

State of AI in Agriculture in Sub-Saharan Africa

State of AI in Africa
Report Series



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About CEIMIA

In an era of rapid development in artificial intelligence (AI), including the arrival of generative AI, governments are faced with the crucial task of effectively navigating the complexities surrounding the deployment of AI and its impact on society. It is in this context that the International Centre of Expertise in Montreal on Artificial Intelligence (CEIMIA) supports the work of the Global Partnership on Artificial Intelligence (GPAI), a multi-stakeholder initiative aiming to bridge the gap between theory and practice on delivering responsible AI. GPAI does this by supporting cutting-edge research and applied activities on AI-related priorities. Built around a shared commitment to the OECD Recommendation on AI, GPAI brings together engaged minds and expertise from science, industry, civil society, governments, international organizations and academia to foster international cooperation.

With its unique position supporting GPAI, CEIMIA mobilizes international experts and resources (from the academic, private, and civil society sectors) to promote the responsible development and use of AI for the benefit of humanity. CEIMIA is therefore acting as a key player in the responsible development of AI based on human rights, inclusion, diversity, innovation, economic growth and the well-being of society, while seeking to achieve the United Nations' sustainable development goals.

In this shared effort to develop responsible AI, CEIMIA, with the support of the International Development Research Centre (IDRC), has launched a Researcher-in-Residence Program to facilitate the development of links with AI ecosystems in Global South, particularly in Africa, and to identify opportunities for collaboration with GPAI expert groups and the Canadian AI ecosystem. Such a mission would not be possible without knowing the current state of AI in Africa. It is for this reason that CEIMIA, with the support of the researcher in residence, has decided to produce a series of reports on the state of AI in Africa, which will enable us to target priority areas based on the needs of Africa and Africans, when it comes to developing responsible AI.

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Disclaimer

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Acronyms

ACTS	African Centre for Technology Studies
AfDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
AIMS	African Institute for Mathematical Sciences
AMMI	African Master's in Machine Intelligence AI: Artificial Intelligence
AI4D	Artificial Intelligence for Development in Africa
BMGF	Bill and Melinda Gates Foundation
CAD	Canadian Dollar
CAIR	Centre for Artificial Intelligence Research
CEIMIA	International Center of Expertise in Montreal on Artificial Intelligence
CV	Computer Vision
DSA	Data Science Africa
FCDO	Commonwealth and Development Office
GDP	Gross Domestic Product
GISs	Geographic Information Systems
GPAI	Global Partnership on Artificial Intelligence
GPS	Global Positioning Systems
IDRC	International Development Research Centre of Canada
IBM	International Business Machines Corporation
IoT	Internet of Things
ML	Machine Learning
OECD	Organisation for Economic Cooperation and Development
Sida	Sweden's government agency for development cooperation
R&D	Research and Development
UAVs	Unmanned Aerial Vehicles
UQAM	Université du Québec à Montréal
USAID	United States Agency for International Development

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Executive Summary

Agriculture is a cornerstone of the sub-Saharan African economy, vital for livelihoods and gross domestic product (GDP). Artificial intelligence (AI) technologies offer transformative potential to address critical challenges like climate change, resource management, and food security. AI-driven solutions, such as precision farming, predictive analytics, and automated systems, can enhance crop yields, optimize resource usage, and mitigate climate impacts (McKinsey & Company, 2019; FAO, 2020). However, successful AI integration faces barriers like limited infrastructure and digital literacy, necessitating collaborations among governments, private sector, and research institutions. Investments in infrastructure, capacity building, and digital education are crucial to empower farmers and ensure equitable access to AI benefits (World Bank, 2021; African Union, 2018). By addressing these challenges, AI can revolutionize agriculture in sub-Saharan Africa, fostering economic growth, sustainability, and food security (McKinsey & Company, 2022).

This second report of the State of AI in Africa series, developed under the Researcher-in-Residence Program at the International Centre of Expertise in Montreal on Artificial Intelligence (CEIMIA), with the support of the International Development Research Centre (IDRC), provides an in-depth analysis of the current state of AI in agriculture across sub-Saharan Africa. This report will enable policymakers, developers, researchers, entrepreneurs, and citizens to target priority areas based on the needs of Africa and Africans, when it comes to adopting, developing and implementing responsible AI.

Takeaways

1. AI Techniques and Technologies

- Data Gathering: Utilization of robotics, drones, sensors, and smartphones to collect agricultural data;
- Machine Learning (ML) and Computer Vision (CV): Essential for analyzing data to identify patterns, make predictions, and aid in decision-making;

- Free Satellites: Access to satellite data aids in weather prediction and crop performance analysis.

2. Applications of AI in Agriculture

- **Precision agriculture:** helps in increasing crop yields, reducing resource wastage, and promoting sustainable farming practices;
- **Automation in agriculture:** The integration of AI with robotics and automation is transforming tasks such as planting, irrigation, and harvesting. It enhances efficiency and reduces labor costs;
- **AI-Powered resource management:** AI-driven systems optimize the use of water, soil nutrients, fertilizers, and labor, ensuring efficient resource utilization;
- **Prediction of crop yields:** AI and machine learning models analyze historical data, weather patterns, and real-time field data to forecast crop yields;
- **Supply chain and logistics:** AI enhances supply chain efficiency through traceability solutions, demand-supply matching, and optimized logistics;
- **Fintech for agriculture:** AI-powered fintech solutions provide farmers with access to credit, insurance, and financial management tools.

3. Main Funding Agencies

- Big Tech Involvement: Companies like Google, IBM, and Microsoft have established AI research labs and tech hubs in Africa;
- Funding Initiatives: Programs like AI4D Africa support AI research and applications to address development challenges.

Recommendations for the Uptake of Responsible AI

1. Establish National AI Policies and Regulations Focusing on Agriculture

- Develop policies for technology uptake;
- Set up governance frameworks;
- Provide incentives for ethical AI practices.

2. Facilitate Collaborations between Governments, Tech Companies and Farmers

- Create regulatory frameworks for private sector investment;
- Set up innovation hubs.

3. Invest in Research & Development (R&D)

- Create grants and funding opportunities;
- Establish venture capital funds;
- Support local AI startups.

4. Promote Open Education and Collaborative Research

- Encourage inclusion of social scientists;
- Partner with local schools and universities;
- Organize workshops and training sessions;
- Launch e-literacy programs;
- Form multidisciplinary research teams.

The potential of AI to transform agriculture in sub-Saharan Africa is immense. While challenges exist, targeted efforts in national AI policies and regulations Focusing on Agriculture, collaborations between governments, Tech Companies and farmers, Research & Development (R&D), open education and collaborative research; can help realize AI's full potential in improving agriculture outcomes across the region. This report aims to inform and guide stakeholders in leveraging AI to address agricultural challenges and promote sustainable development in sub-Saharan Africa.

| Introduction

1. Introduction

Agriculture is an integral part of the African economy and the daily lives of the majority of Africans. Africa has 65% of the world's remaining uncultivated arable land, and the soil across most of the continent is rich and fertile (FAO 2020). With the burgeoning young African population, the agriculture sector accounts for 35% of the continent's gross domestic product (GDP) and employs more than 50% of Africa's working population (World Bank 2021). Despite its central role, the agricultural sector is characterized by its low productivity due to the fact that the sector is dominated by smallholders producing mainly for their own consumption; private sector infrastructure, beyond production facilities, remains underdeveloped. This reality faces high human and economic challenges such as food insecurity, malnutrition, post-harvest losses, and inefficient supply chains (FAO, 2020; McKinsey & Company, 2019). However, artificial intelligence (AI) seems to have the potential to infuse innovation and energy into transforming the continent's food systems landscape (AGRA, 2022).

Artificial Intelligence and the ongoing digital revolution will inevitably transform the world and its agrifood systems, making it all the more urgent that the transformations they drive benefit everyone and contribute to solving global challenges.

- QU Dongyu, Director-General of the Food and Agriculture Organization (FAO, 2024)

In this research report, we aim to provide the current state of AI in agriculture in sub-Saharan Africa. Based on the analysis of existing online resources, this report shows how dynamic the African AI-ecosystem is, with local talents and experts who are proactive in applying AI to enhance farm surveillance, disease management, prediction of crop yields, market access facilitation, etc.

The report explores how AI techniques are applied to agriculture and presents a set of concrete AI solutions in agriculture. We conclude the report by discussing the opportunities and challenges related to the adoption of AI in the agricultural sector; providing a set of recommendations for key players.

| Methodology

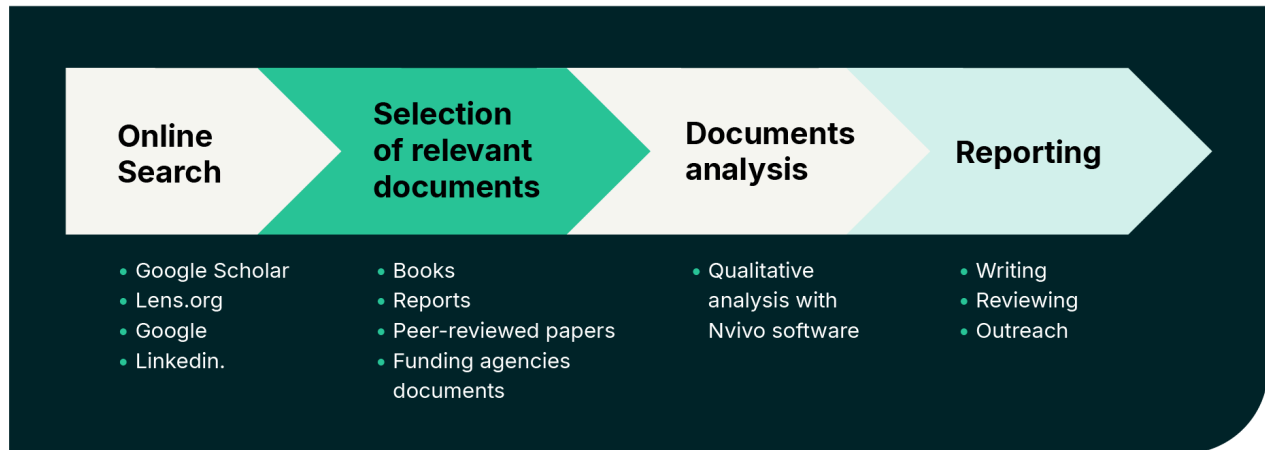
2. Methodology

Research Approach

This report is the result of an analysis of data gathered through four main platforms: Google Scholar, Lens.org, Google search, and LinkedIn. We did our research in French and English, using:

- **Keywords** such as Africa, agriculture and agriculture-associated words (farmers, crops, etc.), artificial intelligence, machine learning, and deep learning. Among the results obtained, we restricted our selection to the date range from 2018 to 2024.
- **Relevant documents** including books, reports, peer-reviewed papers, and documents from funding agencies were selected. The bibliographic references are available in this Zotero group: [CEIMIA - AI in Agriculture in Africa](#); (note: please feel free to join the group and contribute).
- **A sample of 40 active AI initiatives** in agriculture in Africa (see the annex). We are aware that our research did not cover all existing initiatives of AI in agriculture in Africa. We encourage the reader to complete [this form](#) so we can collectively uphold a dynamic repository of AI initiatives in African agriculture.

These resources were then processed and analyzed using Nvivo, a qualitative analysis software programme. The information we present in this report has emerged from this analysis.

Figure 1: The research approach

Limitations

- **The lack of linguistic diversity** in the various sources of information used to write this report is a limitation. Indeed, in sub-Saharan Africa, there are English-speaking, French-speaking, Portuguese-speaking and Spanish-speaking countries. However, we only used French and English keywords to gather information for this report.
- **The report focuses on local initiatives.** The information gathered about agriculture in Africa mainly comes from Western countries that work in Africa as a research field, either through African diasporas or collaborations with local researchers. In this report, we aimed to highlight initiatives originating from the continent. Therefore, some globally recognized initiatives based in the West may not be included in this report.
- **Our figures are indicative only.** The representations and breakdowns shown in this report are only reflecting an assessment based on the numbers of initiatives we found.

Applications of AI in Agriculture

3. Applications of AI in Agriculture

AI is revolutionizing the way we grow food and manage our agricultural systems. The most well-known uses of AI technology in agriculture are through automation and precision agriculture, which are data-driven systems devoted to improving the profitability and sustainability of agriculture.

AI and automation solutions are transforming agri-food production and trade by completing complex physical tasks and decision-making functions usually carried out by humans. Automation is the use of technology to complete routine tasks with minimal human intervention. AI is transforming what is possible through automation by not only automating more complex physical tasks, but also functions usually associated with human intelligence.

- Genesis Analytics. Inclusively Advancing Agri-Food Systems through AI and Automation (2023).

From predictive weather forecasting to crop monitoring, disease detection and market access tools; the following sections list examples of technologies by application categories¹. But before we do that, let's look at the different AI techniques and technologies involved here.

3.1. AI Techniques and Technologies

The introduction of AI to agriculture is enabled by advanced technologies such as the Internet of Things (IoT), remote sensing technologies, and unmanned aerial vehicles (UAVs) allowing for increasing amounts of data to be collected on farms. The analysis of these agricultural data is enabled by advanced AI techniques such as machine learning (ML) and computer vision systems; facilitating identification of patterns, making predictions and assisting in decision making.

¹ Note: The initiatives highlighted here are indicative and geographically representative. Their presence and ordering is not intended to promote any one initiative or to demonstrate its superiority over others.

Collecting Agricultural Data Technologies

Robotics

Robotics in agriculture is mainly utilized to speed up repetitive tasks in the production process like spraying, mowing, seeding, harvesting, weed control, picking, and finally in sorting products and packaging. Robotics has proven to be a viable part of farming processes due to the need for better output and resource optimization. Indeed, in the realm of making farming sustainable, field robots are used in precision farming by targeted weed control functions replacing treatment of crops and soil with harmful and excessive chemical sprays. We can see that automated tractors, harvesters, and fruit-picking robots replace human labor in routine tasks leading to a more efficient, precise, and cost-effective mode of farming.

Internet of Things (IoT)

IoT encompasses wireless communications technologies that provide the opportunity to access farm data from a distance, enabling farmers to make decisions regarding harvest, farm conditions, and ways to bring their products to market. Indeed, IoT is able to transform physical data such as temperature, humidity, pressure, speed, and flow into an identifiable virtual or electronic form without any human involvement. This data assists farmers to get real-time information concerning the health of the crop, weather patterns and conditions, and the soil quality without going to the farm in person.

Unmanned aerial vehicles (UAVs) - Drones

UAVs, such as drones, and geographic information systems (GISs) are also used to collect aerial imagery for mapping and monitoring damage on crops, crop yield or livestock location. Generally, this farm-specific data is combined with external data, such as local weather information sourced from nearby weather stations. Access to this data enables farmers to precisely monitor and manage their inputs and production. Drones are also used for targeted interventions by applying the right treatment in the right place at the right time to optimize the use of available

resources and thus increase the profitability and sustainability of agricultural operations; this reduces negative environmental impacts, and improves the quality of the work environment.

Free Satellites

Landsat² and Sentinel³, are satellites that provide free data such as information on weather and other aspects that can be used on a farm. Such information can be used to predict potential diseases and the performance of specific crops. At a national level, Ethiopia launched its first observatory satellite into space in 2019 for agricultural, climate, mining, and environmental observations, allowing the Horn of Africa region to collect data and improve its ability to plan for changing weather patterns, by using such data to decide on when and what to plant.

Smartphone and mobile applications

In recent years, large amounts of smartphone apps that use AI technology have been developed to allow data to be collected on farms, to diagnose crop disease, and to disseminate information (about crop diseases, prediction models, best practices for prevention, control strategies, real time market information) directly to farmers. UAVs, in combination with smartphone platforms to provide remote sensing data, also use global positioning systems (GPS) for digital soil mapping for various environmental and agricultural development purposes.

² [Data | Landsat Science](#)

³ [Sentinel Hub](#)

Analysis and Decision Making Technologies

The basic premise of ML is to build algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data become available. More specifically, computer vision algorithms analyze visual data such as images and videos captured by satellites, drones or smartphones. In an agricultural context, the analysis of these data provides real-time information on soil moisture, allowing farmers to make data-driven decisions to optimize crop planting, irrigation, disease control and increase crop yields. This is promising for agriculture, as it assists farmers, policymakers and other stakeholders of agriculture in making intelligent decisions.

Table 1: AI-Techniques and Technologies Used in Agriculture in Sub-Saharan Africa

Functions	Technologies	Techniques
Agricultural data collection	<ul style="list-style-type: none"> ● Internet; ● Cloud computing; ● Desktops, Laptops, tablets, smartphones and mobile apps; ● Drones; ● Satellite imagery. 	<ul style="list-style-type: none"> ● SMS; ● Sensors and IoT devices; ● Chatbots.
Analysis of agricultural data and decision-making	<ul style="list-style-type: none"> ● Artificial intelligence ● Automation ● Blockchain 	<ul style="list-style-type: none"> ● Machine Learning; ● Deep Learning; ● Computer vision; ● Generative AI; ● AI modeling. ● Predictive analytics.

3.2. Farm Management

Crop Monitoring

Crop monitoring often includes sensors for monitoring crop health and field conditions. By analyzing data collected from sensors, AI systems are able to provide predictive insights for improving crop yields; and can recommend personalized fertilizer and nutrient management plans.

Charis UAS, Rwanda	www.charisuas.com/agriculture
<p>Charis UAS' mission is to revolutionize Africa's approach to solving its most pressing challenges including urban planning, health improvements, natural resource management, disaster response, and climate change adaptation, by leveraging the power of AI-driven near real-time and easily accessible 3D geospatial data analytics.</p> <p>In Agriculture, Charis UAS builds on analytics utilizing drone data to offer farmers real-time insights into individual crop performance, enabling precise monitoring and informed decision-making. By the way, Charis UAS is committed to create a brighter future for Africa and its communities with early threat detection, disaster preparedness, smart input management, digital farm records, data-driven land Optimization.</p>	

Aerobotics, South Africa	www.aerobotics.com
<p>In South Africa, Aerobotics is a company that is developing a digital platform for using AI to interpret data gathered by drones and satellites. The data interpretation algorithms are targeted at detecting plant pests and diseases. Aerobotics employs AI by using drones and other robotics to track and assess crop health, including recognizing sick trees, pest tracking, disease prevention, and yield management analyses. The company has advanced its system by gathering and analyzing tree and fruit footage from farmers and now provides farmers with independent and reliable output estimates and harvest timings. Farmers may then organize their inventory, estimate demand, and ensure that their consumers receive the best possible supply.</p>	

Table 2: Non-Exhaustive List of Crop Monitoring Initiatives

AI Initiatives	Organizations		
	Name	Type	Country
FarmShield	Synefa	Company	Kenya
Africa Agriculture Watch (AaGwa)	AKADEMIYA2063	CSO	Rwanda
Charis Analytics	Charis UAS	Company	Rwanda
karaAgro AI	karaAgro AI	Company	Rwanda
Karibu Mkulima GPT	Mkulima GPT	Company	Rwanda
The MapSPAM	The MapSPAM	Company	Rwanda
TrueFruit™ Size	Aerobotics	Company	South Africa

Disease Management

Poor soil quality, insect pests, and plant diseases are significant threats to global agriculture and are a major problem for African farmers. AI and ML techniques can help maintain soil health, identify and diagnose plant diseases and pests, giving farmers an opportunity to take appropriate measures to control them in advance. For instance, image-based disease diagnosis with mobile phone applications help farmers identify plant diseases quickly and recommend the most effective treatment based on specific plant symptoms or environmental conditions.

GreenLive, Cameroon	www.greenlive-cm.net/solutions
<p>GreenLive aims to solve these issues by implementing precision agriculture techniques through advanced technologies. The core objective is to maximize agricultural production while minimizing environmental footprint and operational costs. By adopting GreenLive's precision agriculture solutions, the expected impacts include increased crop yields, reduced usage of water and chemicals, and enhanced sustainability of farming practices. AI plays a pivotal role in the GreenLive system, driving decision-making processes and optimizing farming operations. Machine learning algorithms analyze data collected from various sources to provide predictive insights on weather conditions, crop health, and soil quality. AI models are used for anomaly detection (identifying disease or pest outbreaks) and for making real-time recommendations on the optimal amounts of water and inputs required, thus enhancing the precision in resource application.</p>	

e-Tolbi, Senegal	www.tolbi.ai
<p>e-Tolbi is an AI-based digital tool for smart, sustainable and efficient agriculture, with the overall goal to provide farmers, producers, and public organizations with real-time yield forecasting information and a field management platform to monitor plant health, fertilization, and water requirements.</p>	

Table 3 : Non-Exhaustive List of Disease Management Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
ClinicAgro	CLINICAGRO SARL	Company	Cameroon
GreenLive	GreenLive	Company	Cameroon
Komaza	Komaza	Company	Kenya
Soil Pal	UjuziKilimo	Company	Kenya
Plantwise Knowledge Bank	CABI	CSO	Rwanda
e-Tolbi	Tolbi	Company	Senegal

Prediction of Crop Yields

The use of predictive analytics, powered by AI and machine learning, is effective in predicting crop yield at different scales such as local, regional, and country levels. Farmers can better protect their crops from extreme weather conditions, anticipate droughts, floods, and other extreme weather events, enabling them to adjust their farming practices accordingly. The ability to predict crop yield before harvesting may also assist farmers in making favorable financial and management decisions. In addition, policy makers rely on these accurate predictions to make import and export decisions to strengthen national food security.

AgriPredict, Zambia	www.agripredict.com
<p>AgriPredict harnesses state-of-the-art technology to deliver services tailored to address the distinct needs of farmers, particularly in accessing essential on-demand agricultural information allowing farmers to:</p> <ul style="list-style-type: none">• Stay ahead with current, hourly, and daily weather information by receiving precipitation forecasts, temperature trends, and humidity levels crucial for planning.• Protect their yield with an Early Warning System. Report warnings that can be shared with farmers in a given area and receive tailored alerts for potential threats such as severe weather, diseases, or pest outbreaks.• Stay informed and take proactive measures to safeguard their crops and livestock.	

FarmView, Mozambique	www.cmu.edu/work-that-matters/farmview
<p>In order to address the global food crisis, Carnegie Mellon University has teamed up with agricultural experts and plant scientists by developing and deploying a system called FarmView to increase plant breeding and crop production. In Mozambique, farmers use Farmview to identify the pests and diseases affecting their crops by sharing the photos with relevant authorities. To address the low literacy barriers, farmers have been able to use AI speech recognition systems as well as speech to text functions, particularly when accessing text-related applications. Robots can now assist the farmers during the seasons of crops harvest and also in predicting the correct methods of cultivating different crops.</p>	

Table 4: Non-Exhaustive List of Prediction of Crop Yields Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
FarmView	Carnegie Mellon University	Academia	Mozambique
AgriPredict	AgriPredict	Company	Zambia
FarmDrive	FarmDrive	Company	Kenya

Resource Management

AI supports sustainable agriculture by optimizing the use of resources like water, fertilizer, and energy. For example, automated irrigation systems leverage AI, sensors, and IoT devices to optimize water usage, ensuring that crops receive the right amount of water at the right time.

Zenvus, Nigeria	www.borgenproject.org/zenvus-nigerian-startup-for-farmers
<p>Zenvus aims to transform African farming practices through innovative and data-driven solutions. By integrating smart sensors and data analytics, Zenvus monitors soil conditions, crop health, and environmental factors to provide actionable insights for farmers. These insights help in precision farming, enabling farmers to make informed decisions about irrigation, fertilization, and pest control, ultimately increasing crop yields and promoting sustainable agriculture.</p>	

Agrix Tech, Cameroon	www.agrixtech.com
<p>Agrix Tech is an innovative agri-tech company based in Cameroon, focused on enhancing agricultural productivity through advanced technology. Utilizing AI-powered solutions, Agrix Tech provides farmers with tools for pest and disease detection, crop management, and yield prediction. By analyzing images of crops, the platform offers real-time diagnostics and actionable recommendations, helping farmers to mitigate risks and optimize their farming practices. Agrix Tech aims to empower smallholder farmers with accessible, data-driven solutions to improve yields and ensure sustainable agriculture.</p>	

Table 5: Non-Exhaustive List of Resource Management Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
Zenvus	Zenvus	Company	Nigeria
Agrix Tech	Agrix Tech	Company	Cameroon
Pula Advisors	Pula Advisors	Company	Kenya

Digital Farming Advisory Service

Digital farming advisory services are revolutionizing agriculture by providing farmers with the information they need to make better decisions and improve their yields. These services, tailored to specific regions and crops, utilize digital channels and AI to deliver timely and relevant advice, ultimately supporting sustainable agricultural practices and enhancing food security in Africa and beyond.

Complete Farmer, Ghana	www.completefarmer.com
Complete Farmer's New Farmer initiative provides a comprehensive digital farming advisory platform designed to support new and aspiring farmers. This initiative simplifies starting a farm by offering expert agronomic and managerial support, access to essential inputs, and comprehensive farm services. Farmers receive reliable data and market insights to grow cash crops that meet market demand and buyer specifications. The platform integrates modern farming techniques, financial support, and real-time data analytics to optimize farming practices and ensure successful crop cultivation and sales.	

M-Shamba, Kenya	www.m-shamba.net
M-shamba digital platform supports digital learning on agronomy, climate smart interventions and food safety to the farmers through the Interactive Voice Response (IVR) service and interactive SMS. The platform also connects the farmers to the experts in the field through the Cloud Based Virtual Call Centre for real time and personalized support.	

Table 6: Non-Exhaustive List of Digital Farming Advisory Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
M-shamba	M-shamba	Company	Kenya
PlantVillage Nuru	CGIAR	CSO	Kenya
CF Grower	Complete Farmer	Company	Ghana
National Hotline for Agriculture	Crop2Cash	Company	Nigeria

3.3. FinTech

In the era of AI, fintech is revolutionizing agriculture by providing innovative financial solutions that enhance access to credit, streamline transactions, and improve financial management for farmers. AI-powered fintech solutions bridge the gap between traditional financial services and the unique needs of the agricultural industry, leading to increased productivity, sustainability, and financial inclusion. These platforms connect farmers directly with buyers, eliminating the need for intermediaries, thus ensuring farmers receive fair prices for their produce.

AgroCenta, Ghana	www.agrocenta.com/platforms.html
<p>AgroCenta aims to improve the agricultural value chain in Ghana by solving two critical problems that rural-based smallholder farmers face, namely access to market and access to finance, be it formal or informal. AgroCenta has developed a platform called Velociti, to accelerate the access to digital financial services for the underserved in the African agricultural ecosystem. For example, rural smallholder farmers can access financial services such as micro lending, mobile payments, insurance, and savings and pensions.</p>	

Apollo Agriculture, Kenya	www.apolloagriculture.com
<p>Created in 2016, in Kenya, Apollo Agriculture's primary goal is to assist farmers in emerging markets in increasing their yields and profits. Apollo achieves this goal by using ML, remote sensing, and mobile technology. Apollo Agriculture collects satellite imagery of farms, using artificial intelligence to estimate solvency and machine learning to make better decisions concerning the loans that can be granted to a specific farmer. Moreover, Apollo Agriculture helps farmers (with personalized guidance) to secure loans, high-quality farm inputs; and to give customized seed, fertilizer, and even tips on how to grow better crops based on satellite data, soil data, farmer behavior, and crop yield estimates.</p>	

Table 7: Non-Exhaustive List of FinTech Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
Velociti	AgroCenta	Company	Ghana
Apollo Agriculture	Apollo Agriculture	Company	Kenya
iCow	iCow	Company	Kenya
Farmcrowdy	Farmcrowdy	Company	Nigeria
Khula	Khula	Company	South Africa
Akaboxi	Akaboxi	Company	Uganda
SACCO	Ensibuuko	Company	Uganda
Harvest Money	Harvest Money	Company	Uganda
M-Omulimisa	M-Omulimisa	Company	Uganda

3.4. Supply Chain and Logistics

AI and automation solutions for supply chain and ecosystem management facilitate seamless value chain linkages. These technologies enhance the efficiency and transparency of agricultural supply chains, ensuring that products move smoothly from farm to market. Key applications include traceability solutions, demand-supply matching, and optimized logistics.

Hello Tractor, Nigeria	www.hellotractor.com/farmer
<p>Hello Tractor is an innovative platform that leverages technology to connect tractor owners with smallholder farmers who need tractor services. Hello Tractor has a strong presence in Nigeria, Kenya and Ghana where it has significantly improved access to mechanization for smallholder farmers, thereby increasing productivity, reducing labor costs for farmers and supporting food security efforts.</p>	

TechShelta, Ghana	www.techshelta.com
<p>TechShelta is a company based in Ghana that specialises in providing comprehensive digital solutions for greenhouse farming. By integrating technology with agriculture, TechShelta offers a range of services, including expert advisory on greenhouse farming practices, automation tools for efficient operation monitoring and control via mobile devices or PCs, and market linkage services through their A-Market platform. Additionally, TechShelta conducts hands-on training programs to equip farm owners and workers with essential skills to enhance productivity and sustainability in greenhouse farming.</p>	

Table 8: Non-Exhaustive List of Supply Chain and Logistics Initiatives

AI Initiatives	Organisations		
	Name	Type	Country
Hello Tractor	Hello Tractor	Company	Nigeria
TechShelta	TechShelta	Company	Ghana
Agroplexi	Agroplexi	Company	Nigeria
Twiga Foods	Twiga Foods	Company	Kenya

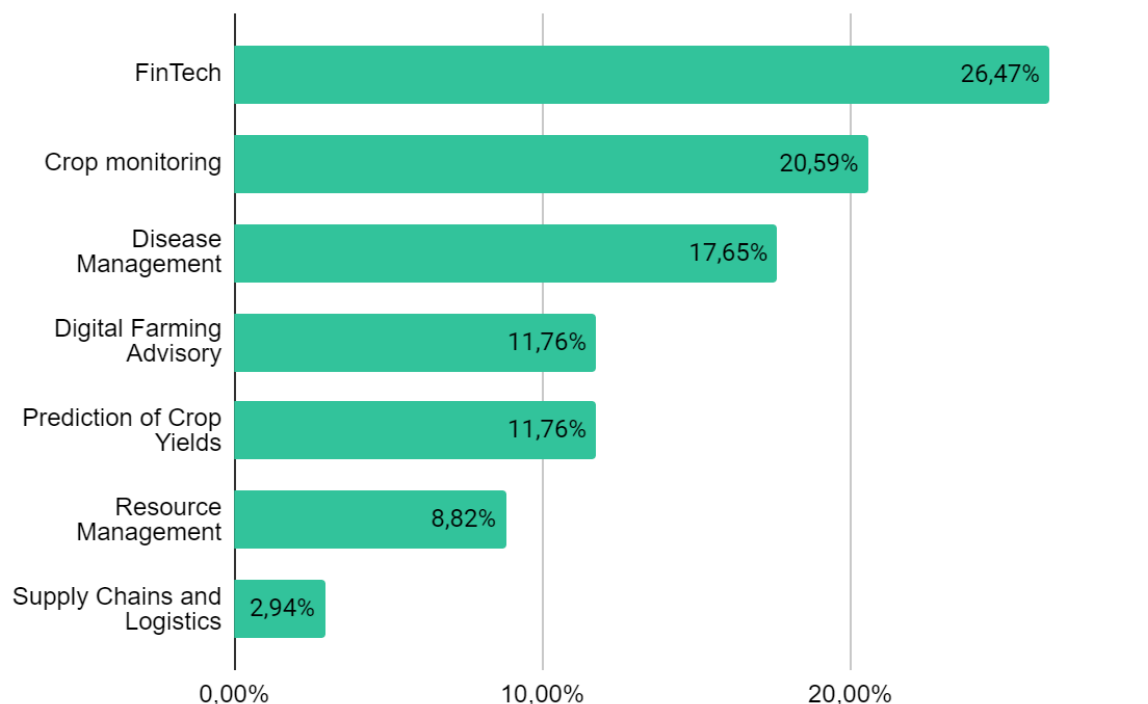


Additional Observations

4. Additional Observations

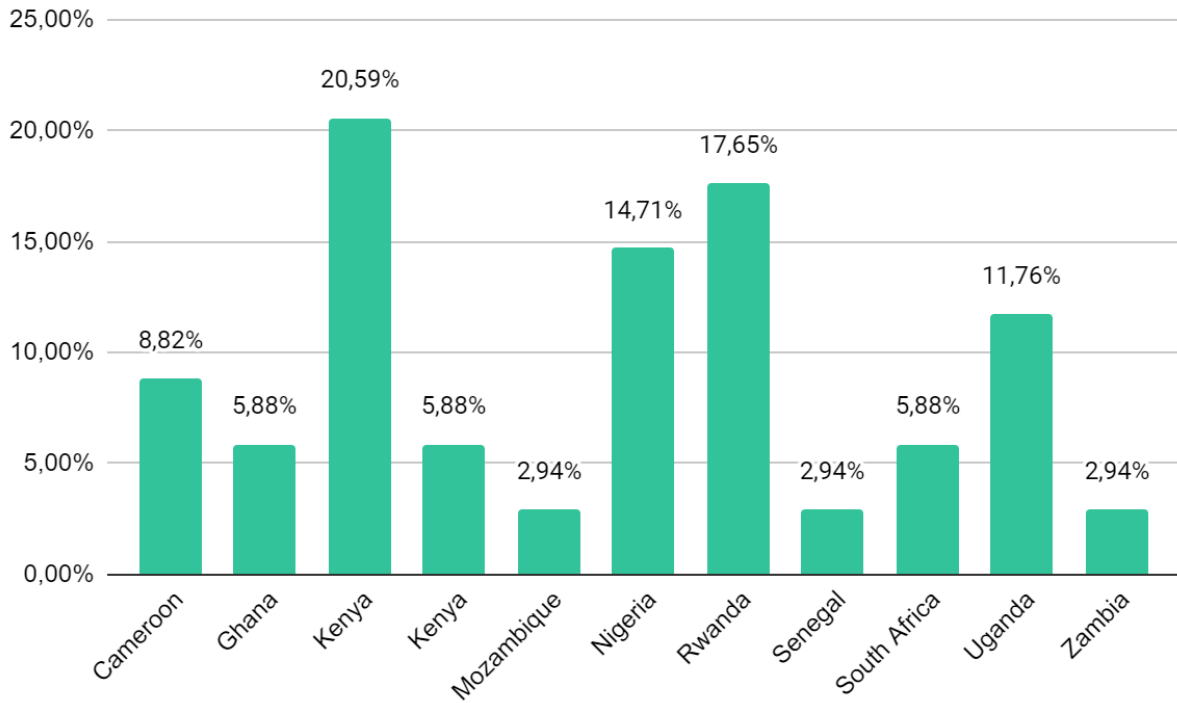
An analysis of our various non-exhaustive lists of AI initiatives in sub-Saharan Africa has enabled us to provide an indicative breakdown of the adoption of AI in different fields of agriculture (figure 2); the most active countries in developing AI solutions in agriculture (Figure 3) and the most active type of organizations (Figure 4).

Figure 2: Areas of Agriculture in which AI is Widely Applied in Sub-Saharan Africa



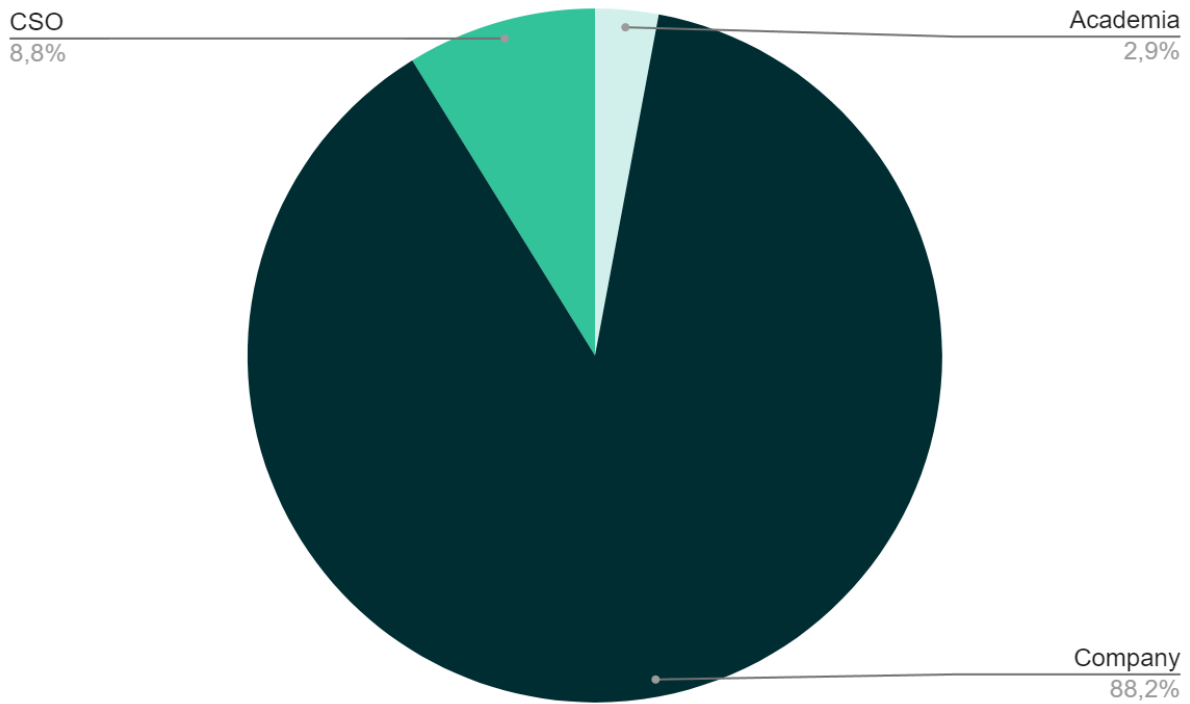
This figure shows an indicative rate of the adoption of AI solutions in the field of FinTech (26,47%), crop monitoring (20,59%), disease management (17,65%), digital farming advisory (11,76%), prediction of crop yields (11,76%), resource management (8,82%) and supply chains and logistics (2,94%).

Figure 3: The Hot Spot Countries for AI in Agriculture



Based on the results we found, this figure shows that Kenya, Rwanda, Nigeria and Uganda are the most active countries in developing AI solutions in Agriculture.

Figure 4: Types of Organisations Leading the Development of AI in Agriculture in Sub-Saharan Africa.



Finally, our indicative results show that private companies (88,2%) are much more involved in the development of AI solutions applied to agriculture; followed by Civil Society Organisations (8,8%), then academia (2,9%).



Main Funding Agencies

5. Main Funding Agencies

Several key funding agencies are actively supporting AI initiatives in agriculture across sub-Saharan Africa. These agencies play a crucial role in advancing technological innovations, enhancing agricultural productivity, and promoting sustainable farming practices. Here are some of the main funding agencies:

5.1. The International Development Research Centre (IDRC) of Canada

In 2020, Canada's International Development Research Centre (IDRC) and Sweden's government agency for development cooperation (Sida) launched the Artificial Intelligence for Development in Africa (AI4D Africa) program. This partnership, spanning four years and valued at CAD 20 million, is dedicated to a future where Africans across all regions create and use artificial intelligence (AI) to lead healthier, happier and greener lives. The program promotes excellence in applied research and applying AI technologies in the service of solving development challenges and improving livelihoods for those living in poverty. The Artificial Intelligence for Agriculture and Food Systems Innovation Research Network⁴ is an example of the initiatives funded under this programme. The AI4D program has now grown with combined investments from the United Kingdom's Foreign, Commonwealth and Development Office (FCDO), the Bill and Melinda Gates Foundation (BMGF), United States Agency for International Development (USAID) and IDRC⁵.

5.2. The Bill & Melinda Gates Foundation

The [Gates Foundation Agricultural Development](#) program invests in innovations that enhance the productivity and sustainability of smallholder farms in sub-Saharan Africa. By supporting the development and deployment of AI technologies, such as climate-smart crop varieties and digital soil maps, the foundation aims to improve crop yields, resilience to climate change, and overall food security. Their efforts

⁴ [Artificial intelligence for agriculture and food systems innovation research network](#)

⁵ [Combining forces for a new phase of AI for development: Africa and beyond | IDRC](#)

include partnerships with local organizations and governments to ensure these technologies reach the farmers who need them most. Their initiatives are focused on:

- **Digital Tools and Platforms:** Supporting the creation of digital platforms that provide farmers with real-time data on weather, soil health, and market prices.
- **Innovative Crop Varieties:** Funding research and development of crop varieties that are resilient to pests, diseases, and climate change.
- **Capacity Building:** Training programs for farmers to adopt new technologies and farming practices.

5.3. The African Development Bank (AfDB)

[Technologies for African Agricultural Transformation \(TAAT\)](#) supported by the AfDB, leverages AI and other digital technologies to enhance agricultural productivity and sustainability in Africa. TAAT is a major continent-wide initiative designed to boost agricultural productivity across the continent by rapidly delivering proven technologies to millions of farmers. TAAT aims to double crop, livestock, and fish productivity by expanding access to productivity-increasing technologies to more than 40 million smallholder farmers across Africa by 2025. TAAT seeks to generate an additional 120 million metric tons (MT). TAAT is a key flagship programme of the Bank's Feed Africa strategy (2016 – 2025).

5.4. The Food and Agriculture Organisation (FAO)

Supported by the Food and Agriculture Organisation (FAO), [FAO E-Agriculture](#) funds and implements AI-driven projects that focus on data collection, precision farming, and sustainable resource management. The initiative aims to support farmers with innovative tools and technologies to improve agricultural practices and ensure food security.

5.5. The United States Agency for International Development (USAID)

USAID's [Feed the Future initiative](#) funds agricultural research and development projects that incorporate AI technologies. The initiative aims to improve crop yields, pest management, and resource use efficiency, thereby enhancing food security and resilience among smallholder farmers in Sub-Saharan Africa.

5.6. Big Tech Companies

In the last few years, a growing and thriving AI ecosystem has emerged in Africa. Within this ecosystem, there are local tech spaces as well as a number of internationally driven technology hubs and AI research labs established by big tech companies such as Twitter, Google, Facebook, Alibaba Group, Huawei, Amazon, and Microsoft.

- In April 2019 Google opened its first African AI research centre in Ghana;
- The IBM laboratory in Nairobi;

These big tech companies have significantly increased the development and deployment of AI systems in Africa; and have contributed to the emergence of local AI practitioners and research groups.

| Recommendations

6. Pathways to Responsible Uptake of AI in Agriculture

The deployment of artificial intelligence in Africa faces challenges related to infrastructure disparities, lack of digital skills, and a lack of data and ethical concerns, which have stymied progress in different parts of the continent. Despite these challenges, AI remains a powerful opportunity for transforming agricultural systems in Africa; demonstrated by the wide range of initiatives we have been able to identify in this report. However, for this potential to be fully realized, certain conditions will have to be met. Echoing the Food and Agriculture Organization of the United Nations (FAO), we would like to make the following recommendations to relevant stakeholders, such as governments, funding bodies, farmers, communities, researchers, developers, farmers, etc.

“Disruptive digital technologies such as Artificial Intelligence (AI) have now emerged as powerful tools that can revolutionize the agricultural sector by enhancing efficiency, precision, and sustainability.”

- Dejan Jakovljevic, FAO Chief Information Officer, Director of the Division of Digitalization and Informatics (FAO, 2023).

Recommendation 1: Establish National AI Policies and Regulations Focusing on Agriculture

African countries need robust policy and governance frameworks to ensure that agritech solutions are beneficial and rights-respecting. In this sense, India and its national AI policy may be a good example to follow, with the emphasis on agriculture as one of the key sectors with the aim of optimising Precision Farming, Pest and Disease Prediction, Supply Chain Optimization, and Smart Irrigation Systems⁶. To achieve this, there is a need to:

⁶ [India National Strategy for AI.](#)

- **Develop Policies for Technology Uptake:**
 - Create and implement policies that encourage the adoption of appropriate technology within the agriculture sector.
 - Address emerging challenges regarding data protection, data ownership, and governance to ensure that AI solutions are both effective and ethical.
- **Set Up Governance Frameworks:**
 - Establish governance structures to oversee the deployment and use of agritech solutions, ensuring they are beneficial, rights-respecting, and aligned with national interests.
 - Include provisions for monitoring and evaluating the impact of AI technologies on agriculture and rural communities.
- **Provide Incentives for Ethical AI Practices:**
 - Offer incentives for companies that adhere to ethical AI practices, including transparency, accountability, and fairness.
 - Encourage the adoption of best practices in AI development and deployment through recognition and reward programs.

Recommendation 2: Facilitate Collaborations Between Governments, Tech Companies and Farmers

Collaboration between governments, tech companies, and farmers can result in AI-powered solutions tailored to local challenges. Public-private partnerships are crucial in facilitating the integration of AI tools by offering training, technology access, and market connections to smallholder farmers. To this end, it is important to:

- **Create Regulatory Frameworks for Private Sector Investment:**
 - Develop regulations that encourage private sector investments in AI-driven agritech solutions, ensuring that these investments benefit local communities.
 - Promote a favorable business environment that attracts and retains tech companies interested in agriculture.

- **Set Up Innovation Hubs:**

- Establish innovation hubs where farmers, tech experts, and researchers can collaborate on AI projects.
- Facilitate knowledge exchange and co-creation of solutions by organizing regular meetups, hackathons, and collaborative projects.

Recommendation 3: Invest in Research & Development (R&D)

African governments should support the adoption of AI by investing in research and development. This will ensure that local interests are prioritized and help prevent an "AI brain drain"⁷. To do so, governments should:

- **Create Grants and Funding Opportunities:**

- Establish grants and funding opportunities specifically for AI research and development in agriculture.
- Ensure that funding mechanisms are accessible to local researchers and innovators.

- **Establish Venture Capital Funds:**

- Develop venture capital funds to support local AI startups focusing on agricultural solutions.
- Encourage private investors to contribute to these funds through tax incentives and other financial benefits.

- **Support Local AI Startups:**

- Provide resources and mentorship to local AI startups, helping them scale and succeed.
- Promote success stories to inspire other entrepreneurs and attract further investment.

Recommendation 4: Promote Open Education and Collaborative Research

Developing robust, practical, and contextually relevant AI methods for agriculture in Africa requires interdisciplinary teams, including experts in AI, agriculture/agronomy, remote sensing, climate science, and soil science. Therefore, it is essential to:

⁷ Brain drain is the departure of educated or professional people from one country, economic sector, or field for another usually for better pay or living conditions (Merriam-Webster Dictionary).

- **Encourage Inclusion of Social Scientists:**
 - Integrate social scientists into AI projects to study the socio-economic impacts of AI adoption in agriculture.
 - Conduct research on the effects of AI on local communities, ensuring that benefits are equitably distributed.
- **Partner with Local Schools and Universities:**
 - Collaborate with educational institutions to develop AI-related content in local languages.
 - Promote STEM education and encourage students to pursue careers in AI and agriculture.
- **Organize Workshops and Training Sessions:**
 - Facilitate workshops and training sessions where tech companies can educate farmers on the use of AI tools and applications.
 - Provide ongoing support and resources to help farmers implement and benefit from AI technologies.
- **Launch E-Literacy Programs:**
 - Implement e-literacy programs targeting farmers, providing training on how to use AI tools and interpret data.
 - Develop accessible online resources and courses tailored to the needs of the agricultural community.
- **Form Multidisciplinary Research Teams:**
 - Create multidisciplinary research teams comprising AI experts, agronomists, climate scientists, and local farmers to develop context-specific AI applications.
 - Foster collaboration between local and international researchers to leverage diverse expertise and perspectives.

Figure 5 : Challenges and Recommendations

Challenges	Recommendations
<ul style="list-style-type: none"> • Gaps in regulation • Data paucity • Biases 	<p>Establish National AI Policies and Regulation focusing on Agriculture</p>
<ul style="list-style-type: none"> • Collaboration • Scalability 	<p>Facilitate Collaborations between Governments, Tech Companies and Farmers</p>
<ul style="list-style-type: none"> • Lack of funding • Infrastructure 	<p>Invest in Research and Development</p>
<ul style="list-style-type: none"> • Shortage of Skills • Participation 	<p>Promote Open Education and Collaborative Research</p>

| Conclusion



7. Conclusion

The integration of artificial intelligence (AI) into agriculture in sub-Saharan Africa holds transformative potential for enhancing productivity, sustainability, and food security. Throughout this report, we have explored the diverse applications of AI technologies, ranging from precision farming and predictive analytics to supply chain optimization. Advancements in AI offer promising solutions to the unique challenges faced by the agricultural sector in this region.

Key insights from this study highlight the importance of fostering a collaborative ecosystem that includes government bodies, research institutions, private sector stakeholders, and local farming communities. To fully harness the benefits of AI, there must be a concerted effort to improve digital infrastructure, provide access to training and education, and ensure the inclusion of smallholder farmers in the digital revolution.

Furthermore, ethical considerations and responsible AI deployment are paramount to avoid exacerbating existing inequalities and to ensure that the benefits of AI are equitably distributed. Policymakers must prioritize the development of regulatory frameworks that promote transparency, data privacy, and accountability.

In conclusion, while AI presents significant opportunities for the agricultural sector in sub-Saharan Africa, realizing its full potential will require a multi-faceted approach that addresses technological, socio-economic, and ethical dimensions. By leveraging AI responsibly, sub-Saharan Africa can achieve a more resilient and prosperous agricultural future, ultimately contributing to the broader goals of sustainable development and food security for all.

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| Annex

9. Annex: List of AI Initiatives in Agriculture

Country	Domain	AI Initiatives	Type
Cameroon	Smartphones and Mobile apps, Machine learning, Computer vision and Soil management.	CLINICAGRO	Company
		Greenlive	Company
Ghana	Infrastructure, Capacity building and Access to Market.	Velociti	Company
	Smartphones and Mobile apps, Access to market and mobile payment, Infrastructure, Capacity building and Funded initiatives.	CF Grower	Company
Kenya	Computer vision, Weather forecasting, Soil management, Prediction of crop yields and Infrastructure.	SoilPal	Company
		M-Shamba	Company
		Komaza Kenya	Company
		FarmShield	Company
	Infrastructure	Apollo Agriculture	Company
	Pest and disease management, Infrastructure and Capacity building.	PlantVillage Nuru	CSO
Smartphones and Mobile apps, Access to market and mobile payment, Infrastructure and capacity building.	iCow	Company	
Mozambique	Internet of Things, Drones, Machine learning, Computer vision, Soil management, Pest and disease management, Prediction of crop yield and Infrastructure.	Farmview	Academia
Nigeria	Access to market	Hello Tractor	Company
	Prediction of crop yields, Access to market and mobile payment, Infrastructure and Capacity building.	Farmcrowdy	Company

Country	Domain	AI Initiatives	Type
	Smartphones and Mobile apps, Computer vision, Access to market and mobile payment, Infrastructure, Capacity building and Funded initiatives.	National Hotline for Agriculture	Company
Rwanda	Internet of Things, Drones, Machine learning, Computer vision, Soil management, Pest and disease management, Prediction of crop yield and Infrastructure.	The MapSPAM	Company
		karaAgro AI	Company
		Africa Agriculture Watch (AAgWa)	CSO
		Plantwise Knowledge Bank	CSO
		Charis UAS	Company
	Robotics, Smartphones and Mobile apps, Machine learning, Infrastructure and Capacity building.	Mkulima GPT	Company
Senegal	Smartphones and Mobile apps, Access to market and mobile payment, Infrastructure and Capacity building.	e-Tolbi	Company
South Africa	Access to market	Khula	Company
	Computer vision, Prediction of crop yields, Infrastructure and capacity building.	TrueFruit™ Size DataProphet	Company Company
Uganda	Access to market	Akaboxi	Company
		Harvest Money	Company
	Smartphones and Mobile Apps, Access to market and mobile payment, Infrastructure and capacity building.	SACCO M-Omulimisa	Company Company

Country	Domain	AI Initiatives	Type
Zambia	Pest and disease management, Infrastructure and capacity building.	AgriPredict	Company