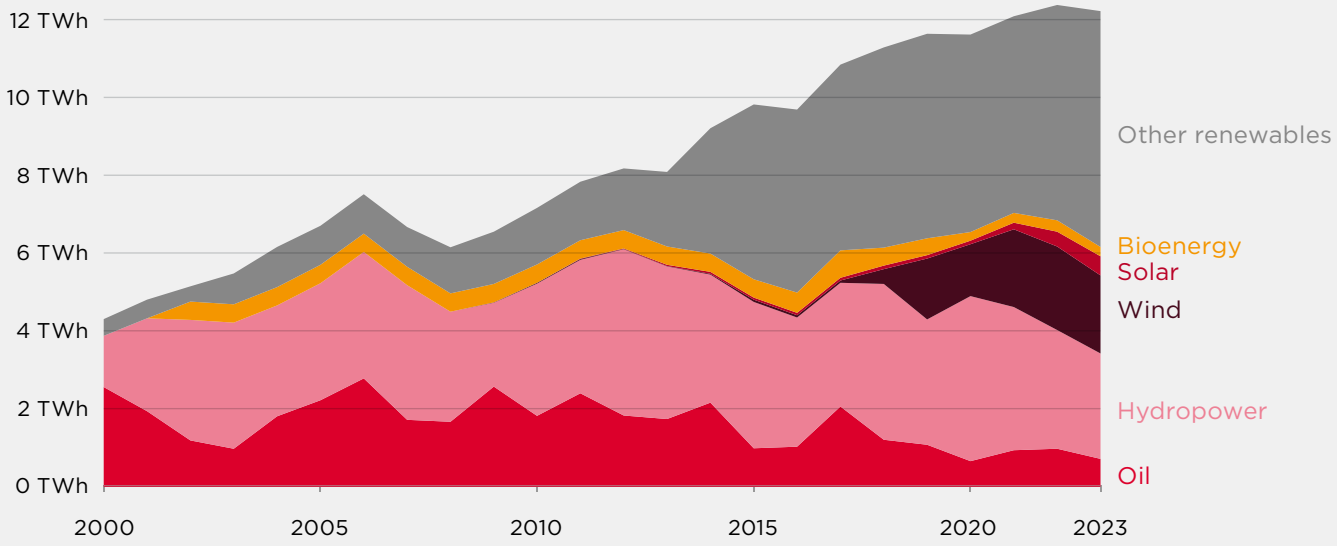
Kenya has achieved remarkable success in expanding generation capacity and developing a well-diversified generation mix, with more than 90% of energy generated from clean sources, including 48% from geothermal. Kenya has more than quadrupled its geothermal capacity in the last 10 years, and developed other sources of clean energy such as hydro (33%) and wind (12%). However, some of its clean energy potential, particularly solar, remains untapped. Biomass remains the main source of energy for 68% of households, especially for cooking and heating.[25]

Access to electricity increased from 20% in 2010 to over 75% of the population today in 2021.[26] However, over one-third of the rural population does not have access to electricity.[27] In addition, despite upgrades of the transmission and distribution systems, electricity access remains unreliable due to frequent power outages, and utilities grapple with high technical and commercial losses, as well as high upfront costs for the expansion of infrastructure.[28,29] Utilities like KPLC particularly struggle with expanding connections, declining revenue from commercial-industrial customers, and declining profits.[30]

Figure 3

Electricity production by source in Kenya

(terawatt-hours, 2000-2023)



Note: electricity is just one component of total energy consumption – the other two being transport and heating. The electricity mix should not be misinterpreted as the breakdown of the total energy mix.
Source: Energy Institute

23 World Bank. (2023). Kenya Green and Resilient Expansion of Energy Program.
24 See: Kenya overview - GET.invest
25 Only 30% of rural households and 54% of urban households currently use clean cooking technologies and fuels. See: Ministry of Energy. (2022). Behaviour Change and Communication Strategy for Promoting Clean Cooking in Kenya 2022.
26 See: World Bank data.
27 See: Tracking SDG 7.
28 IASS. (2022). Fostering a sustainable and secure energy supply for Kenya: The role of grid quality, energy market structure, and decentralisation.
29 World Bank. (2021). Climate Risk Country Profile Kenya.
30 Energy for Growth Hub. (2020). The problem with Kenya Power's revenue model in three graphs.

The role of digital and AI

Digitalisation of the grid infrastructure can facilitate the development of a smart grid and deliver significant efficiency gains. Smart grids, supported by digital technologies like smart and IoT sensors, enable operators to monitor and forecast demand more accurately and detect faults in real time, ensuring continuity of supply, improving reliability and reducing costs.[31] Following the installation of 67,000 smart meters, KPLC grew its annual sales by Sh347 million.[32] Smart meters also empower customers to monitor their consumption patterns via mobile apps. Although the use of IoT in Kenya's national grid remains limited, KenGen installed IoT technologies at the Olkaria Geothermal Power Station to enhance operations and maintenance at the facility.[33]

AI can further optimise operations by reducing inefficiencies and lowering operations costs. Safaricom, for example, uses AI and ML algorithms to deactivate idle equipment during periods of low usage.[34] The growing use of IoT technologies can be an entry point for the incorporation of AI, due to the complementarity of the two technologies. However, many of the initiatives supporting the deployment of sensors are funded by development partners and Development Finance Institutions (DFIs). Like many utility providers, Kenya's energy utilities operate in challenging financial environments that make it difficult to justify investment in new technologies, and may limit their potential for scale.[35] Given that Kenya has the largest wind power plant in Africa, there is also an opportunity for wind power generators to use AI to predict output using weather data, enhancing storage and energy dispatch.[36]

Digital technologies can also support decentralised supply options to deliver energy to remote communities. With two-thirds of the microgrids identified by the Africa Minigrid Developers Association, Kenya is the regional leader in microgrid deployments.[37] Kenya has also pioneered the use of PAYG Solar Home Systems (SHS) to provide cost-effective energy solutions, with established companies such as Sun King and M-KOPA. IoT-enabled PAYG models are being replicated in adjacent sectors in Kenya, such as irrigation (SunCulture), clean cooking (M-Gas and SimGas), and water (CityTaps).[38] The use of IoT is common in PAYG models and AI facilitates the efficient processing of vast amounts of data gathered by IoT sensors, supporting smart energy management for both energy providers and customers.

There is also huge potential for AI to improve planning and deployment of decentralised energy solutions and bridge access in rural areas and for low-income customers. Geospatial data modelling can support energy prioritisation and micro-level planning required for last-mile access. For example, ENGIE Energy Access and Atlas AI leveraged predictive AI for a pilot project seeking to identify areas with potential demand for solar appliances (Spotlight in Annex 1).[39] Nithio leverages geospatial data combined with other data sources to provide a sustainable, risk-informed approach to finance aggregated receivables for the off-grid solar sector (Spotlight 3).[40] Use case applications such as Nithio also look at projected customer creditworthiness and the different types of financing off-grid solar providers would need to extend energy access to different sets of communities, such as commercial capital for low-risk customers and grant or results-based financing funding[41] for higher risk and lower-income customers.

31 IASS. (2022). Fostering a sustainable and secure energy supply for Kenya: The role of grid quality, energy market structure, and decentralisation.
32 Business Daily. (2024). Smart meters lift Kenya Power's sale by Sh347m.
33 CIO Africa. (2022). KenGen Installs IoT Technology at Olkaria Power Station.
34 Converge. (2023). Safaricom Kenya deploys Nokia AVA Energy Efficiency.
35 GSMA. (2023). IoT and Essential Utility Services: Opportunities in low- and middle-income countries.
36 Odero, H. et al. (2022). Wind Energy Resource Prediction and Optimal Storage Sizing to Guarantee Dispatchability: A Case Study in the Kenyan Power Grid. Journal of Electrical and Computer Engineering.
37 AMDA. (2021). Benchmarking Africa's Minigrids Report 2022.
38 GSMA. (2023). IoT and Essential Utility Services: Kenya market case study.
39 See: Atlas AI and Engie Energy Access Partnership Case Study.
40 Receivables financing is a financial method where businesses use their outstanding invoices as collateral to secure immediate cash from lenders or financial institutions. See: GSMA. (2023). Digitalising Innovative Finance: Emerging instruments for early-stage innovators in low- and middle-income countries.
41 In an RBF scheme, funders make payments to an agent who assumes responsibility for achieving predefined results. Funding is then released upon the independent verification of achievement of these results by a third party. Such approaches shift the financial risk associated with the non-delivery of results from the donor to the recipient. See: GSMA. (2023). Digitalising Innovative Finance: Emerging instruments for early-stage innovators in low- and middle-income countries.

Spotlight 3
Nithio uses AI and blended finance to make receivables financing more accessible

Nithio is a climate fintech platform that seeks to address the investment gap in Africa's sustainable energy transition to facilitate access to off-grid solar. It unlocks finance at scale and directs it towards highly impactful efforts that improve energy access and build climate resilience and adaptation. The company has standardised credit risk assessments to develop capital into solutions that help achieve universal energy access and address climate change.[42]

Nithio's Risk Analytics Engine calculates the real value vs. the face value (contracted) of a ring-fenced receivables portfolio on a discounted basis by directly accessing the CRM systems of distributors. AI helps process this raw, anonymised customer repayment data, which is then combined with a rich database of geospatial, socioeconomic, demographic and climate data. Together, these serve as the training datasets for Nithio's AI models. The resulting predictive valuation can then facilitate a structured repayment or ownership transfer scheme in case the distributor fails. Such an approach enables subsidies, grants and concessional funding to support the deployment of receivables finance to distributors that would otherwise be ineligible for such solutions.[43,44]

By taking over the servicing of a portfolio of receivables in case the company fails, Nithio ensures that all stakeholders benefit. The receivables can continue to be serviced sustainably, energy customers do not lose access to their products, and investors are repaid. Through its blended-finance vehicle, Nithio finances not only large solar companies, but also small and medium local operators who often reach last-mile customers, with the goal to increase access to and lower the cost of financing for the clean energy sector. Nithio is also committed to expanding equitable energy access by incentivising solar companies to prioritise women customers.[45]

42 See: Nithio.
43 Nithio. (2023). Nithio's SOLAR ("Servicer of Last Resort") Solution.
44 GSMA. (2023). Digitalising Innovative Finance: Emerging instruments for early-stage innovators in low- and middle-income countries.
45 Nithio. (2023). Nithio's Innovative Gender Lens Financing – Incentivizing Borrowers to Expand Equitable Energy Access.

Key takeaways and considerations for AI deployment

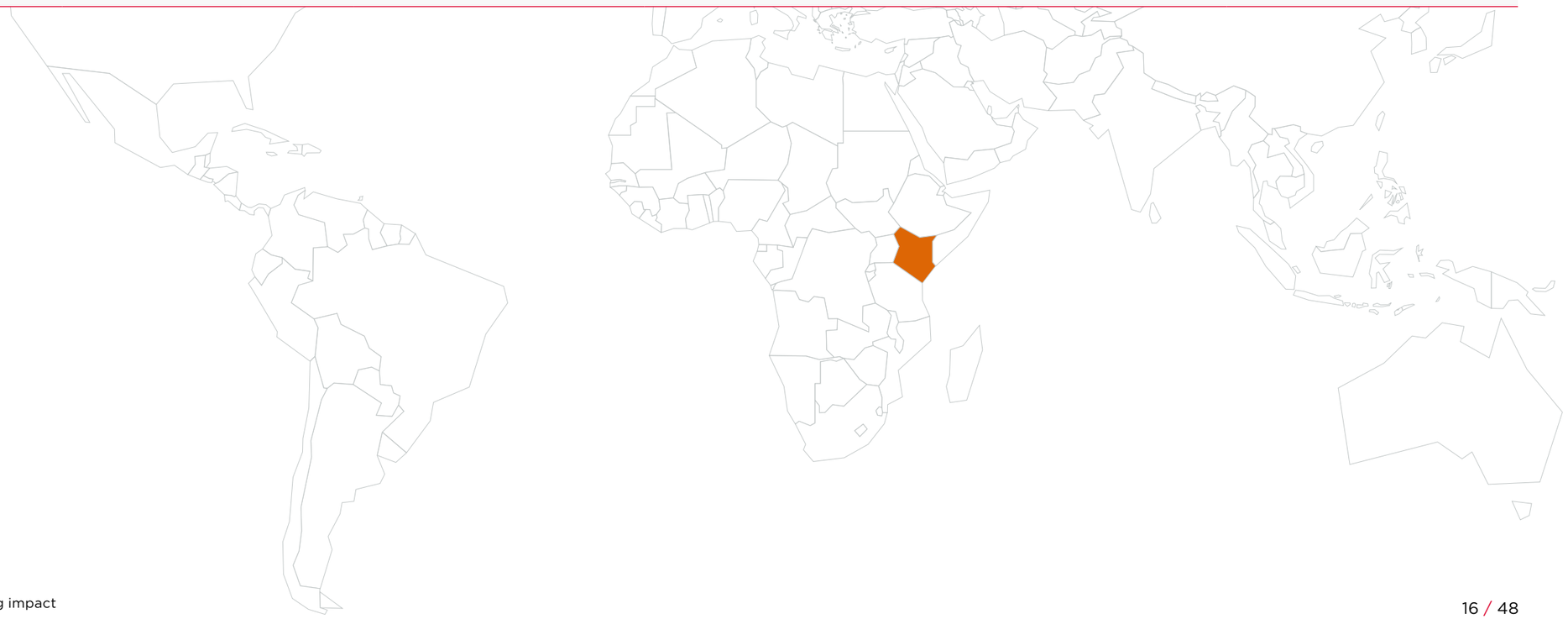
As Table 3 shows, fewer use case applications were identified in the energy sector in Kenya compared to agriculture, which reflects the relative performance of the sector in expanding and diversifying generation capacity. Despite this, there is an opportunity to leverage AI to drive efficiency, sustainability and resilience for both on-grid infrastructure and off-grid systems. Scaling predictive maintenance and smart energy management use cases will require significant investment in technologies such as IoT sensors and smart meters to facilitate data collection. Yet the high costs of hardware pose a significant barrier. Public utilities, which face significant financial challenges, and off-grid energy providers, often with limited resources, may lack the necessary funds to invest in these technologies. Many of the established off-grid solar providers have secured funds from international donor organisations and development partners.

Energy access and demand assessment and productive use asset financing remain nascent use cases in Kenya but present significant potential to bridge the energy gap in rural areas. They support both private energy providers in their expansion strategies and government agencies to inform policymaking in energy planning. However, there are still risks that energy providers lack incentives to expand in low-income and low-density areas due to limited return on investment prospects. This highlights the need for blended financing mechanisms combining commercial capital with grant funding. In addition, these use cases require extensive resources, including advanced data analytics platforms and sophisticated AI models, to process diverse datasets and unstructured data. Significant data gaps remain, especially in terms of data quality and representativeness. This may explain why these use cases are primarily led by international organisations like Nithio, ENGIE Energy Access and Atlas AI. These organisations have in-house cutting-edge AI and ML capabilities and the necessary resources to conduct rapid and targeted data collection to offer unique localised population data to enable comprehensive understanding of the current state of demand-side considerations.

Table 3

Mapping of use cases in energy in Kenya

Use case	Description	Data	End users	Delivery channels	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	KenGen, Safaricom
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, online dashboards	Reduced energy waste, optimised energy consumption, cost savings, increased sustainability	Green Innovation Ventures, KOKO Networks, SunCulture
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, industry organisations, development partners	Web-based dashboards	Evidence-based energy planning, improved access for underserved areas	ENGIE Energy Access, 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	Nithio



Climate action

While Kenya has very low greenhouse gas emissions, it is highly vulnerable to the impacts of climate change. Kenya accounts for less than 0.1% of global emissions[46] but is ranked 41 out of 185 countries in terms of its vulnerability to climate change (Table 4). Temperatures in Kenya are projected to continue rising by 1.7°C by the 2050s and by approximately 3.5°C at the end of the century (Table 5).[47]

Table 4

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

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

Table 5

Projected changes in temperature and precipitation

CMIP5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.5 to +1.4** (+1.0°C)	**+1.2 to +2.4** (+1.7°C)	**+2.0 to +3.7** (+2.5°C)	**+2.7 to +5.1** (+3.5°C)
Annual Precipitation Anomaly (mm)	**-13.7 to +21.6** (2.6 mm)	**-17.1 to +25.2** (3.5 mm)	**-17.0 to +34.0** (6.7 mm)	**-17.8 to +44.0** (10.5 mm)

Note: Bold value is the range (10th – 90th percentile) and values in parentheses show the median (or 50th percentile)
Source: World Bank

Climate change is expected to increase the risk and intensity of flood events as well as increase average rainfall amounts, while also furthering the likelihood of droughts for some areas across Kenya. Flood and drought events are already becoming more frequent, with drought cycles occurring every two to three years instead of every five to 10 years. Droughts have the most severe impact in the country's arid and semi-arid areas, which comprise 18 of the 20 poorest counties. Floods have caused significant losses in terms of human life and disproportionately affect the lower-income population who reside in informal settlements and more hazard prone areas.[48] In May 2024, the country experienced some of its worst weather events in years, with floods causing loss of life and displacement.[49,50]

In addition, Kenya's biodiversity and environmental ecosystem is under increasing strain due to population pressures, coastal erosion, deforestation and poor land management, combined with seasonal variability and climate change. This threatens the country's unique biodiversity and wildlife, as well as local livelihoods for a significant segment of the Kenyan population. Deforestation has exacerbated water scarcity. The country's montane forests, known as 'water towers' due to their ability to store water during the rainy season and release it during dry periods, provide 75% of the country's fresh water supplies. Yet thousands of hectares of forest have been lost in the past two decades, and estimates suggest that the resulting costs to the economy far exceed the financial gains from forestry and logging.[51]

46 See: International Energy Agency - Kenya.
47 World Bank. (2021). Climate Risk Country Profile Kenya.
48 Ibid.
49 Al Jazeera. (2024). Why has the flooding in Kenya been so devastating?
50 Financial Times. (2024). Kenya brings in emergency measures to combat 'unprecedented' floods.
51 The Africa Report. (2019). Kenya has lost nearly half its forests – time for the young to act.

The role of digital and AI

Digital solutions play a pivotal role in addressing challenges that are linked to climate change by supporting mitigation strategies, building the resilience of vulnerable communities, and driving sustainable use, management and protection of natural resources. For example, mobile-based early warning systems (EWS) provide timely alerts for disasters and climate-related events such as heatwaves and flooding,[52] while weather and climate services support farmers to better adapt to the effects of climate change. Recently, innovative solutions for natural resources management (NRM), such as payment for ecosystem services, where local communities receive financial incentives for managing land or natural resources, has increased in East Africa, including in Kenya. For example, Greenstand has developed a tracking mobile app that incentivises reforestation efforts by compensating community members for planting and caring for trees.[53]

AI has the potential to be integrated into climate tech solutions to enhance their effectiveness and impact. Organisations like Ushahidi and Humanitarian OpenStreetMap Team (HOT) use AI and advanced analytics for EWS and disaster management, providing open-source data and crisis mapping to help disaster responders reach those in need.[54,55]

In NRM, EarthAcre use spatial technologies for biodiversity and ecosystem management (Spotlight in Annex 1).[56] In addition to providing actionable insights for climate-smart farming practices, Amini layers satellite data with data on soil quality, topography and climate patterns to assess the effectiveness of reforestation initiatives and predict long-term sustainability.[57] Several organisations also seek to address human-wildlife conflict (HWC), such as the Microsoft AI for Good Lab's project with the Kenya Wildlife Trust and the Smithsonian Conservation Biology Institute (Spotlight 4). Similarly, Vodafone and Safaricom developed m-Twiga, a tool that utilises infrared cameras and AI to act as an early warning system, preventing HWC by detecting and deterring predators from attacking livestock while notifying communities of the presence of wildlife species (Spotlight in Annex 1).

52 GSMA. (2021). The Climate Crisis: Mobile-enabled solutions in humanitarian emergencies.
53 GSMA (2024). The Nature Tech Nexus: Bridging biodiversity and business.
54 See: Ushahidi
55 See: Humanitarian OpenStreetMap
56 See: EarthAcre
57 See: Mapping deforestation: How satellite data drives reforestation efforts - Amini

HWC prevention

Spotlight 4
Microsoft AI for Good Lab: leveraging AI for human-wildlife conflict resolution

The Microsoft AI for Good Lab focuses on empowering partners to tackle local challenges using AI, providing resources such as technology and expertise. The AI for Good Lab – Africa team based in Nairobi has been working with local partners to address human-predator conflict in the Maasai Mara. Communities living in the reserve coexist with an array of predatory species and, as their population expands, they clash with predators more frequently. This affects livelihoods as predators attack livestock housed in poorly protected cattle enclosures (bomas). As a result, communities, fearing for their livelihoods, resort to predator killings.

Microsoft's initiative employs high-resolution satellite imagery and ML to detect bomas and differentiate between occupied and unoccupied enclosures. It relies on widely-used methods in the field of semantic segmentation, such as tasks in computer vision that involve partitioning an image into multiple segments and assigning a label to each segment. By leveraging geospatial ML capabilities, the project is aiming to automatically identify hotspots of conflict and mitigate human-predator clashes through scalable cost-effective AI models.

In this project, Microsoft partnered with the Kenya Wildlife Trust, which provided domain expertise and ground truth data on wildlife conflict in Kenya, and the Smithsonian Conservation Biology Institute, which provided high-quality satellite imagery crucial for ML models. Both organisations provided local and domain expertise that was necessary for the AI for Good Lab to build its model with accuracy.

This project enabled the Kenya Wildlife Trust to design targeted interventions, such as constructing predator-proof bomas, thus mitigating conflict and protecting endangered species. Microsoft continues collaborating with the two organisations to ensure the data's accuracy and usability in conservation. The project, which started in 2023 as a pilot, has the potential to be scaled across other countries facing similar challenges, such as Tanzania.[58]

58 Microsoft. (2023). Wildlife conflict resolution: Boma & cattle detection in the Masai Mara using AI

Key takeaways and considerations for AI deployment

Most of the climate-related use case applications identified in Kenya fall under NRM, particularly biodiversity monitoring (Table 6). This trend can be explained by the increasing availability and accessibility of satellite imagery, 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. The Microsoft AI for Good Lab, for example, plays a leading role in providing project-based support to local partners. Many of the climate-related use case applications follow a business-to-government or business-to-business approach, delivering products or services to inform decision-making for environmental protection and biodiversity conservation at the ecosystem level. Some use cases, such as EarthAcre, directly target local communities, allowing them to be recognised and compensated for their role in NRM by receiving carbon and biodiversity credits.

As most of the climate use case applications are led by ecosystem-level stakeholders such as government agencies or environmental organisations, they are more likely to follow a top-down approach. This comes with the risk of disempowering local communities, exacerbating inequalities, and resulting in unintended consequences if solutions are poorly designed. Integrating local and indigenous communities in project design and implementation and consulting with them to account for social and cultural contexts is critical to ensure inclusivity, effectiveness and sustainability. While community members may lack technical expertise, their traditional ecological knowledge can enhance the interpretation of environmental and biodiversity changes captured by remote sensors. The value of indigenous knowledge has been recognised by the Group on Earth Observations (GEO) Indigenous Alliance, who use hackathons to co-design creative digital solutions with indigenous communities. In 2020, the Alliance held a hackathon that gave way to a digital solution for the Samburu community in Northern Kenya, allowing community members to design their own maps to document their land's natural resources and important locations.[59]

59 Space4Innovation. (2021). From Indigenous Hackathon to Empowerment: Namunyak App paves the Way for Climate Action.

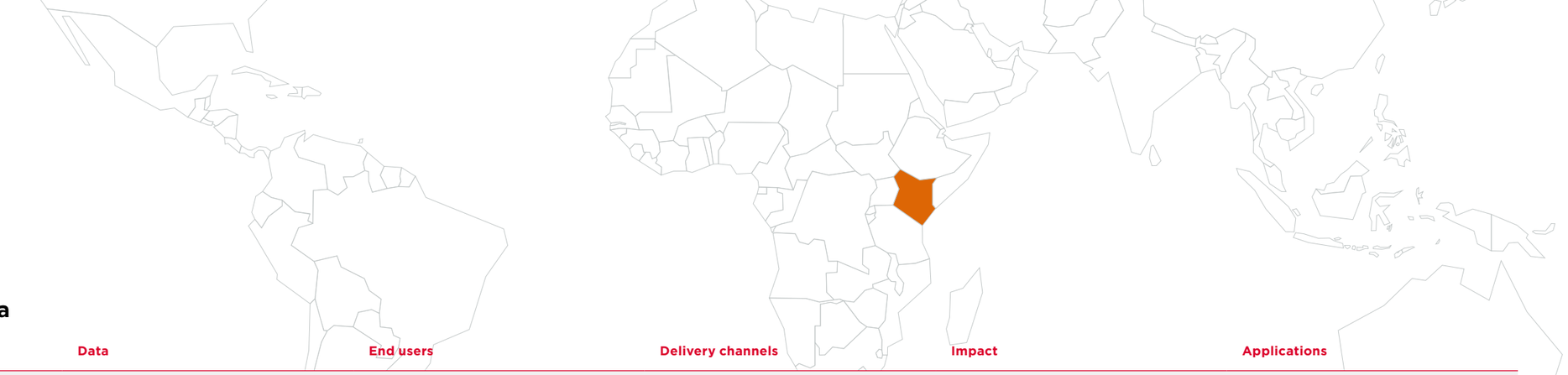
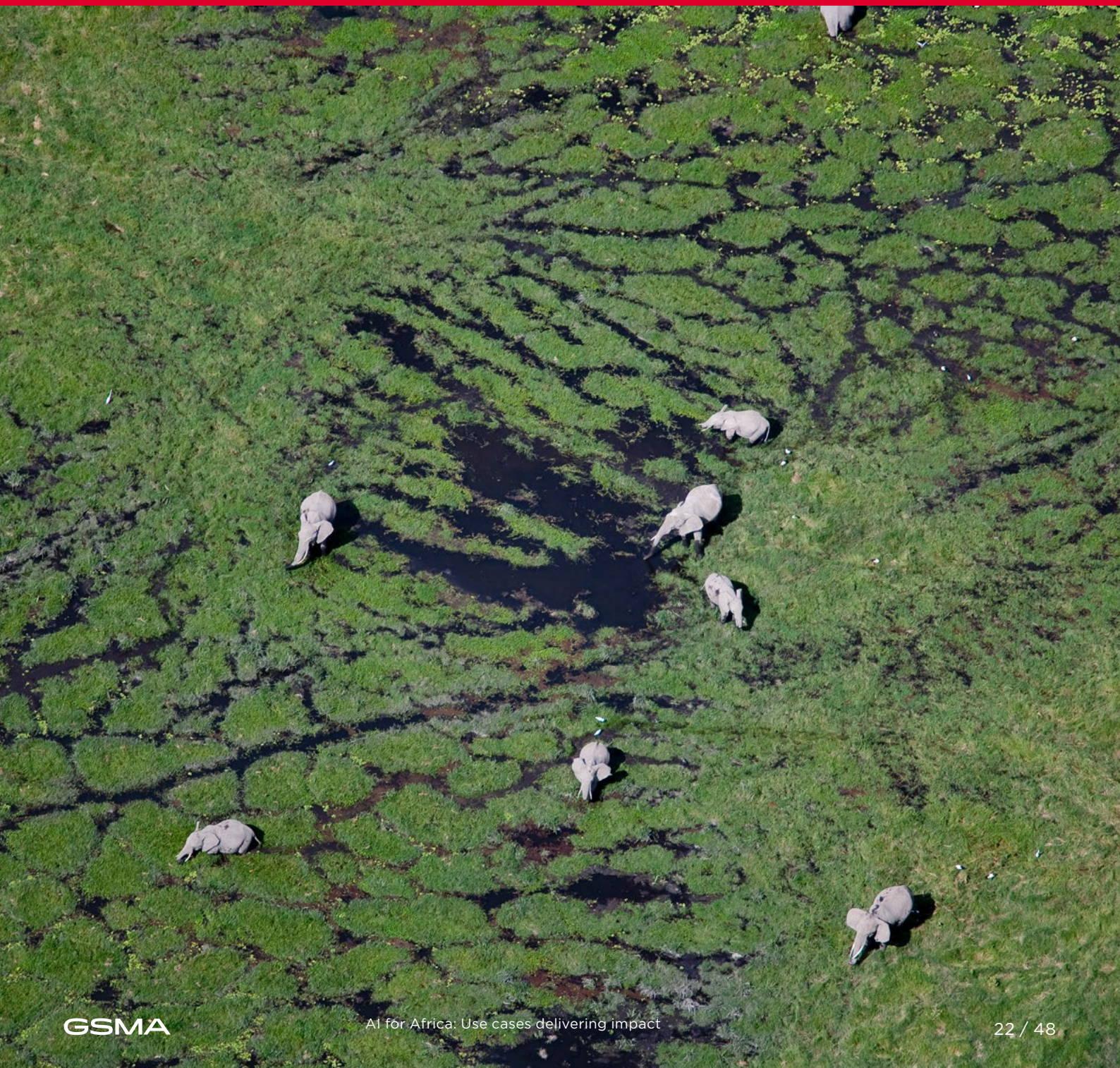


Table 6

Mapping of use cases in climate action in Kenya

Use case	Description	Data	End users	Delivery channels	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, government agencies	USSD, SMS, mobile apps, data visualisation dashboards	Enhanced resilience and adaptation to climate change	Amini, TomorrowNow
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, social media and crowdsourced data, infrastructure data, population and demographic data, MNO data	Local communities, disaster response agencies, humanitarian organisations	SMS notifications, mobile apps, radio	Enhanced preparedness and response to climate disasters, timely and targeted interventions to reduce loss of life	Google Floods, Humanitarian OpenStreetMap Team, Ushahidi
Carbon credits	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, incentivising carbon sequestration projects, fostering sustainable development	Boomitra, EarthAcre, Verst Carbon
Biodiversity monitoring	Assessment and tracking of changes in ecosystems, species distribution, and habitat health	Geospatial and remote sensing data, habitat health indicators, climate data, species distribution data	Environmental agencies, conservation organisations, government agencies	Interactive maps, web-based platforms, community workshops	Conservation of biodiversity hotspots, sustainable land management, ecosystem restoration	Amini, AstraZeneca/ Earthbanc, Connected Conservation Foundation, EarthAcre, National Tree Growing and Restoration Campaign, Microsoft AI for Good Lab
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	Microsoft AI for Good Lab, Safaricom/Vodafone

3. Building a thriving AI ecosystem



The successful development and deployment of AI-enabled use cases depends on the establishment of robust AI fundamentals, encompassing factors such as data availability and quality, capacity and skills, and infrastructure and compute capacity. It also relies on the broader enabling environment, which includes critical enablers such as strategic partnerships, sufficient and targeted investment and funding, conducive policy frameworks, and dedicated research and development (R&D) efforts. Figure 4 illustrates the key actors involved in building and strengthening Kenya's tech and AI ecosystem along these enablers through various initiatives. This section explores existing gaps and opportunities to strengthen Kenya's ecosystem and unlock the potential of AI to support the Sustainable Development Goals.

Figure 4

Key ecosystem players in Kenya

Government agencies	KALRO; KNBS Kenya National Bureau of Statistics; Kenya Space Agency; Ministry of Information, Communications and The Digital Economy
Development partners	UK International Development; giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH; Bill & Melinda Gates Foundation; IDRC · CRDI; Tony Blair Institute for Global Change; Artificial Intelligence for Development Africa
Digital infrastructure/ HPC providers	aws; kenet Kenya Education Network; Konza Technopolis; NVIDIA; Olkaria ecocloud Data Centre; iXAfrica DataCentre
Data and NLP initiatives and organisations	Lacuna Fund Our voice in data; Common Voice; Kenya Open Data Initiative; Digital Earth Africa; AMINI; Kenya Space Agency
Capacity building initiatives and organisations	Ajira; Moringa Discover · Grow · Transform; WiMLDS Women in Machine Learning & Data Science; Impact Hub Nairobi; iHub
Academic and research institutions	Strathmore University Centre for Intellectual Property and Information Technology Law; IBM Research; CIPIT Centre for Intellectual Property and Information Technology Law; Microsoft AI for Good Lab; LDRI Local Development Research Institute; MARI
MNOs and industry associations	Safaricom; airtel; GSMA; Communications Authority of Kenya

AI fundamentals

Data

The development of AI-enabled use cases and solutions requires availability and access to high-quality and trustworthy data. Existing and emerging use cases identified in Kenya show the diversity of data that is needed for AI models, from micro and macroeconomic data to sector-specific data such as climate and weather data or energy consumption data. While locally relevant data is increasingly accessible, it remains limited and tends to be more easily accessible to the bigger players, such as technology companies.

In Kenya, data collection and availability has significantly improved over the years, led by both public and private sector initiatives. The Kenyan government has been committed to building and providing open-source access to data. It has built national datasets, such as the Census from the Kenya National Bureau of Statistics (KNBS), and sector-specific datasets from the Kenya Open Data Initiative. These datasets can be useful for use cases that require socioeconomic and population data, but AI practitioners face issues with the quality of existing datasets, which are often incomplete, outdated, or in inadequate formats.

Many use cases have emerged with the increased availability of geospatial and remote sensing data. While geospatial data has traditionally been collected by international space agencies, such as NASA and the European Space Agency, independent and pan-African actors are playing an increasingly important role. Actors like Digital Earth Africa and Kenya Flying Labs enable free access to satellite data and drone data services that can be used for a wide range of use cases across sectors, such as tracking changes in land use, monitoring natural disasters, and predicting crop yields. Companies like Amini have been able to leverage such data to build new datasets, providing tailored insights that are crucial for farmers and agri-businesses, environmental organisations, researchers and policymakers. In 2023, Kenya's Space Agency deployed its first Earth observation satellite into space, with the aim to supply the government with imagery for agricultural and NRM decisions and reduce dependence on global vendors of space technology.[60]

However, use cases that rely on LLMs, which can be applied across sectors, remain limited due to the low availability of local language datasets. As a result, generative AI solutions, which rely on user prompts, also remain at a nascent stage, despite having immense transformative potential. Among the use case applications identified, only Digital Green has developed text recognition, although several organisations, like TomorrowNow, are also exploring how to incorporate a generative AI component into their solutions. These solutions are available in English and Swahili, but the lack of local language datasets still undermines the quality of responses in Swahili.

Several initiatives are working to address that gap by creating open-source language datasets. Examples include the Mozilla Common Voice Project, which seeks to build voice datasets in Swahili, and the Lacuna Fund, which supports the creation of a language corpus with Kenyan languages such as Swahili, Luo and Luhya, in partnership with the University of Nairobi. However, such initiatives are often dependent on grants and donor funding, posing limitations to their sustainability and potential for impact at scale. Data curation is expensive and challenging to undertake, and remains undervalued and therefore underfunded, affecting the quality of AI models. Several experts pointed to the disconnect between current funding and the required level of investment and expertise to create and manage language datasets. In addition, while making data open source is considered positive and increasingly a condition for donor funding, it does not necessarily promote a level playing field as smaller, local actors cannot always comply with this requirement.

> "The amount of effort and money it takes to build and manage datasets is underestimated, and therefore often undervalued and underfunded. Funding cycles are often short and not aligned with these requirements."
>
> **– Focus group discussion participant**

60 The Africa Report. (2023). Kenya's Taifa-1, the first satellite designed locally, rockets into the space economy.

There are also untapped opportunities to leverage data from the private sector. For example, MNOs have vast amounts of data, such as call detail records, which can be anonymised and aggregated and used to build language corpuses and voice datasets. 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.[61] However, a lack of clear data-sharing frameworks give 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. In addition, the lack of perceived benefit for sharing their data can act as a barrier, given the inherent cost of extracting and analysing mobile indicators.

Compute and infrastructure

Kenya is emerging as a regional leader in terms of infrastructure for physical storage. Its data centre capability is expanding at a rapid pace, but this brings environmental considerations. Data centres, such as Konza Technopolis, are sometimes located in semi-arid and water scarce areas, yet they have substantial water demands.[62] In a context of increasing demand for power, Kenya has the opportunity to tap into its geothermal resources to establish green data centres, in line with its dedication to green growth. The Olkaria Ecocloud Data Centre is Africa's first data centre fully powered by geothermal energy.[63] It is located in the Rift Valley near Lake Naivasha in Nakuru County, with multiple lakes as water sources.[64]

Beyond physical infrastructure, Kenya is fostering the development of local hardware capabilities. For example, the Dedan Kimathi Science and Technology Park (DeST-Park), hosts the Ol Borana System, the first advanced semiconductor manufacturing system designed and built in Kenya. The private sector also contributes to hardware development, such as Semiconductor Technologies Limited, which focuses on semiconductor and chip manufacturing, and Gearbox, which specialises in Printed Circuit Boards Assemblies, which are crucial components of various hardware applications.[65] Raspberry Pi is now manufacturing hardware in Kenya, although it cannot run large models such as LLMs.[66] Overall, local compute capabilities remain small in scale and still lag in high-performance computing (HPC).

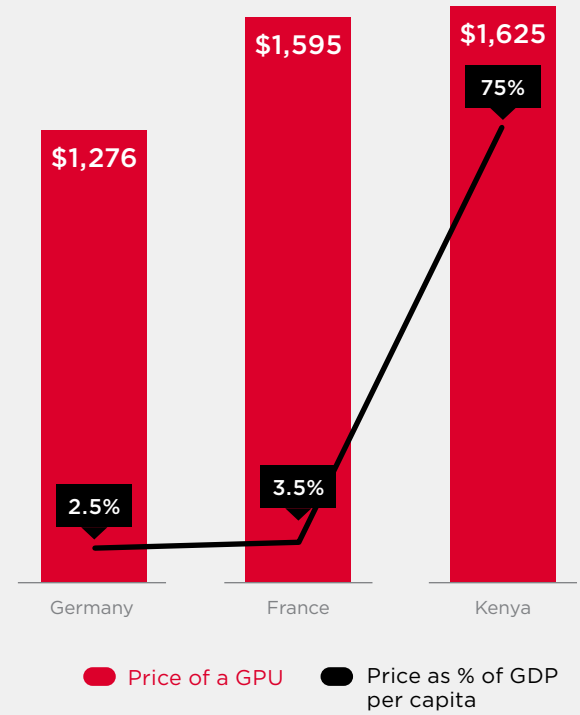
The high costs of computing constitute a major barrier to the development of the local ecosystem. For smaller organisations such as local startups and research institutions, the cost of the requisite computing to run complex models far exceeds their budgetary capabilities. In Kenya, the price of graphic processing units (GPUs) represents 75% of GDP per capita, making it 31 times more expensive than in high-income countries (Figure 5).[67] As a result, developers turn to large tech players such as Microsoft's AI for Good Lab and IBM Research Africa that provide cutting-edge infrastructure and computing resources to local actors. Similarly, the Kenya Education Network (KENET) provides HPC and storage services at no cost for researchers and academics to increase their research output.[68] While positive, these initiatives remain limited in scope, highlighting the need to expand domestic or regional capabilities and provide financing mechanisms for better access.

61 GSMA. (2019). Mobile Big Data Solutions for a Better Future.
62 Buildesign. (2017). Is Konza city really sustainable?
63 Business Daily (2023). Kenya woos global tech giants with green energy data centres.
64 See: Olkaria Ecocloud Data Centre
65 Qubit Hub. (2024). Made in Africa: An African Perspective to the Design, Deployment and Governance of AI.
66 Raspberry Pi. (2022). Made in Kenya.
67 IDRC and Genesis Analytics. (2024). AI in Africa: The state and needs of the ecosystem.
68 See: Advances in research and computing services at Kenet - Kenet

Figure 5

Absolute and relative cost of compute in Kenya

(price in $, 2024)

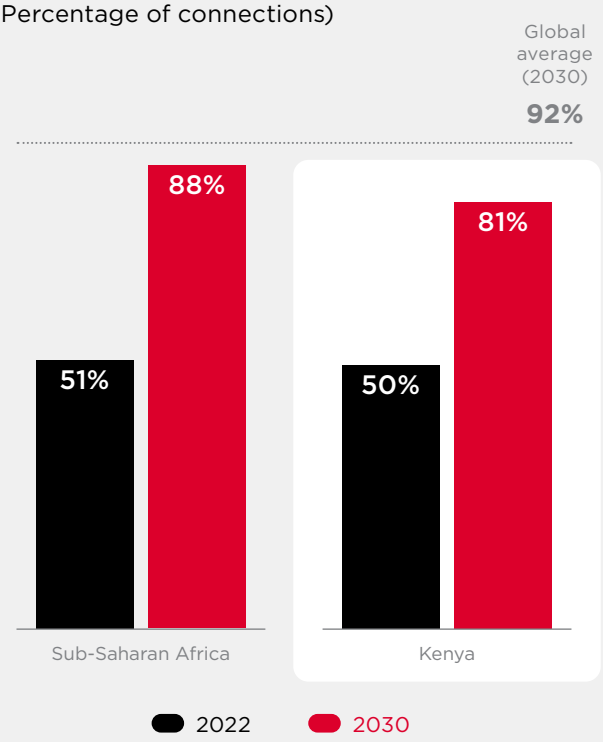


Source: AI4D Africa

Figure 6

Current and projected smartphone adoption in Kenya

(Percentage of connections)



Source: GSMA Intelligence

Edge computing devices, such as smartphones, can act as second-best solutions in low-resource environments. After large amounts of data have been pre-trained, AI models can be transferred to smartphones for fine-tuning. Some AI applications can also be run directly on smartphones, for example for image recognition. The opportunity to leverage smartphones is significant, given the rise of device ownership (Figure 6). Smartphone adoption in Kenya is expected to rise to 81% by 2030.[69] Deeptech company Fastagger develops tools to enable models to be trained, deployed and run on edge devices, including lower-end smartphones (Spotlight 5).

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

Edge computing

Spotlight 5
Fastagger's edge computing solutions support greater AI adoption

Fastagger aims to democratise AI by providing software infrastructure that allows ML and AI models to run directly on edge devices. It aims to enable multimodal LLMs, i.e. models that capture different data types, and other ML models to operate beyond the constraints of traditional cloud-based and high-performance computing systems. Fastagger primarily targets users with lower-end smartphones who are often left behind due to unreliable or limited access to mobile internet.

To achieve this goal, Fastagger is currently focused on adapting pre-trained models such as OLMo, LLM360, Mistral, Mosaic or Llama through compression and fine-tuning. Compression is the process of reducing the number of parameters within a model, optimising it for deployment on resource-constrained devices. Fine-tuning entails adjusting a model on a specific task or dataset, for example to tailor it to specific languages or use cases. In addition, Fastagger has a broader vision of creating custom language models to ensure that AI application can effectively serve users and be most relevant to them.

Skills

The diversity of use case applications in Kenya also highlights the range of skills needed to develop AI solutions, as well as the skillsets that end-users need to use them. For example, various use cases across sectors, such as precision agriculture, environmental monitoring and energy access mapping, are based on geospatial models that require specialised training and knowledge in geographic information system (GIS) techniques for decision-making. Expertise in data science, ML and statistical modelling, along with domain-specific knowledge, is also crucial for developing predictive models.

While Kenya has seen a growing commitment to fostering AI education and expertise across the country, notable gaps exist as institutions' curricula do not always adequately align with industry needs. Recognising the demand for AI skills, universities such as Strathmore University, the University of Nairobi (UoN), Dedan Kimathi University of Technology (DEKUT), and Jomo Kenyatta University of Agriculture and Technology (JKUAT) offer AI-related programmes and courses.[70] However, these courses tend to focus on software development and engineering as a proxy for AI skills,[71] with little consideration for complementary skills such as mathematical foundations.

This deficiency is underscored by the limited availability of advanced AI or AI-related courses, as illustrated by the removal of AI-adjacent PhD programmes such as mathematics at UoN.[72] Formal education sources often fall short in adequately preparing individuals for the demands of the industry. The emphasis is primarily on providing theoretical knowledge, with little focus on practical execution such as programming on computers, leaving students unprepared for real-world problem-solving. Limited

70 GPSDD. (2023). Artificial Intelligence Practitioners' Guide: Kenya
71 International Trade Administration. (2023). Kenya Education and Training Services Industry Snapshot.
72 Kenyans. (2019). Ruto's PhD Course Listed for Scrapping by University of Nairobi.

collaboration and knowledge-sharing between academia and industry means that the content taught in educational programmes is often outdated, and teachers are not actively updating their material to keep pace with the rapidly changing tech industry. This can result in students learning concepts that are no longer relevant or missing out on crucial advancements.

> "As part of my undergraduate programme, I had some programming classes. But in those programming classes, we were writing code on paper, we did not execute."
>
> **– PhD student in Kenya**

Local startups and research institutions struggle to find qualified local expertise due to the mismatch between skills needed by employers and the availability of qualified professionals in the job market. Skilled talent is often poached by large private sector companies such as Microsoft or IBM or by other technology companies overseas, who offer better economic and financial prospects. In fact, even major local players such as Safaricom have cited key talent retention as an area of concern, as well as finding people with the right skillset.[73]

Organisations outside of the academic sector play a significant role in bridging these gaps in Kenya. Institutions like the Moringa School, JENGA School, and communities of practice such as Ai Kenya provide upskilling programmes and standardised certifications and offer a support system to keep learning and gain greater knowledge and skills. Some students also opt to seize other opportunities to benefit from receiving an education from renowned institutions. For example, Carnegie Mellon University, an American institution with a campus in Rwanda, offers practical and project-based learning that increasingly attracts Kenyan students. Many stakeholders also reported that students and young people are increasingly turning to online resources such as YouTube for practical learning. These dynamics reflect a prevalent trend across the tech ecosystem where a large proportion of professionals attribute their skills enhancement to self-teaching.[74]

The emphasis on developing technical skills has also come at the expense of building multidisciplinary skills necessary for a nuanced understanding of the wider context and opportunities surrounding AI. AI-enabled use cases for impact require both technical and domain experts. For example, food security forecasting requires data science experts as well as domain experts that bring a wealth of knowledge in agronomy, climatology and socioeconomic dynamics to identify indicators and build predictive models for food security assessments. This is reflected in the use case applications identified, where companies like TomorrowNow, Amini and the Microsoft AI for Good Lab have focused on building multidisciplinary teams to effectively tackle multifaceted challenges in agriculture, food security and climate action.

A range of skills are also needed for end-users at the last mile to uptake and actively use AI solutions. Smallholder farmers need basic digital skills to interact with mobile apps and access services such as climate and weather information and farm management advisory. Women, who make up a large share of farmers, tend to have less of those skills.[75] Similarly, rural communities living in hazard-prone areas need basic digital literacy to provide feedback or respond to alerts. As generative AI solutions develop, the awareness and ability to carefully craft input prompts, referred to as prompt-engineering, will become essential so that end-users get a tailored response to their queries.

Kenya currently exhibits low digital literacy levels. According to the 2023 GSMA Consumer Survey, literacy and digital skills is the second most cited barrier to mobile internet use for both men and women.[76] This is more likely to affect specific segments of the population, including women, low-income groups, persons with disabilities and those living in rural areas. This calls for targeted upskilling programmes and trainings. Existing skill-building initiatives include the government's Digital Literacy Programme[77] and the Ajira Digital Programme.[78] Skill-building initiatives need to focus primarily on last-mile populations who are disproportionately affected by development challenges. Structural inequalities disproportionately affect these groups, including access to quality education and schools or opportunities to learn digital skills.[79]

73 Soko Directory. (2023). Plugging Into Kenya's Brain Drain And Retain IT Talent.
74 Mercy Corps. (2020). Competing in a Digital Age: The Development of IT Skills & Jobs in Kenya and Uganda.
75 GSMA. (2024). The Mobile Gender Gap Report 2024.
76 Ibid.
77 KICTANet. (2023). Digital Literacy Training as an Enabler to Meaningful Access in Kenya.
78 Ministry of ICT, Innovation and Youth Affairs. (2022). The Kenya National Digital MasterPlan 2022-2032.
79 GSMA. (2023). The State of Mobile Internet Connectivity Report 2023.

Broader enabling environment

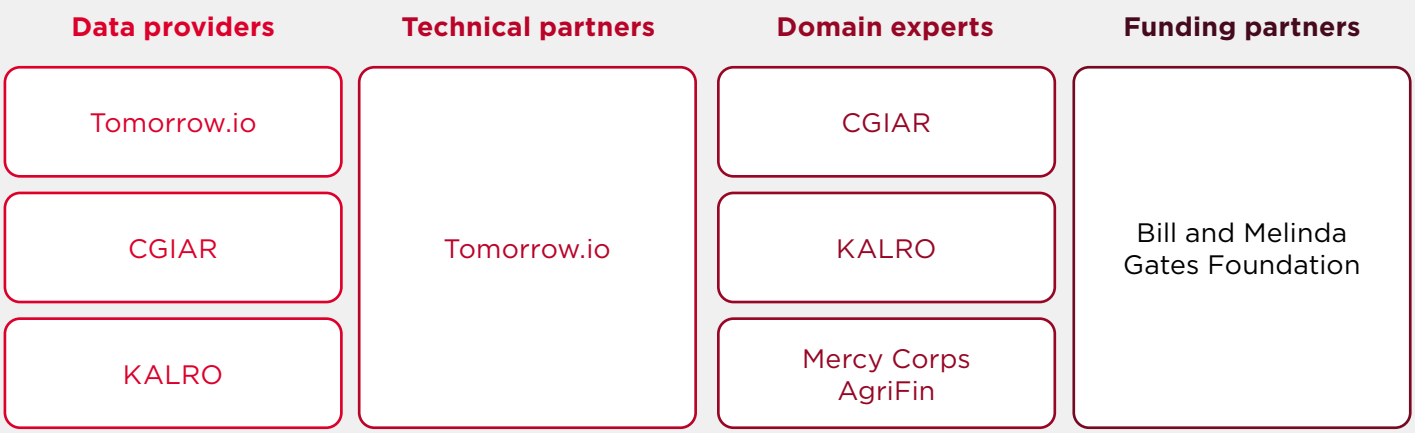
Partnerships

The use case applications identified as part of this research show how partnerships are critical to access a diverse range of resources from a variety of organisations. In Kenya, all five types of stakeholders identified in our primary report – data providers, hardware and software providers, technical partners, domain experts, and financial partners – play a role across use case applications.

Big Tech players like the Microsoft AI for Good Lab act as hardware and software providers and technical partners by offering project-based support to local actors who do not have the required compute resources and technical expertise. Atlas AI, a predictive analytics company, has supported various organisations in Kenya by providing ML talent and deep domain expertise. The company worked with ENGIE Energy Access to identify areas with demand for off-grid solar systems, and with Hello Tractor to build a predictive model for tractor utilisation.[80] Similarly, TomorrowNow leverages weather data and AI/ML capabilities from its founding tech partner, Tomorrow.io. It has established partnerships with key stakeholders, including KALRO and CGIAR, which both provide domain-specific secondary data through their agricultural research, and MercyCorps Agrifin, an expert in digital product development and programme implementation (Figure 7).[81]

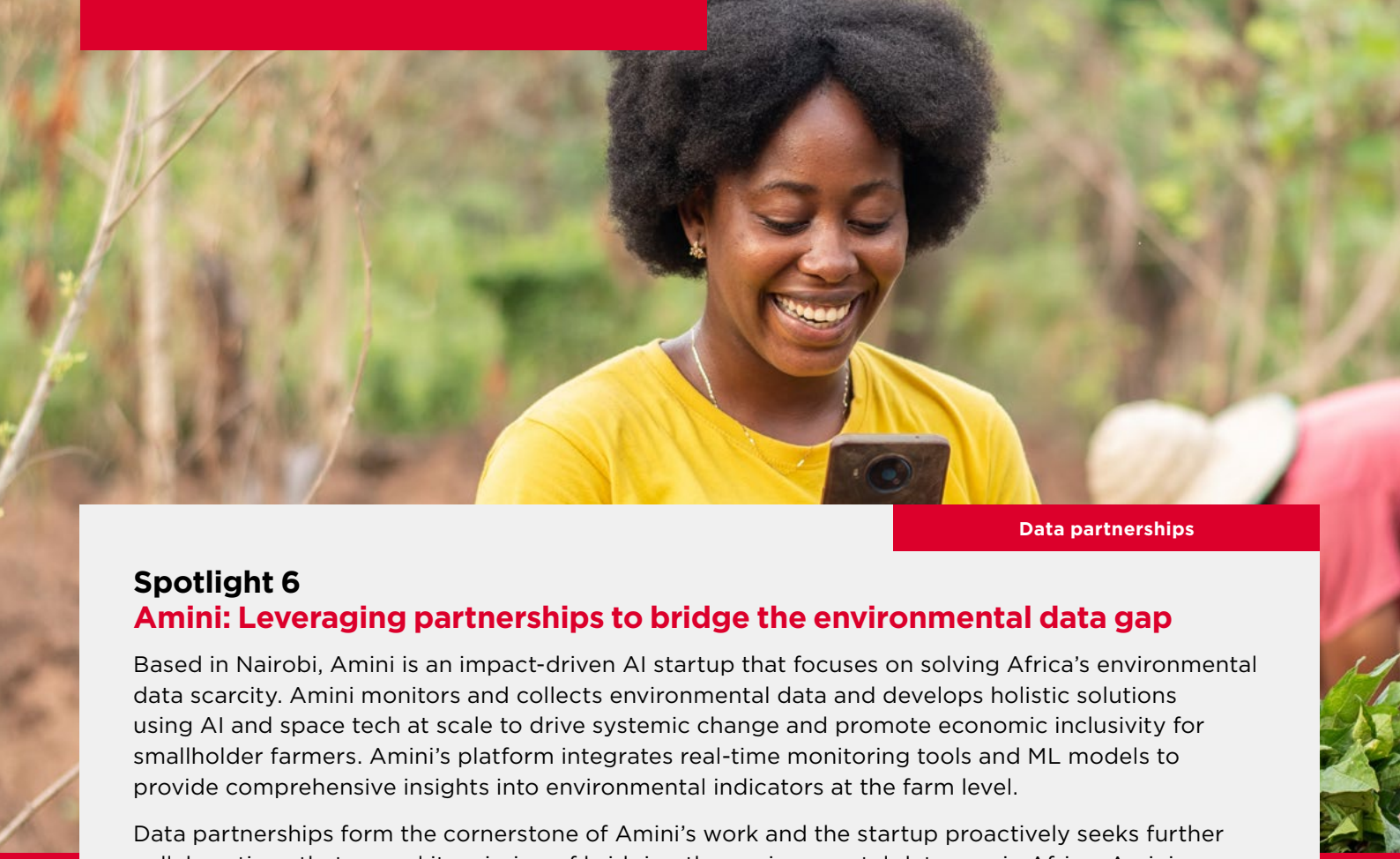
Figure 7

TomorrowNow: Partnerships and key contributions



Cross-sector partnerships also support the development of the ecosystem. For instance, KALRO has partnered with both TomorrowNow and Digital Green to improve data sharing in Kenyan agriculture and provide locally relevant services to smallholder farmers.[82,83] Similarly, Amini focuses on data partnerships with various ecosystem players to build environmental datasets and bridge the data gap in Africa (Spotlight 6). In May 2024, Microsoft and G42, a global AI company, announced a $1 billion digital investment to support economic development as part of an initiative with the Ministry of Information, Communications and the Digital Economy (MICDE). This investment includes constructing a green data center and several initiatives to enhance local language models, internet connectivity, and digital skills in Kenya and East Africa.[84]

80 See: Atlas AI Case Study
81 Tomorrow.io. (2022). Urgent Need for Climate Adaptation Brings $100M Investment to 20M African Farmers.
82 TomorrowNow. (2022). TomorrowNow-KALRO Partnership Celebrated by Gates Foundation as Example of Urgent Action at COP27.
83 Digital Green. (2023). Launching a Data Sharing Network in Kenya.
84 Microsoft. (2024). Microsoft and G42 announce $1 billion comprehensive digital ecosystem initiative for Kenya.



Data partnerships

Spotlight 6
Amini: Leveraging partnerships to bridge the environmental data gap

Based in Nairobi, Amini is an impact-driven AI startup that focuses on solving Africa's environmental data scarcity. Amini monitors and collects environmental data and develops holistic solutions using AI and space tech at scale to drive systemic change and promote economic inclusivity for smallholder farmers. Amini's platform integrates real-time monitoring tools and ML models to provide comprehensive insights into environmental indicators at the farm level.

Data partnerships form the cornerstone of Amini's work and the startup proactively seeks further collaborations that propel its mission of bridging the environmental data gap in Africa. Amini partners with local entities to obtain governmental and farm data and directly sources satellite imagery from organisations like Digital Earth Africa. Recently, Amini launched a new partnership with Zindi, a leader in data science competition, to harness on-the-ground data sources and create new agricultural datasets. This partnership emphasises community engagement in data collection efforts.[85]

Infrastructure-sharing partnerships have also enabled Amini to overcome one of the main challenges faced by African AI entrepreneurs and researchers: limited access to computing resources. Through collaboration with HP, Amini gained access to essential workstations for their operations and AI model training. Equipped with NVIDIA GPUs, these workstations have significantly accelerated Amini's workflows. Previously reliant on costly cloud computing services for tasks like training foundational or large language models, Amini can now conduct these operations in-house, saving both time and resources.

Given the central importance of data for AI, many ecosystem-level partnerships have focused on increasing data availability and accessibility in Kenya. While these are essential to build AI solutions, focusing on infrastructure-sharing and innovative mechanisms to democratise access to compute resources is also critical. Such partnerships exist in Kenya, yet they remain limited to specific use cases and often depend on large tech companies. Focusing on driving partnerships that can support the AI fundamentals will be critical for the development of use cases and for Kenya to retain its position as a regional tech leader. Public-private partnerships (PPPs), such as Microsoft, G42 and the Government of Kenya's initiative, hold promise for advancing these goals.

85 See: Amini

Financing

A range of public and private financing actors are driving ecosystem growth, deploying a mix of financing mechanisms. Kenya has been a leading funding destination for the past 10 years and is considered a hotspot for venture capital for the technology sector at the regional level. In 2023, Kenya attracted over $800 million in venture capital funding, surpassing Egypt, Nigeria and South Africa to emerge as the leading recipient of investment on the continent.[86] It is home to the biggest agritech ecosystem in Africa, attracting nearly 60% of total funding.[87] However, many stakeholders pointed out that funding for deep tech remains limited in both volume and value. Risk aversion appears to be one of the main barriers for investors, resulting from a lack of understanding about emerging technologies and a preference for more established sectors.

Table 7

Investments in tech and AI in Kenya

($ millions, 2023)

Investment in tech startups	806
VC investments in AI	15

Sources: Briter Bridges and OECD.AI

Grant funding represents a significant source of funding across development sectors, largely led by multilateral donors and international organisations. The GSMA, through its FCDO-funded Innovation Funds, has supported various organisations in Kenya. In November 2023, the GSMA Innovation Fund provided funding to agritech Synnefa to support the integration of satellite imagery into its farm management platform to provide real-time data on crop health and weather patterns to smallholder farmers.[88] Multilateral donors are also committed to supporting the building blocks of the AI ecosystem, as illustrated by investments from the Bill and Melinda Gates Foundation, GIZ and the FCDO in Mozilla Common Voice's open-source initiative to build Swahili voice datasets.[89]

However, innovators still face significant obstacles to access grant-funding. Development funders frequently prioritise open-source initiatives, presenting challenges to the commercial development of locally-led AI solutions. For example, both the Mozilla Foundation and Lacuna Fund require the use of open-source data as a crucial component of their funding criteria. Local AI startups face difficulties with short funding cycles, given the time-intensive nature of developing, training and testing AI products. Limited collaboration among financiers often results in funding being disproportionately directed towards a select few emerging applications.

Policy

Kenya benefits from a history of technology-enabling policy initiatives, including the 2018 AI and Blockchain Taskforce, the 2019 Data Protection Law, the Digital Master Plan 2022-2032, and the 10-year National Innovation Masterplan, unveiled in 2023, which recognises the role of emerging technologies (Table 8). Kenya does not yet have a named national AI strategy however, which is perceived by some stakeholders as hampering the country's ability to streamline efforts and effectively harness its potential. For example, the lack of clear AI governance frameworks can lead to missed opportunities for data-sharing partnerships, as currently there are no incentives for private actors to share their data. In addition, policy discussions around data privacy and security primarily focus on personal data, but a more holistic approach to data governance is needed.

However, the government is making strides to improve the enabling environment and implement conducive policies. In April 2024, the Kenya Bureau of Standards published a draft AI Code of Practice for public consultation.[90] Notably, the Ministry of Information, Communication and the Digital Economy (MICDE) has recently launched a process to draft a Kenya national AI strategy. The process is based on multistakeholder engagement, bringing together government departments, civil society organisations, the private sector, academia, development partners, NGOs and citizens. This showcases the commitment of the government to better leverage the wealth of expertise present in Kenya. Continuous participation of non-government stakeholders in policy development will be critical to ensure ongoing knowledge-sharing and ensure that policies reflect the dynamic needs and perspectives of different segments of the population.

86 Tekedia. (2024). Kenya Leads African Startup Funding, Overtook Nigeria in 2023 with $800m.
87 Briter Bridges. (2024). Fields of Promise: Creating an Ecosystem for Agriculture Investment in Africa.
88 See: GSMA Mobile for Development.
89 See: Mozilla Foundation.
90 OneTrust. (2024). Kenya: KEBS publishes draft AI Code of Practice.

Table 8

Key AI-related policy initiatives in Kenya

AI and Blockchain Taskforce (2018)	The government established an AI and Blockchain Taskforce aimed at providing a roadmap for the application of these technologies in financial inclusion, cybersecurity, land titling, election processes, single digital identity and public service delivery. The roadmap was released in 2019 and provides a plan for the application of emerging technologies for the next 15 years.
Digital Master Plan 2022-2032 (2022)	The Digital Master Plan was launched to align with global advancements and enhance Kenya's digital economy. It identifies four key pillars: (i) digital infrastructure, (ii) digital services and data management, (iii) digital skills, and (iv) digital innovation for entrepreneurship. The plan recognises AI as a vital emerging technology, committing to support research and development and harnessing AI capabilities for local problem-solving while exporting expertise and products globally.
Kenya National Innovation Masterplan (2023)	The Kenyan government unveiled a 10-year Kenya National Innovation Masterplan, focusing on policy enhancement, infrastructure upgrades, skill development, market growth and startup ecosystems.
Emerging Technologies Institute and Action Lab (2023)	The Kenyan government has announced the establishment of the Emerging Technologies Institute and Action Lab, in partnership with the UK's AI Safety Institute and the US AI Safety body, to promote governance of the AI space.
National AI strategy (ongoing)*	The Kenyan government has started a process to draft a national AI strategy, involving multistakeholder engagement through multiple workshops with industry experts.

*As of May 2024

One of the main barriers to address in AI policymaking is the lack of understanding of AI and its implications in terms of governance. This results in ineffective or inadequate regulation and can also lead to unethical practices in the ecosystem. For example, Kenyan content moderators involved in building the AI chatbot ChatGPT alleged exploitation and underpayment by OpenAI and its local partner. They called for investigation and regulation of tech companies operating in Kenya, highlighting concerns about poor working conditions and inadequate protection for workers.[91] In 2023, Parliament introduced the Kenya Robotics and Artificial Intelligence Society Bill, which proposes the establishment of a professional body to regulate AI practitioners and impose licence fees.[92] This sparked controversy as such measures could stifle the sector by constraining private investment and curtailing opportunities for emerging talent.[93]

Despite the need for regulation, however, there should be a balance to ensure that innovation is not supressed. Fears around the risks of AI, combined with a lack of understanding, can occasionally result in an overemphasis on regulation, overlooking the benefits that AI can offer. A blanket approach to regulation may inadvertently exclude smaller, local developers who lack the resources to comply with stringent requirements designed for larger corporations. This exclusion not only stifles diversity in AI development but also limits the potential for groundbreaking solutions that could emerge from grassroot initiatives.

Implementing a framework for AI governance will be critical for the development of AI and should be a key focus of the future AI strategy. GIZ's FAIR Forward Initiative and the Global Partnership for Sustainable Development Data collaborated with Kenyan stakeholders to co-create an AI Practitioners' Guide specific to Kenya's legal and regulatory environment, on which the AI strategy could draw. It is expected that the Emerging Technologies Institute and Action Lab, announced by the government in December 2023, will fill in some of these policy gaps and provide guidance on policy implementation. In addition, Kenya's first Special Envoy on Technology was appointed in March 2024, signalling the government's commitment to tech diplomacy and its willingness to establish Kenya as a regional and global AI hub.

91 Qubit Hub. (2024). Made in Africa: An African Perspective to the Design, Deployment and Governance of AI.
92 Business Daily Africa. (2024). Why IT experts want state to reject the new robotics bill.
93 This resulted from challenges in the legislative process rather than limited stakeholder consultation. The Bill was introduced by a private member of Parliament and did not necessarily reflect the government views.

Research and Development

Local players, including academic and research institutions as well as civil society organisations, have traditionally led research efforts in Kenya. For example, Strathmore University hosts @iLabAfrica, a Centre of Excellence in ICT Innovation and Development established in 2011 in the Faculty of Information and Technology, as well as the Centre for Intellectual Property and Information Technology Law (CIPIT), which produces evidence-based research on multiple topics, including AI. The Kenya Education Network (KENET) also supports research and education institutions by providing ICT resources and capacity building, while Mount Kenya University is planning to establish an Artificial Intelligence Research Centre.[94]

However, many stakeholders highlighted that R&D has not been prioritised in Kenya, as with the rest of the continent. Research opportunities are often dependent on grants, but there is little funding available. There is also a gap between academic research and its application in practical settings. The emphasis is often on outcomes such as publishing papers with little consideration of how the research can be practically applied. Some stakeholders also highlighted the lack of collaboration and knowledge-sharing between academia, industry and government entities as a major barrier for research. According to the Global Innovation Index 2023, Kenya ranks 119 (similar to Nigeria) out of 132 economies for R&D and 64 for university-industry R&D collaboration (Table 9). Recognising this gap, the 2022 Digital Master Plan puts emphasis on the importance of R&D for Kenya's technological advancement. It includes a goal to develop the National AI Research and Development Strategic Plan to promote and foster research efforts.[95]

Table 9

Kenya's ranks for R&D capabilities

(Rank out of 132 countries, 2023)

	R&D	University-Industry R&D collaboration
Kenya	119	64

Source: Global Innovation Index

In recent years, Big Tech players have taken on a significant role in driving momentum in research in Kenya. Microsoft has considerably expanded its footprint since 2019. It launched the Africa Development Centre (ADC), a premier engineering hub, and created the Microsoft Africa Research Institute (MARI) during that year, before launching a new AI for Good Lab in 2023. Both entities offer opportunities for local researchers and data scientists to help solve local challenges. Similarly, IBM Research launched its first African lab in Kenya in 2013. Located on the campus of the Catholic University of Eastern Africa in Nairobi, IBM Research carries out research in key areas such as agriculture, energy and water management.[96,97] In 2022, Google also deepened its commitment in Africa by launching a product development centre in Nairobi, four years after launching its first Africa Artificial Intelligence research centre in Accra.[98] These large tech companies are playing a significant role not only in terms of driving research efforts and providing opportunities for local talent, but also in terms of providing access to infrastructure and high-performance computing to local and smaller players.

94 TUKO. (2023). AI Hackathon 2023: MKU Set to Build First Artificial Intelligence Research Center in Kenya.
95 Ministry of ICT, Innovation and Youth Affairs. (2022). The Kenya National Digital Master Plan 2022-2032.
96 See: IBM Research – Africa.
97 IBM. (2023). Celebrating a decade of IBM Research Innovation in Africa.
98 Techpoint Africa. (2024). 5 problems Google is solving with AI in Africa.

4. Recommendations

Recommendations to accelerate AI deployment

Different stakeholders across the public and private sector, development partners and multilateral organisations can take a number of actions and collaborate to ensure that impactful innovations in Kenya can be deployed and scaled. Table 10 explores priority actions to support various components of the AI ecosystem, considering Kenya's unique opportunities and challenges. These recommendations work in concert with those published in the primary report 'AI for Africa: Use cases delivering impact'.

Table 10

Key recommendations to support AI deployment and adoption in Kenya

Increase the availability and accessibility of high-quality data

- **Enhance digital public infrastructure (DPI):** Public sector datasets are a critical component of DPI and the Government of Kenya has built open data platforms in an effort to democratise access to government data. However, local entrepreneurs and researchers face challenges in accessing existing datasets and contend with the limited quality of these datasets. There is a need to establish a robust management plan that ensures seamless data cleaning and processing, and regular updates. Government agencies should prioritise upskilling their staff in data curation and analysis techniques to improve the quality and reliability of national datasets. They could also conduct regular audits of existing datasets, ensuring their integrity and reliability for AI applications.

  Relevant stakeholders: Government agencies (e.g. MICDE, KNBS), development partners (e.g. FCDO, GIZ)

- **Invest in the creation of local domain-specific data:** AI startups and research institutions lack access to local-level and domain-specific datasets to customise their solutions to local challenges. Given the role of geospatial and remote sensing data for AI across sectors, there is an opportunity to support the financing of hardware and devices to accelerate data collection across sectors. Dedicating funding to public sector actors championing data collection and analysis, like KALRO in agriculture, can foster the data ecosystem and support a range of use cases. In parallel, it is essential to support local research institutions, which possess contextual knowledge and expertise, to ensure that relevant secondary data is available. Domain-specific research outputs can enrich AI models by reflecting the unique characteristics and needs of the local context. The use of such data should align with intellectual property rights and ensure fair compensation for domain experts and local researchers.

  Relevant stakeholders: Government agencies, development partners (e.g. FCDO, IDRC, GIZ – FAIR Forward), research institutions (e.g. KALRO, Local Development Research Institute)

- **Support local language data development:** Increasing local language data is critical for building or fine-tuning LLMs and developing relevant AI solutions. Kenya, as a leader in African tech with a diverse ecosystem, can spearhead this effort by fostering data-sharing partnerships among various stakeholders. This involves raising awareness about the value of local language data and requirements for building LLMs. Dedicated funding should be allocated to local and regional initiatives, including grassroot groups that possess the right expertise and contextual knowledge. Participatory approaches to data collection, for example through voice journalling, can capture local nuances and accents, but will require establishing clear guidelines to safeguard data privacy. Given the widespread adoption of mobile-enabled services, there is an opportunity to leverage underutilised data such as mobile big data (e.g. anonymised call detail records). This necessitates close collaboration with MNOs and alignment of incentives for all parties involved.

  Relevant stakeholders: DFIs, development partners, NGOs and research/academic institutions, MNOs and industry associations (e.g. GSMA)

Build short- and long-term capacity for infrastructure and compute

- **Invest in infrastructure and promote clean computing:** Kenya's data center capacity is expanding, yet it lags behind countries such as Nigeria and South Africa. More investments are needed in local data centers and HPC. Given its high reliance on renewable energy sources, the focus should be on developing green infrastructure. Kenya has a unique opportunity to champion new approaches to clean computing, as demonstrated by the development of the Olkaria Ecocloud data center.

  Relevant stakeholders: Government agencies, development partners, DFIs, Big Tech (e.g. AWS), MNOs

- **Enhance access to high-performance computing:** The high costs of compute represent a significant barrier to AI development in Kenya, with GPUs costing three-quarters of GDP per capita. A comprehensive approach is needed to tackle affordability issues. Dedicated funding should be allocated in the form of subsidies, grants, and tax incentives to startups and research institutions to offset the costs of acquiring HPC resources. There is a need to support existing initiatives, such as KENET's resource-sharing programme, and invest in shared AI and computing hubs. Expanding local manufacturing or assembly, illustrated by companies like Semiconductor Technologies Limited and Raspberry Pi, can also help reduce costs. By harnessing local talent and resources, Kenya can build a robust infrastructure to support its flourishing AI ecosystem.

  Relevant stakeholders: Government agencies (e.g. MICDE), DFIs and development partners (e.g. FCDO, IDRC – AI4D programme), Big Tech players and private sector investors

- **Build institutional capacity:** As the ecosystem develops, Kenya should assess its compute needs to establish a clear roadmap for targeted investment in infrastructure. The government 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. There are opportunities for Kenya to engage in regional partnerships with other countries to share compute capacity like supercomputers and data centres, and to create regional connectivity hubs across the continent.

  Relevant stakeholders: Government agencies, DFIs and development partners (e.g. FCDO, GIZ, Tony Blair Institute for Global Change)

- **Enhance edge computing capabilities:** Given its high rates of mobile penetration and projected smartphone adoption, coupled with relatively strong connectivity compared to the Sub-Saharan African average, Kenya is well-positioned to capitalise on distributed-edge computing. This involves supporting device financing to enhance smartphone accessibility and funding local initiatives aimed at developing ML capabilities on edge devices, including lower-end smartphones.

  Relevant stakeholders: Government agencies, MNOs and industry associations (e.g. GSMA), development partners

Foster the development of adequate skills for AI builders and users

- **Strengthen academic-industry collaboration:** The lack of cross-sector collaboration and knowledge-sharing significantly contributes to the skills gap, creating a mismatch between market demands and the available talent pool. Establishing academic-industry partnerships is crucial to enabling academic institutions to keep pace with AI advancements and tailor their courses accordingly. Universities in Kenya should leverage the vast private sector, including startups, Big Tech, and MNOs, to bridge the theoretical-practical gap and provide students with hands-on experience to tackle real-world challenges. Additionally, implementing mentorship schemes and inviting industry and domain experts as guest lecturers can enhance students' exposure to industry needs and practices at the intersection of AI and development fields.

  Relevant stakeholders: Universities and networks (e.g. Strathmore University, DEKUT, KENET), Big Tech (e.g. Microsoft Africa Research Institute, Microsoft AI for Good Lab), startups (e.g. Amini, Fastagger)

- **Promote digital skills and literacy for AI users:** Most AI-enabled services are delivered through mobile and digital channels, yet digital literacy rates in Kenya remain relatively low, particularly outside of urban areas. Raising awareness about AI among potential users, addressing digital skills and literacy gaps and adopting human-centric design are critical to ensure adoption and active usage of these services. Existing skill-building initiatives, such as the government's Ajira Digital Programme, should proactively target marginalised groups such as rural populations, low-income groups, and women, who face greater challenges in accessing and utilising digital technologies effectively. As generative AI solutions continue to emerge, integrating training on prompt-engineering into existing programmes, such as the GSMA's Mobile Internet Skills Training Toolkit, is also essential.

  Relevant stakeholders: Government agencies (e.g. MICDE), academic institutions (e.g. Moringa School), development partners (e.g. AI4D programme), civil society organisations and communities of practice (e.g. Ai Kenya), industry associations (e.g. GSMA)

Strengthen the development of the wider AI ecosystem by fostering an enabling environment

- **Ensure an inclusive approach to policymaking:** Kenya is already following an inclusive approach for the formulation of its national AI strategy. Throughout this process, it is fundamental to bring in perspectives from various stakeholders across sectors, with the objective to ensure that all segments of the population are represented. This includes, for example, active participation of women experts to ensure gender-inclusive considerations are integrated into AI development recommendations, thereby addressing and mitigating gender equality issues rather than exacerbating them.

  Relevant stakeholders: Government agencies (e.g. MICDE) and development partners (e.g. GIZ – FAIR Forward)

- **Establish a clear roadmap for policy implementation:** As Kenya formulates its national AI strategy, the government should create a clear roadmap for implementation and could consider appointing a dedicated oversight body to ensure clear ownership and enforcement. The roadmap should include plans for capacity building of policymakers and government officials and lay out responsible ministries and agencies, budget considerations, and a timeframe for implementation. Policymakers must be equipped with comprehensive knowledge and understanding of AI technologies, emphasising both opportunities and risks, to enabled informed decision-making. In addition, introducing a phased regulatory approach and adopting a test-and-learn strategy, like the sandboxes used for M-PESA, will promote learning and adaptation as AI applications evolve and mature.

  Relevant stakeholders: Government agencies (e.g. MICDE), Development partners (e.g. GIZ – FAIR Forward, FCDO)

- **Encourage cross-sector collaboration through partnerships:** Encouraging collaborations between local organisations and data providers, hardware and software suppliers, technical partners, and domain experts will help leverage a broad range of resources and expertise necessary for the development of AI-enabled services. There is a critical need to enhance access to computing resources through public sector collaboration with global GPU manufacturers and cloud service providers. Kenya has the potential to act as a regional leader in AI infrastructure, as demonstrated with the recent initiative between Microsoft, G42 and the Government, but more partnerships are needed between stakeholders to co-finance AI projects and unlock access to critical resources – at both the ecosystem and use case level. Similarly, partnerships between the private sector and universities and academic institutions, for example with tech companies partnering with universities to co-develop curricula, provide guest lecturers, offer mentorship and sponsor practical learning initiatives, can support skills-building and help scale existing R&D initiatives.

  Relevant stakeholders: Development partners (e.g. FCDO, IDRC, GIZ, USAID), Big Tech (e.g. Microsoft, Google, IBM), startups, academic and research institutions

- **Explore innovative financing mechanisms to derisk investments:** There is a need to increase investor awareness and understanding of AI to reduce risk aversion towards deeptech. Simultaneously, proactive steps to de-risk investments are crucial to accelerate AI deployment and maximising impact. Given the nascent and perceived high-risk nature of early-stage AI ventures, philanthropic capital plays a pivotal role in mitigating investment risks. A blended finance approach, starting with grant capital from donors and DFIs for early-stage startups, followed by commercial funding once cash flows are established, can effectively de-risk AI investments. In addition, diversifying portfolios to encompass a mix of commercial and impact-driven investments provides a balanced strategy to address risks, thereby attracting a wider range of investors.

  Relevant stakeholders: DFIS and development partners, investors (e.g. Global Innovation Fund, Founders Factory Africa)

- **Enhance R&D capabilities and collaboration:** Kenya ranks low in R&D capabilities and efforts are primarily led by a small pool of think tanks and private sector actors. Stakeholders involved in developing the national AI strategy should underscore the pivotal role of R&D to stimulate further investment. Dedicated funding to support local startups and researchers, like the Nigeria AI Research Scheme, could drive momentum in the sector. Establishing PPPs with a strong emphasis on research, like Nigeria's AI4Dev Reference Group, offers a significant opportunity to expand R&D capacity. In addition, raising awareness about the importance of R&D and accumulating a robust body of evidence can enhance public funding and facilitate the establishment of a dedicated research network, similar to South Africa's Centre for Artificial Intelligence (CAIR) and AI Institute of South Africa.

  Relevant stakeholders: Government agencies, development partners (e.g. AI4D programme), research and academic institutions, think tanks

- **Leverage private sector resources and invest in capacity building:** Leveraging the presence of Big Tech players and their research arms can enhance local research capabilities, provide advanced infrastructure and offer training and opportunities for local talent. Big Tech players can support the development of home-grown AI labs in academic institutions and build capacity, helping address the gap between academic research and practical feasibility of AI solutions. For example, they could consider having an on-campus presence, such as IBM Research – Africa at the Catholic University of Eastern Africa in Nairobi.

  Relevant stakeholders: Big Tech (Microsoft Africa Research Institute, Microsoft AI for Good Lab, Google)

5. Annexes

Annex 1: Additional examples of use cases across sectors

Data-driven agri advisory

Spotlight 7
TomorrowNow leverages partnerships to provide hyperlocal weather intelligence to smallholder farmers

TomorrowNow is an NGO with a mission to make weather intelligence accessible and useful for communities most impacted by climate change. TomorrowNow, leveraging data from its tech partner Tomorrow.io, developed an innovative weather intelligence platform. The platform provides weather-smart advisory services to smallholder farmers who would otherwise be unable to pay for such services.

TomorrowNow uses AI to generate highly accurate weather forecasts tailored to specific geographic locations, with forecasts generated at a 4x4 km radius, ensuring precision and relevance for farmers. They use AI to analyse various data inputs, including weather forecasts and historical climate data, as well as other data sources such as agronomic knowledge. This allows TomorrowNow to provide tailored advice to farmers, helping them make informed decisions and to adopt climate-smart agricultural practices. The services are delivered through three channels, catering to different needs and constraints: a mobile app for smartphone users, SMS for feature phone users, and a toll-free call centre for illiterate farmers.

TomorrowNow works closely with Tomorrow.io, its founding tech partner, and uses weather intelligence based on data from its proprietary satellite constellation, as well as its forecasting and AI/ML capabilities. In addition, TomorrowNow has established partnerships with key stakeholders, including KALRO and CGIAR, which both provide domain-specific data through their agricultural research, and Mercy Corps AgriFin, an expert in digital product development and programme implementation.[99]

99 Tomorrow.io. (2022). Urgent Need for Climate Adaptation Brings $100M Investment to 20M African Farmers.

Agri DFS

Spotlight 8
Apollo Agriculture uses satellite data of farms and AI to rate the creditworthiness of farmers

Based in Nairobi, Apollo Agriculture is an agri-fintech company that empowers smallholder farmers in Kenya and Zambia to increase their profits and improve their livelihoods. Apollo provides farmers with the financing they need to buy quality inputs such as seeds and fertilisers, as well as advisory services and insurance products.[100]

When farmers purchase inputs in credit, they apply for financing and get an instant credit decision, powered by Apollo's ML credit models. The models assess the risk of crop failure and the climate resilience of farmers' agricultural practices, generating a credit score that they can use as an alternative to collateral. Apollo can assess farmers' ability to repay loans by applying AI/ML to data sources that include satellite images, third-party credit ratings, and information gathered through a network of more than 5,000 agents. It then provides loans in the form of vouchers that can be spent on farm inputs.[101]

Apollo's bundled services have allowed customers to produce on average 2.5 times more than other Kenyan farmers. Apollo has reached over 350,000 small-scale farmers – among which around half are women – across Kenya and Zambia since its launch in 2016. In January 2024, Apollo secured $10 million in funding to support its expansion across Africa, just two years after raising $40 million. The new funding will help Apollo expand throughout Kenya to serve 400,000 additional farmers.[102]

Energy access/demand assessment

Spotlight 9
ENGIE Energy Access uses AI to identify future areas of expansion

ENGIE Energy Access is a global provider if off-grid solar home systems. In late 2022, it worked with predictive AI company Atlas AI to identify areas with high potential demand and accelerate the adoption of its solar appliances in Kenya, a relatively new market for the energy company.

ENGIE Energy Access harnessed Atlas AI's proprietary platform that uses high-resolution geospatial data and ML to make customised recommendations on business expansion. Atlas AI leverages various data sources essential for market segmentation, such as population density, consumer spending levels, electrification rates and infrastructure reliability. By combining these data points with ENGIE's historical operational data such as transactions, market presence and performance, the platform can pinpoint areas with the most potential for market expansion.

To validate Atlas AI's recommendations, the two companies set up a pilot programme in which the Coast region in Kenya achieved a 48% increase in monthly sales after fully utilising Atlas AI's insights, while control regions saw stable trends. The pilot demonstrated the potential of high-resolution market segmentation to expand ENGIE's solar appliance business while bridge the energy access gap and reducing energy poverty among underserved communities.[103]

100 See: Apollo Agriculture.
101 Financial Times. (2023). AI and space technology boost smallholders' access to finance.
102 Techpoint. (2024). Kenya's Apollo gets $10 million funding for African expansion, two years after a $40m Series B.
103 See: Atlas AI Case Study.

Biodiversity monitoring

Spotlight 10
EarthAcre pioneers biodiversity credits for conservation through spatial technologies and AI

EarthAcre uses advanced spatial technologies and AI to improve biodiversity mapping and conservation. EarthAcre is pioneering biodiversity credits to support the conservation of natural habitat and the equitable compensation of Indigenous peoples and local communities for the stewardship of land. While the carbon market currently allows corporations and investors to trade carbon credits and offsets, in a biodiversity market biocredits are created to stop and reverse actual species loss by addressing environment threats and working with biodiversity custodians.

EarthAcre applies ML models to monitor ecosystem health, predict biodiversity capacity, and quantify the impact of land stewardship. The models combine field data and high-resolution remote sensing data from drones and satellites to map biodiversity across landscapes. The technology is used by landowners to drive holistic regeneration of land and ecosystem conservation.[104]

Wildlife protection/HWC prevention

Spotlight 11
M-Twiga uses AI to safeguard communities and wildlife

Human-wildlife conflict (HWC) occurs when human encounters with wildlife result in negative consequences for both parties, including property loss, livelihood disruptions and fatalities. HWC raises both conservation and humanitarian concerns which disproportionately affect low-income communities.

M-Twiga is designed to act as an early warning and deterrent system that prevents elephants from crop raiding and stops predators attacking livestock, while also notifying communities of the presence of specific wildlife species. Using infrared cameras and AI software, the system can detect and identify various predator species and send an SMS to predetermined numbers to alert nearby communities. It is designed to recognise animals moving at different speeds and in various weather conditions, both day and night. Powered by an integrated solar photovoltaic cell with rechargeable battery back-up, m-Twiga is intended to be robust, simple and suitable for off-grid regions. It operates via SMS, ensuring functionality even with limited coverage, and the deterrent feature will work independently of coverage.

M-Twiga is the result of a collaboration between technology and conservation experts from Vodafone, Safaricom and WWF. While the m-Twiga solution is still in early proof of concept stage, it presents a compelling case for the involvement of MNOs in addressing conservation issues. Longevity has been central to its design, with an emphasis on being low cost, scalable and adaptable to different environmental contexts. Various business models are being explored, including its potential application in ecotourism or within national parks. The objective is to ensure the project is sustainable beyond the initial business support. In doing so, the m-Twiga team hopes to scale the solution to protect wildlife, manage natural resources and mitigate the loss of property, livelihoods and lives.[105]

104 See: EarthAcre.
105 GSMA. (2024). The Nature Tech Nexus: Bridging biodiversity and business.

Annex 2: Full list of Kenya-specific use case applications considered in the research

Agriculture and food security

Apollo Agriculture	SME that uses ML and satellite imagery to analyse agricultural data, estimate farmers' solvency for input financing, and provide customised insights.
Amini	Startup that seeks to bridge the environmental data gap in Africa and develops holistic solutions using AI and space tech at scale.
Aquarech	Startup that offers a platform that leverages AI and satellite imagery to enhance transparency and efficiency within the aquaculture industry.
Baridi	Startup that uses IoT to enhance its solar-powered cooling initiative in the livestock value chain.
Cropnuts	Company that launched an AI-based soil testing and digital crop advisory service for smallholder farmers, called AgViza.
Digital Green	Non-profit organisation developing a generative AI solution to provide customised recommendations to extension agents and farmers.
Hello Tractor	SME that uses AI to forecast crop yields, optimise tractor scheduling, and match farmers with tractor owners.
ITIKI project	University-funded project that developed a drought prediction tool using AI in combination with indigenous environmental knowledge, providing alerts to farmers on mobile phones.
Kuzi	Startup that uses ML and satellite data to predict the likelihood of locust swarms for pest control.
mfarmPay	SME that leverages ML and satellite data to assess farmers' creditworthiness.
Microsoft AI for Good Lab	Large tech company using AI/ML to support local partners addressing pressing agriculture and food security challenges. Projects considered include using AI and ML to forecast malnutrition hotspots, delineate farmlands boundaries, and address food and water security conflicts.
One Acre Fund	Social enterprise that leverages Dataiku's platform to identify farmers at risk of defaulting on their seasonal loan.
SunCulture	Startup that designs and sells solar-powered irrigation systems and uses AI for tailored digital advisory.

Synnefa	Startup that integrates satellite imagery into its farm management platform, FarmCloud, to provide real-time data on crop health and weather patterns to smallholder farmers.
ThirdEye	SME that uses flying sensors to monitor soil needs and identify pests/diseases in crops at an early stage.
TomorrowNow	Non-profit organisation using AI to provide weather and climate information and customised recommendations on climate-smart agricultural practices to smallholder farmers.
Twiga Foods	SME that uses AI and ML to optimise its food value chain, enabling efficient procurement, pricing, waste reduction and logistical operations.
UjuziKilimo	SME that uses AI to analyse soil health and provide farmers with tailored insights on fertilisation, irrigation, and crop rotation to optimise yields.
WFP	Non-profit organisation using AI to digitise handwritten health records, helping health workers to collect and analyse nutrition data efficiently.

Energy

ENGIE Energy Access	Utility company that leverages predictive AI to promote off-grid solar.
Green Innovation Ventures	SME that uses an IoT platform to digitalise electrical appliances and allow consumers to track energy consumption.
KenGen	Public utility using IoT and AI at the Olkaria Geothermal Power Station for decision-making and maintenance.
KOKO Networks	Company that uses IoT and ML technologies that dramatically increase the efficiency, visibility and control of cooking fuel.
Nithio	SME that uses blended-finance to provide a sustainable, risk-informed approach to finance aggregated receivables for the off-grid solar sector.
Safaricom	Telco using Nokia's AVA Energy Efficiency Software, which relies on AI and ML, to automatically deactivate idle equipment during periods of low usage.
VIDA	Software company that uses satellite imagery and big data to estimate optimal locations for mini-grid deployments.

Climate action

AstraZeneca/ Earthbanc	Company that utilises AI deep learning models to analyse drone footage and satellite imagery for monitoring tree growth, health, and carbon sequestration, as part of its AZ Forest Programme.
Boomitra	SME that uses satellite and AI technology to measure, report, and verify soil carbon credits across the globe.
Connected Conservation Foundation	Foundation that uses high-resolution satellite imagery with local geospatial and conservation expertise to monitor wildlife, habitat and landscape changes over space and time.
EarthAcre	Startup that uses spatial technologies for biodiversity mapping and ecosystem management.
Google Floods	Big Tech company that developed AI models to forecast floods to alert people before a disaster strikes, limiting damage and loss of life.
Humanitarian OpenStreetMap	Non-profit initiative that uses AI to generate building footprints, road data, and community-identified flood-prone areas.
IBM	Large tech company supporting the government's National Tree Growing and Restoration Campaign to advance reforestation and water sustainability by leveraging its geospatial foundational model to monitor reforestation and measure sequestered carbon.
Microsoft AI for Good Lab	Large tech company using AI/ML to support local partners addressing pressing climate challenges. Projects considered include using AI and ML to identify and prevent human-wildlife conflict, prevent illegal logging and forest fires, and wildlife protection.
Safaricom/ Vodafone	MNO using infrared cameras and AI to prevent human-wildlife conflict.
UK Centre for Ecology and Hydrology	Research institute that is working on a project called AMBER to test the use of camera and acoustic technology for monitoring nighttime flying insects and acoustic species.
Ushahidi	Non-profit organisation that uses real-time mining of social media, news articles, and geo-tagged, time-stamped data for open-source crisis-mapping software.
Verst Carbon	SME that uses AI to scale Africa's participation in carbon markets.

Annex 3: List of organisations consulted

Kenya

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

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