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Funded by the European Union

DISCUSSION PAPER No. 396

How AI can benefit smallholder farmers in Africa: Opportunities for EU-Africa

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October 2025

Agriculture remains a cornerstone of Africa's economy. Yet, agricultural productivity is among the lowest globally due to climate risks, outdated practices, limited access to input, finance and markets, and weak policy support. Artificial intelligence (AI) offers a promising avenue to help overcome these challenges and build more resilient and inclusive agri-food systems.

In this paper, we explore the growing role of AI in African agriculture and identify strategic entry points to accelerate its impact. AI is increasingly used for early warning systems, crop and disease diagnostics, climate-smart advisory services and agri-fintech solutions. These tools have shown early success in boosting yields, enhancing resource efficiency and improving credit access, sometimes with EU support. However, the benefits of AI are unevenly distributed. Many innovations target big commercial farms, while smallholders face major barriers such as high costs, poor connectivity, fragmented data ecosystems and limited digital literacy. Policy and investment gaps hinder their participation, especially in underserved regions and less-explored sectors like livestock.

We argue that AI could be a powerful catalyst for sustainable and equitable agricultural transformation in Africa if it empowers rather than marginalises smallholder farmers. Achieving this requires supportive policies, financial support and alignment with African development frameworks. Strong government leadership is essential to support inclusive innovation ecosystems, prioritising multilingual and user-centred tools that are adaptable to diverse crops. We also highlight opportunities for greater EU-Africa cooperation, not only through funding, but also through co-creation, capacity building and ethical data governance.

Table of contents

List of tables

Acknowledgements

The authors would like to thank Chloe Teevan and Koen Dekeyser for their invaluable input and constructive feedback and Joyce Olders for the layout. The views expressed in this paper are those of the authors and do not represent those of ECDPM or any other institution. Any errors or omissions remain the responsibility of the authors. For comments and feedback, please contact mmu@ecdpm.org or cte@ecdpm.org.

Acronyms

ACTS	African Center for Technology Studies
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AI	Artificial Intelligence
AIMS	Agricultural Information Management System
ATDCs	Agricultural Technology Demonstration Centers
AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
CSA	Climate Smart Agriculture
DTS	Digital Transformation Strategy
EC	European Commission
EU	European Union
EUDR	European Union Deforestation Regulation
FAO	Food and Agriculture Organisation of the United Nations
FCDO	Foreign, Commonwealth and Development Office
GISs	Geographic Information Systems
GSMA	Global System for Mobile Communications Association
IDRC	International Development Research Centre
ICTs	Information Communication Technologies
IFAD	International Fund for Agricultural Development
IoT	Internet of Things
ITU	International Telecommunication Union
KNUST	Kwame Nkrumah University of Science and Technology
ML	Machine Learning
MoALD	Ministry of Agriculture and Livestock Development
NAIPs	National Agricultural Investment Plans
NEPAD	New Partnership for Africa's Development
NLP	Natural Language Processing
NORAD	Norwegian Agency for Development Cooperation
SIDA	Swedish International Development Cooperation Agency

SMS	Short Messaging Service
SSA	Sub-Saharan Africa
TEIs	Team Europe Initiatives
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USSD	Unstructured Supplementary Service Data
WB	World Bank
WEF	World Economic Forum
WFP	World Food Program
ZANACO	Zambia National Commercial Bank

Executive summary

Smallholder farmers, who produce more than 70% of Africa's food and make up the majority of the agricultural labour force, are critical to the continent's food security and rural development agenda. Yet, their productivity remains among the lowest in the world, hampered by climate vulnerability, outdated farming practices, limited access to inputs and finance, insufficient market linkages, and poor infrastructure. Artificial intelligence (AI) presents a compelling opportunity to address some of these systemic bottlenecks and enable more resilient, inclusive, and sustainable agri-food systems.

This paper explores the increasing significance of AI in African agriculture, examining its practical applications and highlighting key opportunities to accelerate its impact. This analysis is based on a review of existing literature and policy papers, supplemented by interviews with relevant stakeholders. The study aims to identify strategic avenues for collaboration between African and European stakeholders to expedite the positive impact of AI in this sector. Evidently, AI is demonstrating value in supporting climate-smart extension services, early warning systems, crop and disease diagnostics, and innovative agrifintech models, with evidence of support from the European Union. AI applications have begun to improve yield forecasts, reduce input misuse, and expand access to credit.

However, uptake remains highly uneven and often fails to reach the most marginalised farming communities. Key barriers include inadequate digital infrastructure, low affordability of AI tools, data fragmentation, limited digital

literacy, and a lack of policies tailored to smallholder needs. Many existing advances are geared towards large-scale commercial farms, resulting in a widening digital divide in African agriculture.

The study finds evidence of regional disparities in the assessment of emerging use cases of AI in agriculture across the continent. Furthermore, most AI applications currently focus on crop productivity, with fewer addressing livestock, aquaculture, or the nexus between agriculture and forest management. It is thus important for developers and funders to expand support to under-represented regions and thematic areas.

To close the gap in AI deployment in agriculture, policymakers need to create enabling environments that promote ethical and inclusive AI. This includes forging strategic partnerships with AI researchers, academia, startups, civil society, and farmer organisations to ensure that AI in agriculture not only delivers production and market efficiency but also reinforces inclusivity, data rights, and rural resilience. Policymakers should also prioritise developing national AI strategies and policies focusing on inclusive innovation models that prioritise co-creation with farmers, support local language tools, and invest in multi-crop AI applications.

African policymakers can explore diverse investment and funding models with different partners to align with African priorities under Agenda 2063 and the Comprehensive Africa Agriculture Development Programme (CAADP). Africa can also deepen its partnership with one of its strongest partners in agriculture, the European Union, and leverage frameworks such as the Global Gateway and Team Europe Initiatives to support initiatives on AI in African agriculture. European partners can use their experience in agricultural innovation and regulatory expertise to support capacity building, co-create ethical AI governance frameworks, and ensure that digitalisation efforts are equitable, sustainable, and climate-smart. Notably, the integration of AI in agriculture can support compliance with EU trade and sustainability regulations, offering mutual economic and environmental benefits.

For Africa’s smallholder farmers to thrive in the digital age, targeted policy reforms and catalytic financing need to converge. AI must not widen inequality but become a driver of inclusive agricultural transformation.

1. Introduction

Africa's agriculture sector employs 42% of the continent's workforce, yet it is 60% less productive than economywide productivity (AfDB, 2024). Within this sector, 80% of the farmers are smallholders contributing over 70% of Africa's food production despite being excluded from structured policy processes and lacking adequate access to knowledge, markets, sustainable financing models and more land for farming (FANRPAN, 2025; Smart Africa et al., 2023). In addition, Africa is experiencing a growing concern of food insecurity which is partly attributed to outdated traditional farming practices, limited use of quality inputs, insecurity, political instability, climate change, increased pest infestations, gender inequality and lack of political will to invest (IPCC, 2022; Musa et al., 2023).

Technologically driven farming approaches and emerging technologies like artificial intelligence (AI), machine learning (ML), internet of things (IoTs), drones, robotics, cloud computing and blockchain present a unique opportunity for Africa to tackle challenges, boost agricultural productivity and drive economic growth (Signé, 2025). In particular, AI can boost agricultural production and productivity by optimising resource use - such as water, fertilisers, and pesticides - delivering personalised, data-driven advice tailored to specific crops, and enabling precision agriculture through advanced weather forecasting, soil monitoring, and early pest and disease detection. Additionally, AI-powered digital platforms can enhance farmers' access to markets and financial services, serving as transformative tools within the African Continental Free Trade Area (AfCFTA). While AI has the potential to tackle challenges faced in African agriculture, there are concerns that smallholder farmers may be excluded from these benefits.

This paper explores the emerging trends in AI use cases in African agriculture and the extent to which AI use cases add value to smallholder farmers. It identifies some of the barriers and challenges and proposes tailored interventions which can help to deliver tangible benefits for smallholder farmers. To promote Africa-Europe partnership, the paper also proposes strategies for the EU to strengthen collaboration with Africa while ensuring alignment with the continent's Agenda 2063. In this paper, we conducted desktop research, analysing existing literature and policy documents on AI in agriculture, digital agriculture, or the use of digital technologies in agriculture. We also conducted several interviews with AI developers, AI researchers, agritech companies, farmer organisations, farmers, agricultural and digital policy experts, development partners, and funders in Africa.

2. A primer on AI in agriculture

2.1. Terminology and definitions

AI is defined as a type of technology characterised by the development and use of machines that are capable of performing tasks that usually require human intelligence (WEF, 2023). For example, instead of a farmer manually and visually inspecting crops, identifying crop pests and diseases, AI can perform the same task of disease detection and diagnosis. In this study, we observe that while AI is already in use, it is not always explicitly labelled as 'AI in agriculture'. Instead, terms like 'digital agriculture', 'AgriTech', 'eAgriculture', 'smart farming' or 'agric 4.0.' are often commonly used (at times interchangeably)- terms that often include the use of AI as part of broader technological advancements.

The most commonly used terms encompassing AI in agriculture are 'digital agriculture' and 'agricultural technology'. Digital agriculture is viewed as the adoption of information communication technologies (ICTs) or digital technologies and their application in agriculture and consists of different components from IoTs, cloud computing, robotics and big data analysis (Australian Farm Institute, 2016; Shen et al., 2010; Ozdogan et al., 2017). This term seems to be the broadest, as it covers the entire agriculture value chain. African policymakers often use the term 'AgriTech' (agricultural technologies), which is defined as the fusion of agriculture and technological innovations with the purpose of increasing agricultural yield, efficiency and profitability (Smart Africa et al., 2023). This definition includes both digital and non-digital innovations like biotechnologies embedded in seeds, modern breeding stock, irrigation, synthetic inputs in fertilisers and pesticides, etc (Suri and Udry, 2022).

The other terms that are commonly used and associated with AI in agriculture are 'smart farming', 'climate-smart farming' and 'precision agriculture'. Smart farming is defined as more advanced precision agriculture technologies such as on-farm remote sensors-enabled devices that generate and transmit real-time data about a specific crop, animal or practice (FAO, 2024; Foster et al., 2023). Climate-smart agriculture (CSA) is a concept developed by the Food and Agriculture Organisation (FAO) as an approach to transform agriculture in response to climate change by increasing productivity, enhancing resilience, and reducing greenhouse gas emissions (Campbell, 2017; Campbell et al., 2014; Djido et al., 2021). AI is increasingly being integrated into CSA practices to increase productivity while significantly reducing environmental impacts (Mmbando, 2024; ClimateTech, 2025). Precision agriculture is seen as a modern approach to increasing agricultural yield and improving its efficiency through the application of technology and data analysis to agricultural services. (Musa et al, 2023). These concepts reflect various forms of digitalisation across agricultural production systems, value chains and food systems, all involving AI to some extent (Kerkx et al., 2019).

Using inconsistent terminology when discussing AI uses in agriculture can lead to policy misalignment and confusion as policymakers and stakeholders interpret these terms differently. Further, vague or inconsistent terminology may cause duplication of efforts or leave critical areas unregulated. African policymakers should recognise these differences when shaping policy, ensuring that policy interventions focus on broader, systemic issues that can better support the integration and scaling of AI in agriculture. This paper adopts a broad view of AI in agriculture, encompassing its use across these varied terms.

2.2. Key policies on AI in agriculture

The policy landscape for AI in African agriculture is evolving unevenly, largely along two parallel tracks. This might be explained by various factors. Agricultural policy is relatively mature, supported by established institutions and longstanding government priorities tied to food security, livelihood and trade. In contrast, AI policy is in the nascent stages, with very few countries having adopted relevant national AI policies and strategies. These emerging AI policies are being developed by ICT ministries and departments, often in consultation and collaboration with the private sector and international partners. However, most national AI policies and strategies are broad and cross-sectoral, with limited attention to specific sectors like agriculture. As a result, there is minimal coordination between agriculture and AI policy processes, potentially hindering the effective integration and scaling of AI technologies in the agricultural sector.

AI in agriculture policies

Overall, the evolution of African agricultural policies has been marked by a gradual but strategic shift toward highlighting the importance of, and integrating AI and digital technologies into Africa's agricultural transformation aspirations.

African agricultural policies have long supported technology use, notably through the 2003 Maputo Declaration, which established the CAADP as a vehicle to deliver the continent's vision on agriculture. CAADP urged countries to allocate at least 10% of national budgets to agriculture and rural development, and target 6% annual growth. However, most African countries failed to meet the target of allocating 10% of their national budgets by 2013, ten years after the declaration. The Maputo Declaration also identified technology dissemination as a key pillar where available technologies should be adopted to support the immediate expansion of African production through the linking of research and extension systems to producers; technology delivery systems that rapidly bring innovations to farmers and agribusinesses, thereby making increased adoption possible, notably through the appropriate use of new ICTs (Maputo Declaration, 2003).

After the initial 10-year CAADP period, African leaders renewed their commitment through the 2014 Malabo Declaration, focusing on agricultural productivity, trade, and poverty reduction. However, there was no explicit reference to the role of emerging technologies in revolutionising farming. Instead, they reaffirmed CAADP principles, pledged to end hunger and halve poverty by 2025, boost intra-African agricultural trade, build climate resilience and enhance accountability (Malabo Declaration, 2014). However, while the 2014 CAADP Implementation Strategy and Roadmap to achieve the CAADP Vision 2025 did not explicitly mention AI or digital technologies, it did encompass data systems, ICT, science, and innovation, which are all preconditions for AI adoption in agriculture (AUDA NEPAD, 2014b). Despite this framing, only a few countries have fully aligned their policies with CAADP, and digital agriculture continues to receive insufficient attention. Only a few countries, such as Benin, Rwanda, Niger and Nigeria, have started drafting their digital agriculture strategies (FAO and ITU, 2022).

The Fourth CAADP Biennial Review, published in 2024, indicates no African country is on track to fully achieve the seven Malabo Commitments by 2025. Progress has been particularly poor on commitments related to agricultural investment, ending hunger, and poverty reduction through agriculture. While data systems and reporting have improved, leading to improvements in the commitment relating to better mutual accountability, challenges remain in policy coordination, financing, productivity, and trade integration.

The new CAADP strategy and the Kampala declaration both emphasise the transformative potential of AI, digital technologies, and digitalisation for African agriculture. The CAADP strategy specifically mentions AI's role in modernising agricultural extension systems, remote sensing, precision agriculture, and digital decision-support tools. The declaration commits Member States to fostering an enabling policy and regulatory environment for emerging technologies like biotechnology, AI, digitalisation, and precision agriculture, aligning with the CAADP strategy. The CAADP's first strategic objective centres on boosting sustainable food production, agro-industrialisation, and trade. This objective emphasises promoting digital extension services, real-time weather data, pest alerts, and market information platforms, as well as using digital platforms, mobile apps, and online farmer communities to expand service access (African Union, 2024).

Agenda 2063 also captures both agricultural and digital ambitions. One goal includes modernising agriculture and agro-businesses through scaled up value addition and productivity. This goal in turn aims to completely eliminate hunger and food insecurity, reduce imports of food and raise intra-Africa trade in agriculture and food to 50% of total formal food and agricultural trade, expand the introduction of modern agricultural systems, technology practices, training and more (African Union N.d.). It also envisions the development of ICT infrastructure to drive technological transformation across the continent.

Agriculture in digital and AI policies

Digital and AI policies, alongside agricultural policies, are also contributing towards the deployment of AI in African agriculture. The first comprehensive digital policy document created by the AU was the 2020 AU Digital Transformation Strategy (DTS). The DTS is a continent-wide plan to leverage digital technologies for transforming African economies and societies. Its relevance to agriculture can be seen through identifying digital technology as an opportunity for farmers to improve the efficiency of food production and consumption in Africa. The DTS also notes that digital agriculture is only possible by improving rural digital infrastructure, developing digital agrifinance services, supporting agricultural digital platforms, enhancing agricultural digital skills and literacy, empowering women in agriculture using ICTs, and deploying digital solutions in agriculture (Digital Transformation Strategy, 2020).

In 2024, the AU adopted the first continental strategy on AI. This strategy identifies agriculture as one of the core sectors where AI innovations should be prioritised to promote productivity. It promotes the widespread adoption of AI in agriculture through the deployment of AI use cases, establishment of research centres, exchange of knowledge and experience and raising awareness of the potential benefits and risks of AI in agriculture (AU Continental AI Strategy, 2024).

Prior to the adoption of the continental AI strategy, the AU had adopted the AU Data Policy Framework (DPF) aimed at supporting data value creation (which is fundamental to AI innovation). The DPF provides principles and recommendations for building national data systems to derive value from data. While the policy framework is not agriculture-specific, it also highlights the role of open data in driving innovation (Data Policy Framework, 2022). Several AU member states have started developing their national data strategies in line with the DPF (Smart Africa, 2024).

At the continental level, Smart Africa's endorsement of two strategic policy documents (the Continental Blueprint on Agricultural Technology and the Continental Blueprint on AI) shows a deliberate effort to institutionalise AI within Africa's agricultural transformation agenda. The Continental Blueprint on Agricultural Technology exemplifies this approach by positioning AI not merely as a tool, but as a catalyst for systemic change in agricultural productivity. The blueprint recognises the political economy of agritech by calling for harmonised policies and political commitment, while also addressing structural enablers such as targeted agritech funding, private-public cooperation, inclusive infrastructure, digital skills development, regional collaboration, and strategic agricultural data use. The blueprint was developed under the leadership of the government of Zimbabwe with the support of a diverse consortium of stakeholders (Smart Africa et al., 2023). Such active involvement by stakeholders illustrates a growing consensus that effective AI adoption in agriculture necessitates cross-sectoral coordination, multi-stakeholder engagement, and the value of partnerships.

The Continental Blueprint on AI also reflects a concerted effort by Smart Africa member states to position AI as a transformative lever. The blueprint advocates for the development of concrete use cases in priority sectors like agriculture. The identification of agriculture as a strategic sector where AI can boost productivity is particularly significant in tackling challenges of food insecurity and unemployment (Smart Africa, 2021). The emphasis of AI use cases in agriculture signals a broader policy logic where AI is not viewed as a standalone technological domain but as an enabler of inclusive growth and economic and social development.

At the national level, less than 20 African countries have formalised AI policies and strategies to date, highlighting a fragmented and still-nascent policy landscape (Musoni and Okechukwu, 2024; Carnegie, 2024). However, among the countries that have done so (such as Benin, Rwanda and Egypt), there is a notable convergence around agriculture as a priority sector for AI deployment (Benin National AI and Data Strategy; Rwanda AI policy; and Egypt AI Strategy). This thematic alignment suggests an emerging recognition across national contexts of agriculture's dual function: as both a site of urgent developmental need and a proving ground for AI's practical value.

3. Mapping AI use cases in agriculture

3.1. An overview of AI use cases in agriculture

The integration of AI into agriculture is ushering in a promising era—one with the potential to fundamentally reconfigure how smallholder farmers, historically excluded from technological revolutions, interact with and benefit from farming systems. Across the continent, a growing ecosystem of researchers, innovators, and funders is driving a surge of AI applications to address persistent challenges in African agriculture. Agritech as a business is attracting investments and more AI startups, with reports indicating a 110% increase in the number of startups operating in the agritech sector (Smart Africa et al., 2023). This section provides an overview of the use of AI in African agriculture. Rather than listing technologies in isolation, it adopts a functional lens, grouping use cases according to the core problems they seek to solve and the broader functions they are designed to perform in agriculture. This is presented in Table 1.

Table 1: AI use cases in agriculture

Function	Description	Use cases	Examples	Prevalence and Intensity of use
Early warning, prediction and optimised farm practices	The integration of meteorological, environmental, and historical data to forecast extreme weather and pest outbreaks, as well as generate data-driven farming insights through AI, in order to reduce crop loss and the environmental impact of resource use while increasing crop yield and resilience.	Weather forecasting	Ignitia uses AI to provide weather and climate intelligence, enabling smallholders to improve their yield. ITIKI combines indigenous knowledge, data and AI to predict weather patterns.	Nascent
		Yield prediction	AI4MoreCrops project focuses on enhancing crop yield prediction using machine learning models. Croppie is an AI-assisted yield estimator for coffee. High-Resolution Yield Prediction using drones and AI (Senegal). Use of Machine Learning Models to optimise yield (Benin). Africa Agriculture Watch (AAgWa) is a web-based platform that predicts crop yields and production levels in Africa using cutting-edge machine learning and remotely sensed data.	Nascent
		Precision farming	Riwe Technologies Aerobotics Kitovu ThirdEye uses flying sensors (drones) to monitor soil needs and identify crop stress at an early stage. CropScan assesses nutrient and humidity levels, and water needs, and predicts yields. Faminga utilises Machine Learning models and cutting-edge AI technology to detect crop diseases and gather soil composition and weather data, enabling data-driven decisions and yield optimisation.	Accelerating/Established
		Disease outbreak prediction	InstaDeep and Google AI developed an early detection system for desert locust outbreaks. IoT-based early warning system for locust invasion (Zambia) - Research-based.	Nascent

Function	Description	Use cases	Examples	Prevalence and Intensity of use
Farm health monitoring	The continuous assessment of soil, crop, and environmental conditions leveraging AI and remote sensing, to enable early detection of stress indicators such as nutrient deficiencies and pest infestation and targeted interventions.	Disease detection and management	Plantix is a mobile application assisting farmers in diagnosing and treating crop problems. CADI AI and AI4Cashew by KaraAgro Ghana uses an AI and drone-based system to detect diseases in cashew trees.	Accelerating
		Soil condition analysis and monitoring	SoilPal by Ujuzikilimo analyses soil health.	Accelerating
Digital on-farm extension advisory	AI-powered advisory tools that provide tailored, real-time agronomic support to farmers, improving their decision-making capacity for planting, treatment, and harvesting.	Real-time digital advisory and support services	FarmerChat Chatbots	Accelerating
		Farm management advisory platform	FarmSuite by Ujuzikilimo is a complete farm management tool to support decision-making for farmers.	Nascent
Digital financial literacy advisory	AI-assisted chat interfaces and educational tools that simplify complex financial concepts and offer financial advice to farmers.	Financial literacy for farmers	Chatbot by THINK Chama Chat by Shawika Apollo Agriculture	Nascent/Accelerating

Function	Description	Use cases	Examples	Prevalence and Intensity of use
Risk and insurance	AI-driven solutions that utilise climate, yield, and satellite data to simulate agricultural risks and facilitate the development of cost-effective, data-driven insurance products for farmers.	Farmer risk and insurance	Picture-based insurance for cover crops -BlueGreen Labs. Riwe Technologies Pula uses artificial intelligence to provide microinsurance solutions for smallholder farmers.	Nascent
Logistics and market access	AI-driven platforms that optimise supply chains by matching producers with buyers, forecasting demand, and offering real-time price intelligence while facilitating the exchange of market information.	Real-time price monitoring and market insights	Agric e-commerce platform by Shawika.	Nascent
		Buyer-Supplier matching	Agric e-commerce platform by Shawika.	Nascent/Accelerating
Smart agriculture platforms and data systems	Integrated AI systems that combine geospatial, market and agronomic data to enable evidence-based decisions at the farm, policy, and institutional levels.	Integrating data systems consolidating crop, land, water and livestock data	Ujuzi Data by Ujuzikilimo provides high-level agricultural data and insights to support decision-making. Agriculture Information Management Systems (Zimbabwe). Smart Agriculture Monitoring with Satellite Data (Rwanda).	Accelerating

Source: ECDPM Authors

***Prevalence** relates to number of use case applications

****Intensity of use** relates to adoption rate, i.e. how well farmers are using the innovation

Categories:

Nascent:Emphasises early-stage, experimental or proof-of-concept use cases with limited deployment and scalability.

Accelerating: Suggests use cases that are gaining traction, showing promise, and evolving toward broader adoption and ecosystem integration.

Established: Reflects use cases that are well-defined, widely piloted or scaled, with demonstrated impact and institutional buy-in.

3.2. Emerging trends on AI use cases in agriculture

As illustrated in the section above, use cases of AI in agriculture vary, with some solutions specifically targeting the needs of smallholder farmers. Though some AI use cases are in the early stages, there is evidence of AI usability and potential for further opportunities beneficial to farmers (Heifer International, 2021), including young people who are now growing an interest to participate in the agriculture economy due to digitalisation (Smart Africa et al., 2023; FAO, 2024), with some youth using social media platforms to share information on farming as well as using online platforms like facebook marketplace to sell their farm produce (Siaka, 2024).

Some AI use cases are gaining more traction than others

From the research we conducted, we found that the majority of AI uses in agriculture are for early warning and predictive analytics, specifically disease detection, followed by farmer advisory services. Other reports also indicate that the most frequent uses of AI are data analytics for agriculture policymaking and digital advisory services, followed by market access, procurement and supply chain management (FAO, 2024; GSMA, 2020). What explains the popularity of these use cases may be the potential for scalability or alignment of the use cases with the interests of funders, investors and donors (360 Mozambique, 2024; Mazwane et al., 2022). At the same time, agritech businesses often respond to the demands and needs of commercial farmers and develop solutions useful for farming with guaranteed return of investments. For instance, most digital tools developed in South Africa are aimed at large scale commercial farmers (Mazwane et al., 2022).

Emerging AI use cases are mainly related to crop production, specifically staple food crops like cassava, maize, wheat, and other food crops like cucumbers, and tomatoes. AI is also being used for livestock, followed by fisheries and aquaculture and forestry and natural resources management (FAO, 2024). What could explain the dominance of use cases on food crops is the need for innovators to develop solutions that address local problems like boosting agricultural productivity to address food insecurity challenges.

We also noted that developers of AI solutions mostly focus on one crop or the same type of pest or disease and the solutions do not have multi-crop solutions (Interview, 2025).

Fewer countries are leading on developing AI use cases

While the research was aimed at giving an overview of how AI is being used across the continent, we found that some countries are taking the lead in developing AI use cases. On average, countries in East Africa (mainly Kenya, Rwanda and Uganda) have higher concentrations of AI start-ups and AI hubs where these innovations are being developed. Next on the list are West African countries (mainly Nigeria, Senegal and Ghana). Central and Southern Africa, with the exception of South Africa, are less represented (FAO, 2024). This pattern reflects how leading countries have fostered enabling environments that support tech start-ups and attract digital development initiatives. At the same time, major development agencies often choose these countries as partners. One of the respondents in our interviews pointed out that the selection criteria from funders for innovation competitions often excludes solutions developed from none-partner countries (Interview, 2025).

Investments and funding on AI is increasing, yet is not sufficient

Reports have shown that other sectors (such as banking, defence, retail, and space exploration) are likely to see more economic growth from AI than agriculture (Adams, 2025) which may discourage AI investments in agriculture. Compounding this problem are the low levels of interest from African governments to incentivise or provide funding for AI innovations in agriculture. However, there are a few countries like Rwanda and Senegal where innovators have complimented government support. For instance, a respondent indicated that in Rwanda, smallholder farmers without mobile phones can easily get smartphones through government-led incentives (Interview, 2025; ICT for Rwanda Agriculture Strategy 2016 - 2020).

However, beyond agriculture, the kinds of investments needed to develop AI in general are actually high and so far most governments have not made such huge commitments. Fewer countries like South Africa have committed to invest up to 70 Billion Rand (USD 3.7 Billion) in government, local and foreign direct investment in AI by 2030, with 100 - 300 AI start-ups and 5000 AI experts in the country (South Africa AI National Government Summit Discussion Document, 2023). The AU had also proposed the creation of a Continental AI Fund, AI Financing Strategy and organising forums on financing responsible AI for Africa to support AI innovation across the continent and mobilise regional and international development funds, with private and philanthropic funding.

Competitions, workshops and events are used to identify AI use cases

Several AI use cases and ideas were developed and discovered through competitions and hackathons and promoted through events. Zindi Africa is a popular platform which has hosted over 300 AI challenges, including precision agriculture and disease detection using satellite imagery, with partners like Galsen AI, IBM, CGIAR, Lacuna Fund and Radiant Earth Foundation. FAO Regional Office for Africa supported the Pitch AgriHack competition by the African Green Revolution Forum (AGRA), which identified innovations like Tunisia's Robocare platform which uses drones and AI for greenhouse pest management (FAO, 2024). AUDA NEPAD launched AI and robotics competitions for African youth to develop local solutions, while Smart Africa introduced the Innovate Africa Challenge. The Global AgriInno challenge highlighted African innovations like Kenya's Farmer LifeLine, which uses solar-powered cameras, data analytics and ML for pest and pathogen management (Global AgriInno Challenge, 2024).

Since most competitions only focus on one winner, there is a missed opportunity that other equally good use cases, prototypes and models are not promoted. Other challenges with hackathons include ownership of intellectual property and opportunities for scaling of such solutions beyond the competition. To address these problems, Smart Africa Innovate Africa Challenge seeks to support innovators beyond the competition phase by taking some of the ideas through an incubation and acceleration program and the top five winners are given opportunities to exhibit their solutions at major events like Transform Africa Summit (Interview, 2025).

AI and tech startups view conferences as key for showcasing their solutions and networking with funders. Events like GITEX, DeepLearning Indaba, and AI Summits are increasing in popularity among the AI community. The 2025 Africa Agri Tech Conference in Pretoria also highlighted AI's role in agriculture (Carvalho, 2025). AgriTech Hub Rwanda also hosts a digital agriculture summit featuring practical digital agriculture solutions (Siaka, 2024).

Lingering lack of trust in science

While most weather forecast and early detection tools help to predict rainfall and weather patterns, some communities still don't trust these forecasts and prefer consulting their religious and cultural leaders. One of the respondents mentioned that though the public was warned about the 2023/24 El N-nino induced droughts, some people still resorted to 'praying for rains' or engaging in cultural rainmaking ceremonies (Interview, 2025). Political leaders also participated in religious observations like the national day of prayer (Chigunwe, 2024).

The lack of trust may also be as a result of inaccurate weather advisory information. One respondent explained that government issued weather forecasts have not been accurate in the past which resulted in smallholder farmers missing the window to plant their crops (Interview, 2025). It was also expressed that governments may not want to notify or alert citizens about potential or possibility of droughts or flooding because they fear that citizens might start hoarding food causing public panic and unrest (Interview, 2025).

3.3. The impact of AI on smallholder agriculture: opening doors, but not yet building bridges

As illustrated under section 3.2, the integration of AI in African agriculture is no longer a speculative future vision; it is a tangible reality already being experienced on farms, in markets, and in policy arenas. Across the continent, AI is beginning to transform the way farmers grow, make decisions, trade, and adapt to climate change, offering new pathways to resilience, productivity, and inclusion. But while the promise is real, the reach remains uneven. The current landscape reveals a dual reality: one in which lives and livelihoods of some farmers are being transformed in pockets of innovation, and another in which structural barriers limit access, equity, and scale.

For smallholder farmers, AI brings five fundamental and positive changes. First, AI is significantly **improving productivity, efficiency, and resource management in agriculture**. AI systems analyse historical and agronomic data to maximise yields. AI-enabled precision agriculture is helping to recommend optimal planting methods and times, irrigation schedules, and harvest times to improve efficiency (Ozor et al. 2023; Donfouet and Ngouhouo, 2024). AI makes more efficient use of resources, such as water, fertiliser, and pesticides, possible by providing personalised advice based on specific crop needs. A study of the impact of AI on agricultural total factor production in 53 African countries found that a 1% increase in AI use corresponded to a 12% increase in agricultural productivity (Donfouet and Ngouhouo, 2024). AI-powered services from Apollo Agriculture in Kenya and Farmerline in Ghana have significantly boosted agricultural outcomes. These services have provided farmers with enhanced access to credit and expert advice, leading to remarkable increases in yields – 2 to 2.5 times higher than the national average and up to 30% in the respective countries. (Chasin 2025; Muhammed, 2025).

Second, AI-powered image recognition and machine learning algorithms are helping to identify signs of pest and disease infestations using images from smartphones and drones, enabling AI to **play a crucial role in effective pest and disease management**. In South Africa, Aerobotics' drone and AI technology helped decrease pesticide use by 15% (Muhammed, 2025). Additionally, AI is providing early warnings of disease or pest outbreaks, allowing farmers to take preventive measures and treat problems with precision. Third, AI is **removing long-standing barriers to financial access**. In Nigeria, Kenya, and Zimbabwe, alternative credit scoring models powered by machine learning are assessing farmers' creditworthiness based on non-traditional data such as mobile phone usage, satellite imagery, and transaction history, opening up access to credit and inputs previously unavailable to the financially excluded (Genesis Analytics, 2023a). AI's role in digital financial literacy and in the provision of risk and insurance solutions are other ways that AI is improving financial access for farmers.

Fourth, **AI enables greater access to information and expertise, which improves decision-making**. AI-powered digital on-farm advisory tools, such as chatbots, provide farmers with customised, real-time agronomic guidance for critical planting, treatment, and harvesting decisions (Ozor et al., 2023). These platforms provide recommendations for optimal farming practices, tailoring activities to the unique needs of specific crops and environmental conditions to maximise resource efficiency and yields. Fifth, AI is supporting the climate resilience of farmers.

Fifth, AI is **critical to the development and promotion of climate-resilient agriculture practices, supporting the adaptive capacity of farmers**. AI-powered predictive modelling and climate data analysis allow farmers to anticipate and adapt to changing climatic conditions, providing crucial decision-making insights (Gikunda, 2024). AI also provides guidance on appropriate crop selection under changing climatic conditions.

AI gains are not only confined to the farm. At the ecosystem level, AI is improving the way institutions make decisions, allocate resources, and develop agricultural intelligence. In Zimbabwe, for example, the Ministry of Agriculture's AI-powered information management system combines data on land, crops, water, and livestock to facilitate real-time policymaking. In Rwanda, satellite data systems are being used to monitor soil conditions and crop performance to help both the government and commercial sectors to plan (Interviews, 2025).

Yet despite this progress, a critical nuance in the discourse surrounding the impact of AI on African agriculture is essential. While the narrative surrounding the positive impact of AI integration in agriculture is appealing, the reach and equity of these benefits remain significantly limited. Evidence from the literature and interviews reveals a grim reality: the impact of AI on African agriculture, while promising, is still largely fragmented, uneven, and nascent in scale.

Despite the proliferation of successful prototypes, platforms, and applications, many AI advances in agriculture have yet to reach significant scale in a way that systematically benefits the majority of African smallholder farmers (AI4D Africa, 2023). The majority of AI solutions are concentrated in a small number of countries and often benefit larger, commercially oriented farmers more than smallholders (Genesis Analytics, 2023a). Worryingly, those most in need of AI-enabled tools, such as climate-vulnerable farmers and rural women, are the least likely to have access to them to the extent required.

These limitations risk exacerbating existing disparities in adaptive capacity, yield gaps, and market inclusion. Thus, while AI in agriculture is already delivering meaningful benefits such as improved access to finance, increased yields, and extension services, the policy and innovation agenda must focus not only on what AI can do, but also on who it does it for and how equitably its benefits are distributed.

3.4. Unpacking challenges and barriers to AI development in agriculture

Limited advanced computing resources and infrastructure

Most African countries lack high-performance computing systems, data centers, and cloud platforms necessary to support AI innovations (Adams et al., 2025; Data Center Map, n.d.; AU Continental AI Strategy, 2024). When training and running large AI models, substantial computational power is needed to process massive datasets. Yet most research institutions and universities are operating with limited access to advanced computing resources such as high performance GPUs and IoT platforms (Interview, 2025). For African countries to advance in AI innovations in agriculture, they must build and strengthen their infrastructure - particularly energy, broadband connectivity, cloud computing, and access to high-quality data. Without strategic investment, AI development will remain out of reach for local innovators, and policy makers need to start thinking about policy interventions aimed at making cloud services and data centres available and accessible.

Inadequate and unreliable electricity access

Electricity is fundamental to every step in the AI value chain, from powering computing systems to enabling internet connectivity. Energy-intensive systems like data centres and AI research centers and hubs require reliable power. Digital devices like drones, soil sensors, weather stations, and mobile phones also require electricity or solar to function. However, most African countries face chronic electricity shortages, with rural areas, where most smallholder farmers live, facing the worst of it. Power outages, dependence on fuel generators, and lack of off-grid renewable options constrain the adoption of digital solutions in rural areas (AU Continental AI Strategy, 2024; Madubela, 2025; Ishiekwene, 2024; Moss, 2024; Mia, 2024). What could help overcome this challenge are investing in off-grid solar infrastructure solutions, encouraging green data centers, subsidised energy solutions for digital agricultural platforms and introducing policies which promote energy integration.

Poor internet connectivity

Lack of Internet access remains a major barrier to the deployment of digital agricultural tools (Mazwane et al., 2022). Mobile broadband is the dominant form of internet access in Sub-Saharan Africa (SSA) but its coverage is still inadequate, particularly in rural and remote farming communities (FAO and ITU, 2022). Though SSA has not reached universal internet coverage due to limited and sporadic digital infrastructures and low digital literacy, the connectivity and digital divides are narrowing. According to ITU and FAO, 2G and 3G coverage is widespread, with many countries rolling out 4G and testing 5G networks (FAO and ITU, 2022). More farmers now own feature phones or smartphones, enabling them to access SMS-based advisory services and digital platforms. SMS remains the most commonly used digital tool on smallholder farms as it operates without the need for internet connectivity and is accessible on basic mobile phones (Heifer International, 2021). In some cases, satellite internet connectivity is considered to bridge internet connectivity gaps, offering internet coverage to rural and underserved areas (Mabika, Musoni and Teevan, 2025).

Government-led initiatives are helping bridge the digital literacy gaps in rural areas. For example, the Zimbabwe Ministries of Agriculture and ICT are establishing community information centres to provide internet access and services to rural communities, including smallholder farmers (Interview, 2025). Additionally, the Zimbabwean government, in partnership with FAO, is setting up digital villages to enhance connectivity and digital skills.

Significant data gaps

Data is key to the digital economy as a whole and the backbone of the AI industry, including the agriculture sector, with data sharing as essential to promoting economic growth, competition, research and scientific advancements and transparency (Musoni et al., 2024). Effective AI innovation in agriculture depends on access to comprehensive datasets ranging from soil health, high resolution satellite imagery to real time market dynamics, and granular climate data (WEF, 2021). Yet in Africa, there is a significant gap in the quality, inclusiveness and availability of data for AI models. Most public and private sector data remain inaccessible or poorly managed (AU Continental AI Strategy, 2024). At the same time, farmer-contributed data is often 'inconsistent' or 'noisy' which means it is not always of good quality for further use (Interview, 2025). Additionally, AI tools trained on non-African data frequently fail to reflect local realities—undermining performance in areas like pest detection or yield prediction. Although efforts to open public data (e.g., maps, transport) exist, quality and consistency remain uneven.

African countries are increasingly interested in satellite data for agriculture or climate data and are either accessing satellite data provided by others (such as via Copernicus) or launching their own satellites (Signe, 2025; Campbell, 2024). International organisations like FAO are using satellite data, Geographic Information System (GIS) and geospatial technologies to support evidence-based policymaking through initiatives like Hand-in-Hand, which integrates cross-sectoral data across over 20 FAO technical units (FAO, 2024). While satellite data is critical, satellite image resolution is often too low for real-time pest and disease detection. As one respondent noted, databases like Copernicus provide lower resolution data and may be insufficient for smallholder farmers where field sizes are very small and details like pest damage or nutrient deficiency require high granularity (Interview, 2025). New value creation opportunities are being explored, such as the Data Economy Initiative in Senegal, which explores agricultural data spaces for shared use by farmers, agritech businesses, and researchers to enhance decision-making and innovation. To unlock AI's value in agriculture, African governments must implement national data strategies aligned with the AU Data Policy Framework, promote private sector data sharing, and invest in local, annotated agricultural datasets.

High costs to use digital and AI tools

The cost of AI-driven technologies as well as that of the internet is a significant barrier. Many AI-powered agricultural solutions, like drone services, precision farming apps, and cloud-based platforms, are designed with commercial farmers or donor-funded models in mind, not the reality of smallholder farmers. For example, a drone costs over $19,000 in Zambia, while hiring costs are around $30 per hectare – economically viable only for large farms and not smallholder farms (Nalwimba et al., 2024). Even simple tools like image-based sensors, which cost around $10, are considered too expensive by smallholder farmers, and they need subsidies or donor support (Interview, 2025). Most smallholder farmers operate on smaller plots of land less than 2 hectares and cannot amortise these costs. Many tools also come with recurring costs such as subscription fees, cloud services, or maintenance needs (Nalwimba et al., 2024). One respondent said they were paying over $100 monthly subscription fee for cloud hosting of their AI solution, which was unsustainable for their small business (Interview, 2025).

Similarly, mobile broadband remains expensive for most people, with data prices exceeding global affordability standards (FAO and ITU, 2022). Additionally, buying a phone costs around 25% of an average person's monthly income – which is still too expensive for many low-income rural populations (Delaporte, 2025).

Capacity gaps and digital illiteracy

Africa has a young, linguistically diverse and increasingly digitally literate population, which presents opportunities for Africans to be AI-active innovators and informed contributors rather than mere consumers of technologies (Adams et al., 2025). However, most of these young people are concentrated in urban areas and have a lack of interest in farming. The majority of smallholder farmers still lack digital literacy and still struggle to use smartphones to capture images or upload images on mobile Apps (Interview, 2025). The digital literacy level for women is even lower when compared to men, although women make up 60% of the rural agriculture workforce (Smart Africa et al., 2023). However, this digital illiteracy challenge can easily be solved by promoting digital literacy programs for smallholder farmers and agricultural extension officers.

Ethical challenges of AI

Limited representation of African languages in Large Language models (LLMs) and Natural Language Processing (NLP) can reduce the accessibility of AI tools for users who do not speak English or other dominant foreign languages. However, efforts are underway to train AI systems in African languages, including voice-to-text and text-to-speech capabilities. This has improved the usability of chatbots and Apps for smallholder farmers in their local languages. Additionally, NLP is being used to translate scientific literature into indigenous languages, expanding farmers' access to critical agricultural knowledge (Musa et al., 2023).

There are ethical concerns about data exploitation in the agriculture sector. Some researchers argue that precision agriculture and smart farming technologies may represent new forms of control over labor and knowledge, echoing historical patterns of extraction and exploitation (Foster et al., 2023). Some respondents expressed concern that AI developers often engage with farmers primarily during solution testing, without compensating them for their efforts in feeding the AI systems with crop images. This is seen as exploitation of smallholder farmers (Interview, 2025). Farmers have also reported fatigue from repeated requests by different developers to test new tools. In response, some developers have started offering incentives or payments for farmers' participation in data collection and AI training (Interview, 2025).

However, not all stakeholders see the practice as exploitation. Some farmers appreciate the direct benefits, such as improved services and tools. For example, one community that had suffered repeated locust invasions supported testing of an AI-powered early warning system because of its potential impact (Interview, 2025). Another respondent noted that when farmers provide informed consent and understand the additional benefits, like market linkages, they are generally willing to share farming data (Interview, 2025). Others highlighted the value of data spaces, which allow stakeholders to manage access to their data and promote collaborative innovation (Interview, 2025). Further, others argue that there is no value created when data sits with farmers, but value is created when such data is shared with and aggregated with other data sources to provide helpful insights to the farmer (Interview, 2025). These perspectives highlight the complex ethical and practical dynamics of data use in African agriculture. The path forward lies in developing data governance frameworks that ensure that data use is transparent, promote equitable and inclusive value distribution, and prioritise farmer agency.

3.5. Key actors shaping the African AI ecosystem

Due to the interest in AI and the economic potential of the technology in enhancing agricultural productivity and production, there are several players who are making their mark in African agriculture. The main actors in the space are AI innovators and developers who are mostly building start-ups and innovation hubs; universities and academic institutions that are working with AI researchers; private sector companies that are also developing solutions and running research centres; donors and development agencies that are funding specific AI projects, pilot projects and competitions; and governments that create an enabling innovation environment.

Table 2: Key stakeholders in African AI for agriculture

Stakeholder	Contribution to AI development	Examples
Farmers and farmer associations	End users of AI tools, e.g., using mobile apps to get advisory support involved in collection of data and updating of datasets e.g., through capturing images in real time. Farmer associations represent farmers' interests, facilitate pooling of resources like hiring drones for a whole community, policy advocacy.	Initiative Progressive Agricole et Rural (IPAR).
Start-ups, innovation hubs and incubators	Tech start-ups are very popular, and develop diverse AI use cases for different sectors, including agriculture. Some actively engage with farmers to test their products. AI hubs are supporting AI innovation, talent development and infrastructure building. Rely on funding and investments.	Senegal AI Hub, Galsen AI, Kenya's Agri Innovation Hub (female-led), UNDP AI Hub for Sustainable Development, Jatropa Hub (Guinea), JHub Africa (Kenya), Smart City Lab (Rwanda), Tshimologong Digital Innovation Hub (South Africa), and Mountain Hub (Cameroon). Big tech also supports AI hubs. (For start-ups examples, also see section on AI Use cases.)
Private sector companies	Tech companies lead innovation in agriculture. Most big projects on AI are supported by big tech which provides the finance, technical expertise, infrastructure and facilities for research. Also offer support to other stakeholders.	Google Accra AI Research Center, Google DeepMind, Microsoft Research Africa, Centenary Bank of Uganda. Agricultural big 6 companies (Bayer, Monsanto, Dow, Dupont, ChemChina and Syngenta mainly innovating for commercial farmers (Mazwane et al., 2022). Google Research developed MetNet-3 an advanced weather forecasting tool providing high accurate, high resolution forecasts up to 24 hours in advance.
Universities, and research institutions	Educating and skilling students with AI skills. Leading research and development projects on AI. Provide capacity building for different stakeholders, policy analysis and policy engagements.	Responsible AI Lab (RAIL) at KNUST, Carnegie Mellon University Africa, Local Development Research Institute, University of Johannesburg, University of Pretoria, Makerere University, and African Center for Technology Studies.

African governments and regional institutions	Government support varies, some prioritise food security and not AI. Create an enabling environment for AI innovation, data sharing and markets for products and ensuring AI readiness. Develop appropriate data governance frameworks and requisite agriculture and digital policies. Predominantly works on partnered projects with private sector, donors and international partners.	Ministries, Departments and Agencies of Agriculture and ICTs, AUDA-NEPAD, AU, Smart Africa. Kenya's MoALD partnered with GIZ to support ASTGS via a data governance framework to secure farmer agricultural data. Smart Africa supported Zimbabwe in developing its Agricultural Information Management System (AIMS) which integrates AI for data management across multiple departments and Malawi is interested in a similar system.
Donors and funding partners	Support programs which promote the development of AI use cases. Some programs are farmer specific, while others are more broader in scope.	Mozilla Foundation, Lacuna Fund, FAO, WFP, ITU, UNDP, UNEP, WB, Radiant Earth Foundation, Bill and Melinda Gates Foundation. WFP Zambia and ZANACO developed Maano Virtual Farmers Market for farmers to access market information (Nalwimba, 2024). IFAD maintains a library on digital agriculture).
Development agencies	Provide financial, technical and regulatory support.	NORAD, IFAD, Global Environment Facility. GIZ provides regulatory support (e.g., supporting Senegal in developing its national AI Strategy) and technical assistance in data value creation.
International partners	Provide financial and technical support.	The EU, Netherlands, Japan, FCDO. Center for the 4th Industrial Revolution and South Africa Center for Fourth Industrial Revolution. China's Sunagri Investments funded the development of ATDCs to promote smart agriculture (Nalwimba, 2024).

Source: ECDPM Authors

4. The role of policy to support AI adoption by smallholder farmers

While the current integration of AI in agriculture is significant and encouraging, the reach and dividends are neither automatic nor equitable, as noted above. To address this dilemma, the policy imperative is clear: governance, financing, and intervention measures should be designed to accelerate a contextually appropriate, ethically governed, and inclusive deployment of AI in agriculture. Against this backdrop, coherent policy support needs to encompass three intertwined domains: the research and innovation ecosystem that develops and contextualises AI tools, the farmer-facing interface that determines adoption and accessibility, and the infrastructure layer that enables the functioning of digital services at scale. These three domains form the basis for the policy recommendations presented below.

4.1. Research and innovation recommendations

The research and innovation ecosystem is crucial for AI to be effective in agriculture. It is therefore important that African AI innovation be driven by contextually grounded research, representative datasets, and collaborative development models.

First, innovations should be locally relevant and participatory, engaging local farmers, extension officers and cooperatives in the design and testing of AI solutions. This is necessary to ensure that innovations are fit for purpose and market-ready (Adeniyi et al., 2024), and therefore requires greater collaboration between academia, industry, and government to support AI development. The development of relevant and user-centered AI tools, including local language AI tools, needs to be encouraged to enhance accessibility for farmers (CAP 2025). Additionally, promoting the development of multi-crop AI solutions is vital to cater to the diverse needs of farmers, especially smallholders engaged in multi-cropping who find more value in AI solutions that serve multiple crops and purposes.

Second, and relatedly, to foster AI innovation in agriculture, priority needs to be given to establishing competitive, inclusive systems. These systems should champion bottom-up solutions, which are crucial for ensuring innovations are widely adopted and have a significant impact on the sector (Ozor et al., 2024). Initiatives like Smart Africa's Innovate Africa competition and Zindi's AI challenges have been successful in identifying scalable solutions from African data scientists and startups. Policymakers should expand these platforms, link them to incubation and procurement processes, and integrate successful solutions into market and public extension systems.

Third, research and innovation funders and African governments, including science granting councils, should invest in the development of open, high-quality, representative historical and agricultural datasets to bridge the current gap in the quality and availability of data for AI models in Africa. Platforms such as the Lacuna Fund are advancing this agenda; however, coordinated investment is needed to sustain and expand these efforts. In addition, it is essential to establish long-term collaborations with organisations and institutions that provide access to open databases. For example, the EU's Copernicus database could be better utilised to improve AI models in agriculture by providing accessible satellite data (Ngumbi, 2018). AI algorithms can process this data to detect patterns, anomalies and areas of concern, which can then be used to improve resource allocation in farms and risk assessment.

Finally, increased R&D funding is needed to support the development of AI use cases in agriculture. Existing successful AI initiatives should be scaled up, and the lack of continued support after initial funding must be addressed. Development partners and NGOs can encourage public investment in R&D by raising awareness and providing evidence of benefits, while public-private partnerships need to be better explored (Diop, 2025). African governments should also step up their support by prioritising investments in AI's integration into agriculture to benefit Africa's teeming smallholder population.

4.2. Farmer-facing recommendations

Recommendations for how AI tools can benefit farmers can be encapsulated as meeting farmers where they are - geographically, culturally, linguistically, technologically and financially. Failure to do so makes farmer adoption of AI doubtful. With this in mind, any recommendations for the farmer interface need to focus on inclusion and accessibility.

To foster widespread adoption of AI technologies in the agricultural sector, it is imperative to prioritise the digital transformation of existing extension systems. Findings consistently show that integrating AI-based tools and insights into trusted advisory services, delivered in local languages and disseminated through familiar communication channels such as SMS, significantly increases the likelihood of farmer engagement and subsequent action.

In this regard, it is important to recognise the critical role that intermediaries and established networks can play in facilitating the successful dissemination of AI tools and information. Agricultural extension officers, farmer associations, and cooperatives, with their existing relationships and trust within farming communities, can serve as important conduits for introducing and supporting the use of AI technologies. Leveraging these existing networks, rather than focusing solely on individual farmers, can significantly increase the reach and impact of AI-driven solutions.

It is also important to address digital literacy by providing capacity building and training programmes to enhance the understanding and skills of farmers, extension workers, and other stakeholders in the use of AI (GIZ, 2025). Furthermore, continued support and mentoring can help address any concerns or challenges that may arise during the adoption process. Capacity building should also include digital financial literacy programmes to facilitate farmers' access to finance. Innovations such as financial literacy chatbots should be scaled up, as they demonstrate the potential of conversational AI to simplify complex financial concepts and empower farmers.

Finally, regulatory and policy frameworks should be put in place to articulate strategies for integrating AI in agriculture, and to clearly define and enforce farmers' rights regarding data collection, sharing and use (Baumüller and Chichaibelu, 2024). African governments should take the lead in this regard. The call for ethical AI and participatory data governance was a recurring theme throughout the study. Enforceable rights for farmers within this framework should include informed consent, understanding of the value proposition of the particular AI tool, and the provision of opt-out options. At the same time, mechanisms for fair data sharing and potential compensation for farmers need to be explored in line with data justice principles.

4.3. Infrastructure-focused recommendations

The deployment and scalability of AI in agriculture rely heavily on foundational infrastructure, including hardware and software. As mentioned in section 3.4, internet connectivity remains limited and expensive in many African regions (GSMA, 2024), hindering access to AI tools for smallholder farmers, particularly those in rural areas where connectivity is a major challenge. Across most parts of Africa, there is thus the need to improve internet connectivity and reduce costs. To ensure this, governments, in collaboration with donors and the private sector, should drive further investments in expanding rural internet connectivity.

Furthermore, it is critical to provide scalable, appropriate, and cost-effective hardware solutions such as smartphones, sensors, drones, and IoT devices explicitly developed for low-resource environments. One approach is to use industrial policy and procurement to assist local manufacturing, lower import levies, and stimulate open innovation among African tech entrepreneurs and patent holders (Genesis Analytics, 2023a). Ultimately, the emphasis should be on creating and deploying affordable, low-computing technologies that are appropriate for the smallholder farming context in Africa.

To foster AI innovation, increased support for local data centres and cloud platforms in Africa will be critical (Marwala, 2025). This encompasses building AI systems capable of understanding and generating human language texts within these data centres and creating more accessible and affordable cloud platforms. In addition, agricultural systems such as AIMS should be interoperable to allow for data sharing among agribusinesses, developers and governments. These exchanges must uphold data sovereignty while prioritising farmer benefits.

4.4. Positioning AI in Agriculture within Africa's CAADP 10-Year Plan

The upcoming CAADP 10-Year Plan (2026–2035), guided by the Kampala Declaration, presents a crucial opportunity to rethink agricultural transformation with a focus on inclusivity, sustainability, and innovation. Recognising AI as a key enabler of the objectives outlined in this strategy is essential for achieving this transformation.

The CAADP strategy encompasses five pillars: sustainable land and water management, market access and infrastructure, food security and nutrition, research and technology dissemination, and resilience and livelihood (African Union, 2024). AI can play a crucial role in facilitating and enhancing each of these pillars. As this study demonstrates, AI use cases have applications across all areas of the CAADP strategy. Rather than being confined to a single pillar, AI should be seen as a cross-cutting tool that can strengthen and optimise the existing framework. Furthermore, AI can support the Kampala Declaration's focus on inclusivity by enabling the development of contextually appropriate and inclusive interventions that benefit women, youth, and other marginalised groups within the agri-food system.

The CAADP strategy has outlined its implementation mechanisms, providing an opportunity for AI to improve implementation while institutionalising AI at these levels. First, countries could articulate in their National Agricultural Investment Plans (NAIPs) how AI will contribute to or support the achievement of NAIPs objectives. Continental and regional platforms that will support CAADP implementation should also integrate AI-focused activities into their work. CAADP technical networks should include AI and digital agriculture experts to provide technical backstopping to the AUC, AUDA-NEPAD and member states on matters related to AI in agriculture.

Finally, the integration of AI-related indicators should be explored in the CAADP results framework (2026-2025). As consultations continue, considering AI in the results-based monitoring of the CAADP strategy could entail incorporating indicators such as the percentage of farmers with access to AI-based early warning tools, precision farming tools, extension or credit services, and the extent of AI integration in agricultural data platforms, among others.

To further enhance the results-based monitoring of the CAADP strategy, incorporating AI-focused indicators into the ongoing consultations could be explored. These indicators may include assessing the percentage of farmers utilising AI-powered resources, such as early warning systems, precision farming tools, extension services, and credit facilities. Additionally, assessing the level of AI integration within agricultural data platforms could be another valuable metric.

5. Opportunities for Europe-Africa collaboration

As Europe and Africa strengthen their strategic partnership in the digital age, the agricultural sector offers fertile ground for cooperation, particularly in the field of AI, and represents a great opportunity for mutual benefit. The two regions' shared goal of a strong digital economy, well articulated in the report of the EU-AU Digital Economy Task Force (EU-AU DETF, 2019), has a chance to be advanced through cooperation on AI in agriculture. The following sections outline specific opportunities for advancing this shared goal in the agriculture sector.

5.1. The International Digital Strategy, the Global Gateway and AI

The European Union's International Digital Strategy (EC 2025c), launched in June 2025, aims to shape Europe's digital engagement with partners in a joined up and strategic manner. This strategy outlines the EU's vision for strengthening international digital cooperation, aiming to boost European competitiveness through economic and business partnerships, advance a digital agenda focused on the security of Europe and its partners, and shape global digital governance and standards with a network of allies (EC 2025b).

This strategy identifies AI as one of the five priority areas for cooperation with partner states, while it includes Africa as one of the EU's key partner regions where it has ongoing or planned activities focused on supporting the development of AI solutions for the public good, including generative AI, technology transfer and capacity building with Africa.

The strategy aims to support Africa through the implementation of the EU Tech Business Offer which is designed to support partner countries by providing a "comprehensive, modular package." If the EU hopes to be considered a meaningful partner in the field of AI, then investments in infrastructure, and particularly access to compute will be key to any efforts to support AI models that are well-suited to African realities. Existing Global Gateway projects, such as the Data Governance in Africa initiative (notably the Digital Investment Facility), already focus on promoting investments into digital infrastructure - and especially data centres - and enabling cross-continental data collaboration, which will be essential to AI adoption in Africa, including in the agriculture sector. Going forward, the EU will need to play a role in expanding access to green compute in Africa, including via partnerships to develop AI Factories on the African continent. Factories, already being implemented within the EU, bring together: "computing power, data, and talent to create cutting-edge AI models and applications." (EC 2025d). Interviewees mentioned that talks are already underway with Morocco to develop the first AI Factory outside of Europe, but the EU might consider supporting other regional hubs across the continent. Efforts should also be made to find synergies with and develop on likeminded initiatives, such as the Italian-funded UNDP AI Hub for Sustainable Development, which is steering the design of the Africa Green Compute Coalition (AGCC).

5.2. Co-creation and knowledge exchange

Another clear opportunity is the co-creation and co-funding of AI research and innovation ecosystems. Initiatives like AI4D Africa, which receives partial funding from the Swedish International Development Cooperation Agency (SIDA), show how European support can stimulate local AI research for agriculture. Beyond digital skills collaboration, research partnerships between European and African institutions can drive AI innovation in agriculture, through joint projects tailored to local needs.

The creation of knowledge exchange platforms focused on AI in agriculture will be essential to fostering collaboration between European and African stakeholders. Such platforms will need to be strategically aligned with the objectives of the AU-EU Innovation Agenda and the Africa-Europe Innovation Platform. These platforms can enable the sharing of experiences, skills, and expertise, allowing for the identification and application of best practices in AI integration within the agricultural sector.

The European Commission could build on its existing administrative arrangement and grant agreement with Smart Africa under the Global Gateway strategy to enhance cooperation and support a human-centered digital transformation of Africa (European Commission, 2024). Areas of cooperation under the administrative arrangement include continued dialogue and joint initiatives in a number of policy areas of mutual interest, including AI, as well as capacity building through the development of digital skills and competencies, including the provision of technical expertise to AU Member States to facilitate their digital transformation (European Commission, 2024b). This cooperation provides an entry point for launching joint initiatives and providing technical assistance to better harness AI for Africa's agricultural transformation. Such joint initiatives may include the joint development of AI systems for agriculture by developers from Africa and Europe.

As European organisations continue to develop and test AI technologies relevant to agriculture, partnerships with African counterparts can be explored to facilitate the testing and deployment of these AI models in diverse contexts. Additionally, the Team Europe approach can provide opportunities for EU companies and startups working on AI in agriculture to enter new markets and expand their customer base.

5.3. Joint development of data spaces

Another opportunity for Europe and Africa to work together is in developing the data infrastructure that will support the expansion of AI use in African agriculture. AI relies heavily on data, and there are opportunities to work together to build open, accurate, and rights-respecting data ecosystems in Africa. This includes supporting initiatives such as data spaces for agriculture, and addressing data access challenges.

The development of agricultural data spaces is already emerging as a potential cornerstone for strengthening Africa-Europe cooperation in the digital age, fostering agricultural transformation, sustainability and resilience. The EU is coordinating the AgriDataSpace project, which will pave the way for the implementation of the Common European Agricultural Data Space (CEADS) (EC 2024d), with a focus on secure, trusted and transparent data exchange (AgriDataSpace 2024). The effort includes mapping the current landscape, harmonising technical architectures, developing governance models, and creating an interoperability roadmap (AgriDataSpace 2024b). This will lay the groundwork for future AI applications in agriculture, advanced analytics and improved agri-environmental monitoring. African partners seem particularly interested in the European model of data spaces, and could benefit from the EU's experience in creating African agricultural data spaces.

European cooperation could improve access to cloud computing, low-cost IoT devices, and open source software platforms that make AI more accessible to agritech and smallholder institutions. Harnessing earth observation data, such as the EU's Copernicus data, will also be valuable in deriving insights about crops, soil, and water cover to support agricultural decision-making.

5.4. Support on development of AI governance frameworks

In addition, collaboration on the development of AI governance frameworks and data sharing agreements is essential. As African countries develop AI legislation and digital agriculture strategies, there is a growing need for support or guidance on AI ethics, data protection, farmers' rights and cross-border interoperability. European institutions can provide peer learning and technical assistance to support African countries' efforts to build trustworthy AI ecosystems. For example, the EU and some of its member states' work under the Data Governance in Africa Initiative demonstrates that African stakeholders are interested in support that is sensitive to context and balances openness with sovereignty.

The application of AI can also support the integration of agricultural trade between Europe and Africa and is therefore a potential area for cooperation. AI-based tools and platforms can help smallholders meet export requirements and access EU markets by facilitating market access, traceability and certification. AI can also help farmers meet the goals of the European Union Deforestation Regulation (EUDR) by enabling the verification of agricultural commodities to determine if they originated from deforested land (Early, 2024). Therefore, both regions need to work together on how to integrate AI into EUDR compliance efforts and how to support farmers in these processes.

5.5. Financing of AI projects

Importantly, there is a need to structure financing mechanisms to better support the adoption of AI by smallholder farmers. This could include exploring innovative financing models, supporting start-ups, and ensuring the affordability of AI solutions for end users. The EU could learn from existing initiatives like the Lacuna Fund and consider providing similar funding opportunities. In this regard, the Global Gateway and the Team Europe approach need to be better leveraged to advance the use of AI in agriculture in Africa.

Key components of this approach include leveraging private sector financing, utilising loan instruments, and encouraging European companies to invest in Africa's digital economy and agricultural sector.

However, findings indicate a slowness to develop and coordinate efforts on AI in agriculture among Team Europe members. Improved articulation and coordination of activities on AI in agriculture will be critical to track results, avoid duplication of efforts, and ensure maximum impact. While these TEIs present significant opportunities for investment and market expansion in AI for agriculture, addressing potential debt risks will be important. Additionally, more activities focused on harnessing AI for agricultural transformation in Africa are needed.

6. Conclusion

The landscape of AI in African agriculture is rapidly moving from theoretical ideas to concrete, real-world applications. AI is demonstrating real and tangible impacts across multiple activity domains in agriculture. Its growing presence is sparking a transformation that promises to strengthen resilience, increase productivity, and improve access to information, finance, and markets. However, this transformation may be limited and inequitable, with many smallholders potentially missing out on the potential benefits.

True agricultural transformation that benefits smallholder farmers will require innovative policies, inclusive innovation, and investment in the ecosystems that allow new technologies to thrive. To fully harness the potential of AI, stakeholders must adopt a coordinated approach that combines experimentation with accountability, innovation with inclusion, scale with sustainability, and partnership with responsible governance.

As the future of agriculture in Africa and Europe becomes increasingly interconnected – especially given the dynamics of trade, climate change, and food security – both regions now have the opportunity to move beyond the donor-recipient dynamic and forge a mutual partnership in the integration of AI in agriculture based on co-creation, shared learning, and shared investment. Team Europe Initiatives and Global Gateway provide platforms to align EU investments with African AI ambitions in agriculture, supporting inclusive, scalable AI solutions that improve productivity, climate resilience, and agricultural market integration. At the same time, African governments need to prioritise investments in agriculture and digitalisation to promote the use of AI in agriculture.

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This document has been produced with the financial assistance of the European Union. The contents of this document are the sole responsibility of the authors and can under no circumstances be regarded as reflecting the position of the European Union. This publication also benefits from the structural support by ECDPM's institutional partners: The Netherland, Austria, Belgium, Denmark, Estonia, Finland, Ireland, Luxembourg and Sweden.

ISSN1571-7577

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