UK Agri-Tech Centre

Digital Agri-Tech Africa- Brazil Ecosystem Engagement (DATA-BEE)

Public facing report

13th March 2025

For more images, please view here

Introduction

DATA-BEE is one of 12 scoping projects in the Innovate UK Climate-Smart Agriculture Partnership, within the theme of Digital Agriculture and Precision Farming. These projects aim to building knowledge, networks and collaboration ideas between the UK, Brazil and Africa.
We have taken a market-led approach to target opportunities for farmers and agribusinesses to tackle climate change while sustaining and enhancing productivity within sustainable systems.

For further information about our project, please visit the link below:
https://ukagritechcentre.com/digital-agriculture-innovation-with-climate-smart-partnership/

Project summary

Agriculture plays a crucial role in both Nigeria's and Ghana's economies, employing large portions of the population and contributing significantly to GDP. In Nigeria, the agricultural landscape is diverse, with key products including cassava, maize, yams, rice, livestock, poultry, and fisheries. However, the sector faces several challenges, such as limited access to financing, poor infrastructure, outdated farming practices and the ever increasing effects of climate change. These issues hinder productivity and growth, but the adoption of digital farming and precision agri technology is seen as a potential solution to modernise the sector, improve efficiency, enhance yields, and promote sustainable farming practices. Key focus areas of agri-tech adoption in Nigeria include precision farming, digital platforms, agricultural financing, and the use of innovative technologies to address these systemic challenges.

Similarly, agriculture in Ghana is central to the economy, particularly in rural areas, with important crops like cocoa, maize, rice, cassava, and yams. However, Ghana also faces issues such as low productivity, limited access to modern technology, and climate change impacts. Like Nigeria, Ghana is increasingly adopting agri-tech to improve the sector's efficiency. The focus in Ghana has been on precision farming, the use of digital platforms for better farm management, and agricultural financing to support smallholder farmers in overcoming financial barriers.

In both countries, the integration of agri-tech offers a promising path toward enhancing agricultural productivity, resilience to climate change, and overall economic growth.
The UK and Brazil, both global leaders in agri-tech innovation, have significant expertise and technology that can support the transformation of farming in Nigeria and Ghana. By leveraging solutions from these countries, farmers in Nigeria and Ghana can address key challenges related to low productivity, inefficient resource use, and climate change impacts.

Objective

The objective of this report is to serve as a resource for innovators and researchers to identify where their expertise and solutions can help address key challenges being faced in the Nigerian and Ghanaian agriculture sector. Our market led approach highlights broad opportunity areas where innovation is needed to tackle challenges including climate changes, sustainable production and agribusiness reliance. Through online and in-person engagement, we have assessed market demand and identified gaps that present opportunities for innovators and researchers to collaborate with a focus on digital farming and precision agriculture. This analysis is supported by an extensive UK and international farmer and innovation networks, alongside the UK Department for Business and Trade (DBT) and the Science and Innovation Network (SIN) within the Foreign Commonwealth and Development Office (FCDO).

This scoping project aimed to identify key agricultural and technology challenges in Nigeria and Ghana through market engagement, while mapping potential solutions and providers that can bridge UK, Brazilian and African agricultural systems to address climate-related challenges. Beyond building knowledge and networks, this report serves a foundation for fostering future collaboration by facilitating potential consortia from the UK, Brazil, Nigeria and Ghana. By connecting expertise and innovation across these regions, we aim to enable sustainable business models and long-term cooperation in addressing shared agricultural challenges.

The UK Agri-Tech Centre (UKATC) is uniquely positioned to support innovation and accelerate the development of climate - smart agriculture solutions including those from UK and Brazil, and their adoption in Ghana and Nigeria. As the largest agri-tech centre in the UK, international projects have included knowledge exchange visits both to and from Brazil with well-established links to organisations including Embrapa, Supera Park and AgTech Garage.

Ecosystem engagement

Our approach focused on listening to and understanding the common climate challenges faced by small- and large-scale farmers in these key markets, as well as current solutions, practices and mitigations. We have worked closely with farmer organisations and innovation support networks in Ghana, Nigeria, and Brazil to identify shared common themes that can be addressed through enhanced digital agriculture and precision farming interventions. This has allowed us to identify and prioritise where digital agriculture and precision farming solutions are appropriate, and support development of credible routes to market. This will support a framework for collaborative global development with UK businesses and research institutions, helping to build a sustainable digital future.

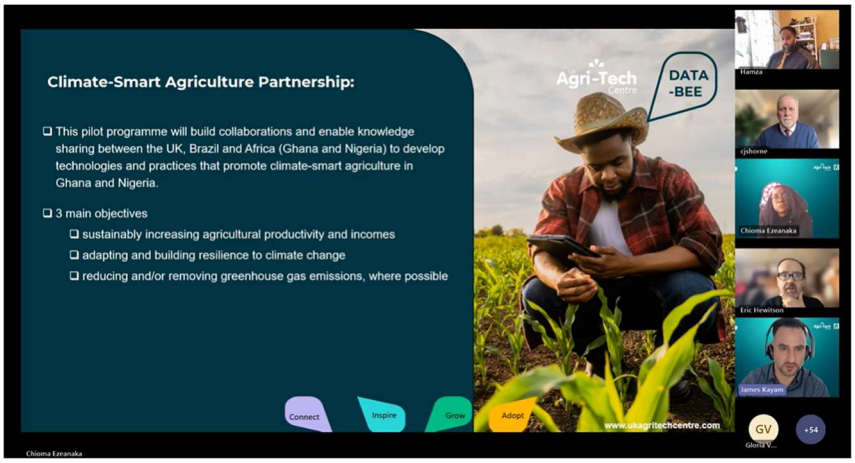
We planned and executed a thorough programme of stakeholder engagement to obtain a clear understanding of the situation on the ground. This enabled us to create proposals to boost climate-smart farming (precision and digital agriculture) driven directly by market need (an “outside-in” or “bottom-up” approach).

Engagement activities

Activity	Objectives	Outcome summary
Desk-based research	• Establish context (secondary sources) • Build stakeholder list	• Survey and interview questions
Online survey	• Quantify importance of challenges, opportunities and barriers to adoption of digital agriculture. • Collect insightful qualitative comments and quotes. • Add to the stakeholder list.	• N=99 achieved, recruited by personal invitation to stakeholder list, via UK AgriTech Centre members and promoted more widely online
Meetings	• Qualify and recruit potential partners • Present the project, receive feedback, test our assumptions, gain further advice and support for our market visits	• British Embassies in Lagos and Accra • UK SIN network • Meeting with DBT African delegation to LAMMA event
Interviews	• Confirm context (primary sources) • Inform plans for online survey and visits to markets	• Personal 1:1 in-depth stakeholder interviews (N=3)
Workshops	• Introduce attendees (from all four countries) to the project. • Hear directly from African stakeholders. • Debate the issues. • Create opportunity for partner matching	• >70 attendees from UK, Brazil, Nigeria and Ghana
In-country visit	• Deep dive into the situation on the ground • Cement stakeholder relationships • Start to build proposals for next project phase/s	• 220 contacts engaged in both Nigeria and Ghana.
Dissemination Webinars	• Feedback the outcomes of the market visits to stakeholders • Present our initial ideas for next project phase/s and get feedback • Highlight examples of existing initiatives from potential project partners	• Two dissemination webinars (one for Nigeria, one for Ghana, N=47 and N=34 respectively)

By leveraging our expertise, we aim to provide farmers with practical, scalable solutions that can be readily adopted, to help them achieve climate - smart, sustainable production while promoting profitability and best practices through sharing knowledge.

Workshops and dissemination webinars



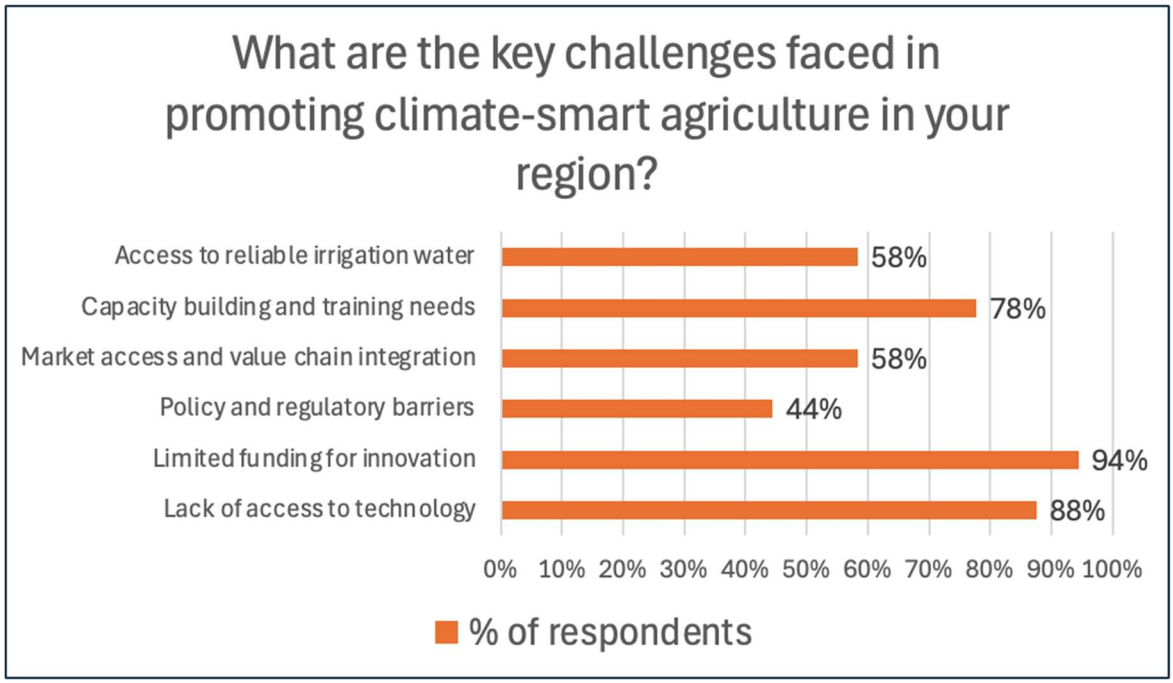
[UK / Brazil – Building collaboration in agri-tech workshop (DATA-BEE project) workshop recording]

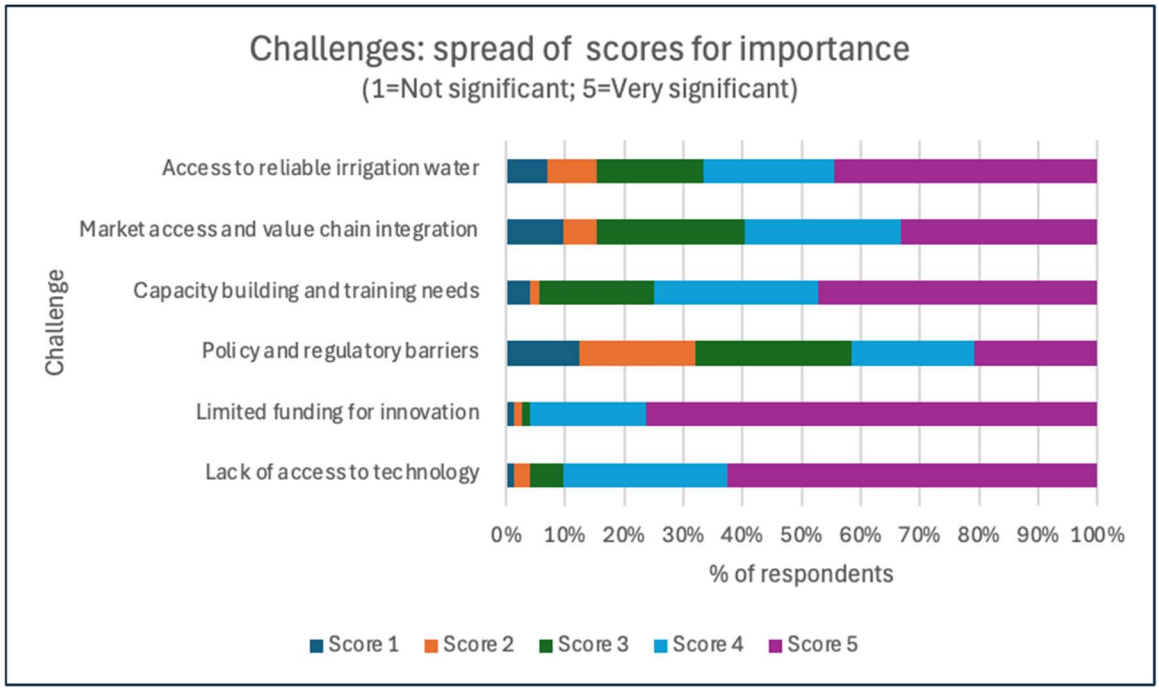
[Exploring opportunities in digital agriculture and precision farming in Nigeria (DATA-BEE project visit 2025) webinar recording]

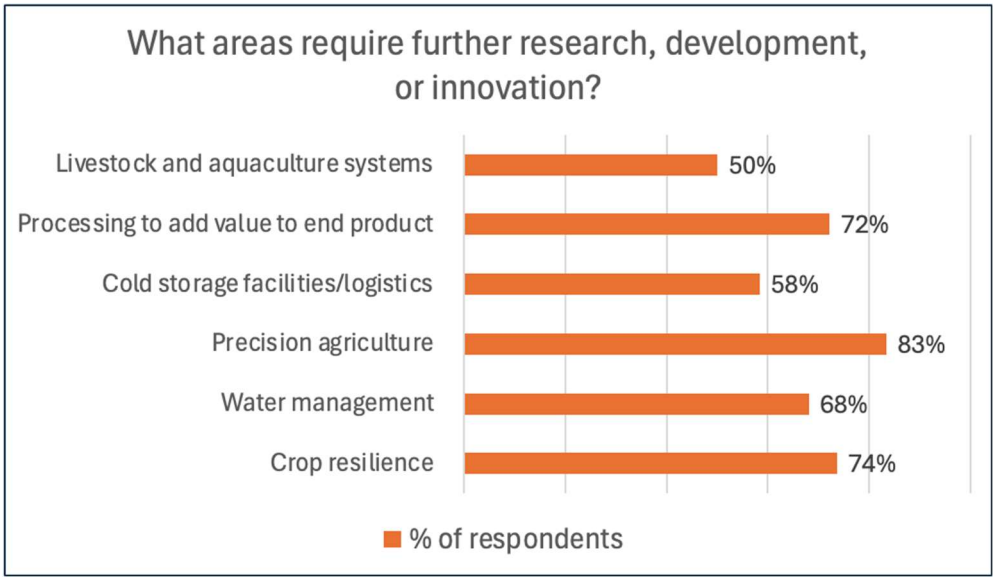
[Exploring opportunities in digital agriculture and precision farming in Ghana (DATA-BEE project]

visit 2025) webinar recording

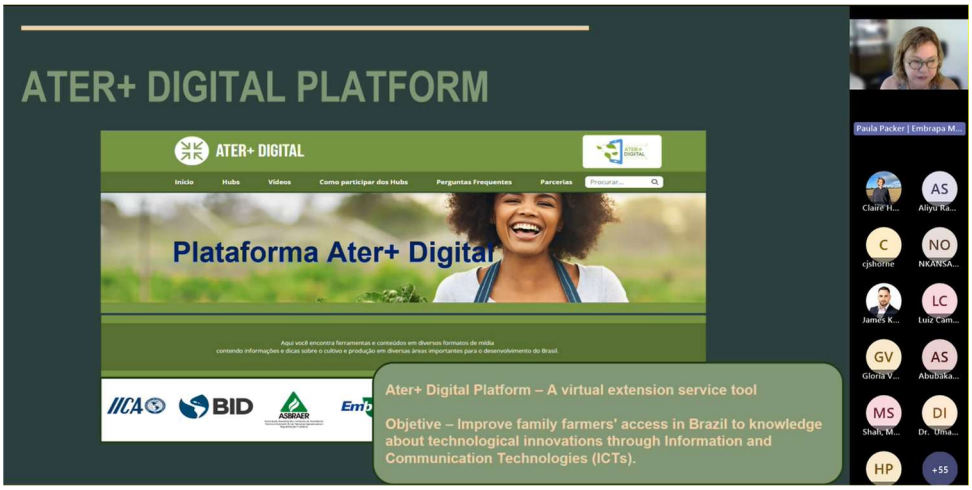
Snapshot of survey results







Sample of stakeholder engagement



(UK / Brazil – Building collaboration in Agri-Tech online workshop 24/01/25)

Below are examples of companies and organisations engaged with in Brazil, Nigeria and Ghana. Information was gathered via virtual calls, in person meetings and through online surveys.

Country: Brazil

Organisation name: Embrapa

Organisation overview

Embrapa, short for the Brazilian Agricultural Research Corporation, is a state-owned enterprise and operates under Brazil's Ministry of Agriculture focusing on developing innovative technologies and solutions for sustainable agriculture and livestock farming. Embrapa's mission is to enhance food security, promote environmental conservation, and support Brazil's position in the global agricultural market. The organisation has a network of research units across Brazil, specializing in various agricultural fields, such as beef cattle, tropical fruits, forestry, and fisheries. Embrapa also engages in international cooperation, with partnerships across the globe. Embrapa supports and develops various technologies in digital farming and precision agriculture to assist smallholder farmers.

What are the main challenges smallholder farmers have faced in Brazil? Particularly in relation to the adoption of digital farming and precision agriculture.

Smallholder farmers in Brazil face several challenges when adopting digital farming and precision agriculture technologies:

- High costs - the acquisition of precision agriculture machinery, equipment, and software can be prohibitively expensive for small-scale farmers.
- Connectivity issues - many rural areas in Brazil lack adequate internet connectivity, which is essential for integrating digital tools and accessing real-time data.
- IT and technical knowledge - farmers often require training to understand and effectively use advanced technologies, which can be a barrier to adoption.
- Socioeconomic factors - challenges such as rural family succession and sustainable rural development also impact the adoption of digital farming practices.

What technologies and practices do Embrapa support to help smallholder farmers in the adoption of digital farming and precision agriculture?

Embrapa supports smallholder farmers in adopting digital farming and precision agriculture through a variety of innovative technologies and practices. Key examples, as outlined below, aim to empower smallholder farmers, making advanced agricultural practices more accessible and impactful.

- ATER+ Digital Platform - this platform enhances technical assistance and rural extension services by providing farmers with access to digital content such as videos, apps, infographics, and courses. It also fosters interaction between farmers, researchers, and extension agents, promoting integrated farming systems like crop-livestock-forest strategies.
- Embrapa AgNest is an open innovation platform to develop agri-tech solutions. It's a collaborative effort between Embrapa, Banco do Brasil, Bayer, CNH, and Jacto, among

others, to find technological solutions for sustainable agriculture in Brazil.

- Precision Agriculture Tools - Embrapa promotes the use of remote sensing, geotechnologies, and data analytics to enhance farming efficiency and sustainability
- Training and Capacity Building - Embrapa offers training programs to improve farmers digital literacy and skills, enabling them to effectively use advanced technologies.
- Collaborative Innovation - Embrapa collaborates with other organisations to expand access to digital farming solutions and foster innovation.

Country : Nigeria

Company name: Vora Robotics Ltd

Company overview

VORA Robotics Ltd is a dynamic Nigerian startup technology company that specialises in manufacturing drones, developing advanced automation and robotics, and manufacturing or technical tools. The company aims to address challenges by streamlining processes, enhancing efficiency, and revolutionizing industries through its solutions. VORA Robotics Ltd targets industries and sectors such as agriculture, oil and gas, security, climate change, and sustainability, as well as governments and other public institutions. The company also plans to venture into consumer electronics products as a minor revenue generator in the future. VORA Robotics Ltd is based in Kaduna and Abuja, Nigeria, and focuses on technology, innovation, sustainability, and people-centric designs.

What specific barriers affect technology adoption among farmers or agri-businesses?

There are several barriers affect technology adoption among farmers and agri-businesses, including:

1. Limited Access to Financing: Lack of grants, loans, or subsidies makes it difficult for farmers to invest in modern technology.
2. Low Digital Literacy: Many farmers are unfamiliar with how to use new technologies, making adoption slow.
3. Poor Infrastructure: Limited internet connectivity, unreliable electricity, and poor road networks hinder access to and use of technology.
4. Resistance to Change: Traditional farming practices are deeply rooted, and some farmers are hesitant to adopt new methods.
5. Lack of Local Technical Support: Without accessible repair services, spare parts, or training programs, maintaining and troubleshooting tech tools becomes challenging.

What technologies or practices have shown promise in addressing these challenges in Nigeria/ Ghana?

Drone Technology for Precision Agriculture: Companies like Vora Robotics Ltd in Nigeria are developing local manufactured agricultural drones for precision spraying, crop health monitoring, and soil analysis to reduce chemical waste and improve efficiency.

What opportunities do you see for collaborative projects between the UK, Brazil, Ghana, and Nigeria?

1. Agri-Tech and Smart Farming Precision Agriculture: Collaboration on drone technology, IoT-based irrigation, and AI-driven crop monitoring can enhance farming efficiency. Climate-Resilient Crops: Joint research on drought-resistant crops suited to African and Brazilian climates.
2. Capacity Building and Skills Development Exchange Programs: Training programs for farmers, agripreneurs, and tech innovators in all the three countries. STEM and Robotics Education: Partnerships on robotics and digital literacy programs for youth, leveraging expertise from the UK and Brazil.
3. Investment and Trade Partnerships Agri-Fintech Solutions: Joint ventures to improve access to credit, insurance, and digital payments for smallholder farmers. Export Market Development: Strengthening trade links for agricultural products and technology solutions.

Country : Ghana (Brazil)

Company name: ManejeBem

Company overview

ManejeBem is a company focused on providing digital solutions for agricultural technical assistance, enabling sustainable farming practices, and driving socio-environmental impact. We offer tools for remote support, data management, and specialized consultancy, empowering farmers and agribusinesses to adopt climate-smart agriculture practices.

What specific barriers affect technology adoption among farmers or agri-businesses?

The main challenges are: Low Connectivity in Rural Areas – Many farmers still struggle with limited access to quality internet, restricting the use of digital platforms for technical assistance and farm management. Cost and Accessibility of Technological Solutions – Small and medium-sized farmers often lack the financial resources to invest in new technologies or find solutions that are not adapted to their economic and operational reality. Lack of Training and Technical Assistance – Technology adoption requires continuous training and support. Many farmers are not familiar with digital tools, making implementation and effective use difficult. Challenges in Value Chain Integration – The lack of an integrated system connecting farmers, technicians, and companies can hinder the adoption of technologies that require collaboration across different segments of the

value chain. Cultural Barriers and Resistance to Change – Many farmers still rely on traditional practices and are hesitant to switch to technological solutions without direct proof of practical and financial benefits. Regulation and Public Policies – Access to incentives and specific funding for technological innovation in agriculture remains limited, preventing wider adoption among farmers. ManejeBem aims to overcome these barriers by providing accessible tools, hybrid technical assistance (both in-person and digital), and training programs to ensure that technology reaches farmers and generates a positive impact in the field.

What technologies or practices have shown promise in addressing these challenges in Nigeria/ Ghana?

Specialised technical assistance tools play a crucial role in implementing climate-smart agriculture practices in Ghana. They help empower farmers by providing the technical support and information needed to effectively apply technologies and practices. Some tools that can help include: Digital Technical Assistance Platforms – Tools like Impactools by ManejeBem enable integrated management of technical assistance, with real-time data on crop management, irrigation and fertilization technologies, as well as weather alerts. This allows technicians to provide accurate recommendations to farmers based on local information and sensor data. Remote Technical Assistance – Remote support tools, such as video call platforms, messaging apps, and collaborative groups (e.g., WhatsApp), are effective in providing continuous guidance. With the help of agronomists and experts in real-time, farmers can quickly adapt their practices to climate changes. Monitoring Sensors and Technologies – Soil sensors, climate monitoring devices, and data platforms like Zarc by Embrapa can be used to monitor environmental conditions and assist in decision-making regarding irrigation, fertilization, and pest control. Online Training and Capacity Building – E-learning tools and interactive modules offer continuous training for farmers. This allows them to gain knowledge on sustainable agricultural practices such as agroecology, soil management, and cultivating drought-resistant varieties, without having to leave their farms. Agricultural Management Apps – Mobile apps that offer agricultural management, like FarmLogs and AgriTech apps, help farmers control their finances, monitor crops, and access guidance on best practices to improve efficiency and sustainability in production. Specialised Consultancy – Digital consultancy tools provide access to experts to answer technical questions and offer advice on implementing efficient irrigation technologies, selecting climate-adapted cultivars, and applying biological pest control techniques. These specialised technical assistance tools are essential to ensure that farmers effectively adopt the recommended technologies and practices, promoting more resilient and sustainable agriculture while increasing productivity and reducing environmental impacts.

What opportunities do you see for collaborative projects between the UK, Brazil, Ghana, and Nigeria?

A great opportunity for collaborative projects between the UK, Brazil, Ghana, and Nigeria lies in leveraging ManejeBem's technology and services to promote climate-smart agriculture. Some possibilities include: Integrated Technical Assistance Platform – ManejeBem can provide a digital

platform for knowledge exchange and experience sharing between the four countries, connecting farmers, technicians, and local experts. The platform can help adapt sustainable technologies according to the specific needs of each country, such as remote crop monitoring and providing data-driven technical assistance. Online Training and Remote Capacity Building – Offering online courses on sustainable agricultural practices, the use of bio-inputs, and soil management techniques could be an effective way to train farmers in different countries. Remote training programs for irrigation technologies, precision agriculture, and biological pest control can be implemented in collaboration with local organizations. Climate and Agricultural Sensing – Using soil sensors and climate monitoring technologies, it is possible to promote more resilient agriculture. ManejeBem can lead the implementation of technologies that help farmers predict climate patterns and make data-driven decisions, which is crucial to cope with climate change impacts in all these countries. Digital Agriculture Solutions – Tools like Impactools can be adapted for each country, offering integrated data management for crops, farming practices, and environmental impact. This includes the use of mobile technologies to facilitate communication between farmers and technicians, promoting the exchange of best agricultural practices. ESG Consulting and Innovation – ManejeBem can collaborate with organizations in the UK, Brazil, Ghana, and Nigeria to provide specialized consulting on ESG (Environmental, Social, and Governance) innovation projects, helping farmers obtain socio-environmental impact certifications and connect with international markets. These opportunities can lead to an international collaboration network for implementing more sustainable, climate-resilient, and technology-driven agricultural solutions, contributing to the development of all these countries and strengthening global agriculture.

Key insights

1. The agricultural environment in Nigeria and Ghana

Agriculture in Nigeria and Ghana is the backbone of economic and social stability, employing the majority of the population and ensuring food security. Despite its importance, the sector faces deep-seated technical challenges that hinder productivity and sustainability. These challenges include climate variability, inadequate access to water, persistent pest and disease infestations, low mechanisation levels, and post-harvest losses.

The Data-BEE project (Digital Agri-Tech Africa-Brazil Ecosystem Engagement) has initiated collaborations between Brazil, the UK, Ghana, and Nigeria to identify scalable solutions that address these agricultural challenges. However, the adoption of technology must be affordable and accessible, ensuring smallholder farmers—who make up the majority of the sector—can integrate solutions without overwhelming financial strain.

2. The economics of farming: Cost pressures and financial constraints

Farming in West Africa is predominantly low-margin and high-risk, with smallholder farmers often operating on subsistence levels. One of the most significant barriers to technology adoption is cost. Fertiliser, seeds, and pesticides make up a large portion of farming expenses, with fertiliser prices rising by over 60% in the past five years, making them increasingly unaffordable. Due to the lack of mechanisation, many farms still depend on manual labour, which is costly and inefficient. Additionally, access to credit is severely limited, with less than 10% of smallholder farmers having access to formal loans, making it difficult to invest in technology. Poor logistics and weak infrastructure further strain revenue, as farmers are often forced to sell produce at low prices due to limited market access and price fluctuations.

For agri-tech to succeed, solutions must be cost-effective, integrate with existing farming methods, and provide immediate economic benefits to farmers. Models such as technology leasing, cooperative purchasing, and microfinancing for digital tools could pave the way for increased adoption and scalability

3. Infrastructure and farm networks in Nigeria and Ghana

Farming networks in Nigeria and Ghana are highly fragmented, with poor infrastructure preventing efficient market linkages. Over 50% of rural roads in Nigeria and Ghana are unpaved, making it difficult for farmers to transport produce to markets before spoilage occurs. Limited access to cold storage results in post-harvest losses exceeding 40% for perishable crops such as tomatoes and peppers. Additionally, many farmers rely on traditional knowledge rather than data-driven insights, creating a gap in efficiency and productivity.

Expanding knowledge exchange (KE) systems through digital education platforms, radio broadcasts, and mobile apps could bridge this gap and drive technology adoption. A critical component of successful agricultural transformation is the role of community-based learning and farmer networks.

During our engagements, we met with organisations that support over 20,000 farmers, demonstrating that these networks play an essential role in influencing adoption and scaling of agri-tech solutions. Understanding how these groups operate, what influences their decision-making, and who the key connectors are within these communities is crucial to effectively implementing new technologies.

Strong engagement with local cooperatives, farmer associations, and extension services can facilitate the adoption of new practices by creating trust and providing consistent, culturally relevant education. Additionally, the use of community-based demonstration farms and peer learning programs can encourage farmers to adopt proven technologies through first-hand experience and knowledge sharing. Ensuring that digital learning platforms and training initiatives are built within these community structures will greatly enhance the reach and sustainability of agri-tech solutions.

4. Key technical challenges in agriculture

West African agriculture, particularly in Nigeria and Ghana, faces several well-known and persistent challenges. While these are often discussed in high-level terms, it is the underlying technical issues that define where and how innovation can make a meaningful difference.

4.1 Climate variability and water management

One of the most immediate constraints for farmers in both countries is change in seasonal rainfall. In the northern regions, longer dry seasons and unpredictable onset of rains disrupt planting and reduce yields. In other areas, excessive rainfall with poor drainage causes waterlogging and crop damage. Most farmers depend entirely on rainfall, and very few have access to irrigation.
The technical opportunity lies in affordable, modular irrigation systems powered by solar energy,

which are already being used in Brazil's semi-arid regions. When paired with soil moisture sensors, these systems can ensure that water is applied only when needed. In the UK, the integration of soil moisture data with automated irrigation scheduling apps has helped reduce water waste and improve consistency in crop production. These tools could be adapted to the West African context, especially when built to function in low-bandwidth, off-grid environments.

Beyond hardware, remote sensing offers an important complementary tool. In Brazil, thermal and NDVI imagery is being used to monitor field-scale water stress, guiding timely irrigation decisions. Similar data services could be provided through extension networks or co-ops in Ghana and Nigeria to support commercial and smallholder farmers alike.

4.2 Pest and disease infestation

Crop losses to pests and diseases are a major issue. Fall Armyworm continues to devastate maize crops across both countries. Cassava is stunted by mosaic disease, and Ghana's cocoa farmers suffer from high levels of Black Pod Disease. Many farmers are reliant on generic chemical solutions, often applied too late or at the wrong dosage.

UK and Brazilian innovation provides clear technical pathways here. AI-powered pest and disease recognition apps are being developed to identify problems in real time through smartphone images. Brazil's Embrapa has also developed weather-linked pest forecasting systems that notify farmers of high-risk periods. These systems are already deployed in cotton and soybean sectors and could be adapted to maize, cassava, and cocoa value chains.

In addition, drone-based field scouting—now common in larger UK farms and increasingly used by Brazilian cooperatives—offers the potential for early detection and mapping of outbreaks. These can be integrated with local advisory systems or commercial agri-service providers to support rapid response.

4.3 Low input use efficiency

Fertiliser, seed, and pesticide use is often inefficient and expensive. Farmers generally apply fixed doses without soil or crop-specific recommendations. This results in both waste and poor outcomes. In many cases, farmers simply cannot afford the inputs at all, or apply suboptimal amounts that limit yield potential.

Here, handheld soil testing kits and mobile input planning apps offer immediate value. In the UK, input decisions are routinely made using precision maps and fertiliser application models. These are now being simplified into mobile versions for global use. Brazil's large farms use variable rate application (VRA) tools to apply inputs based on field variability—tools that could be scaled down to service smallholder clusters or co-ops using shared machinery or custom hire services.

In Ghana and Nigeria, the integration of geo-tagged advisory tools, even basic ones that provide fertiliser recommendations based on location, soil type, and crop, could dramatically improve efficiency and affordability.

4.5 Post-harvest loss and storage

A significant portion of food is lost after harvest due to poor drying, weak storage systems, and lack of pest control. Grains spoil due to moisture, cassava rots rapidly without processing, and most produce is sold quickly at low prices to avoid loss.

Technologies to address this are relatively mature. Hermetically sealed storage bags with built-in sensors are already being deployed in parts of East Africa and in Brazil's grain cooperatives. These can now be equipped with low-cost humidity and temperature monitoring systems to alert users to risk. For fresh produce, solar-powered dryers have proven effective in improving storability and reducing weight loss and could be coupled with traceability or inventory tracking systems.

UK-developed smart warehouse platforms, originally designed for small agribusinesses, could be adapted for use by co-operatives or aggregators in Ghana and Nigeria to improve post-harvest handling and build more efficient supply chains.

4.6 Security and asset protection

Insecurity, particularly in Nigeria, is a real concern. Farmers and agribusinesses are vulnerable to theft, banditry, and conflict-related disruptions. This undermines confidence in investing in equipment or infrastructure.

Technology can support risk reduction. In the UK and Brazil, GPS asset tracking, mobile payment verification, and digital identity tools are used to secure transactions and reduce fraud. These tools are becoming increasingly accessible, even for small-scale operations. The integration of biometric access to storage facilities, combined with mobile alert systems, could help protect both physical and digital agricultural assets in volatile environments.

5. The case for a stacked solution approach

These technical challenges rarely occur in isolation. A farmer facing late rains is also likely to encounter pest pressure and storage issues later in the season. Technology is most effective when deployed in combinations—"stacks" of interoperable tools that address multiple pain points at once.

For example, pairing soil moisture sensors with solar irrigation and mobile weather alerts creates a complete water management stack. Similarly, AI pest ID apps, forecasting dashboards, and targeted spraying tools form a disease management stack. Post-harvest stacks might combine drying systems, sealed storage, and digital inventory monitoring.

Stacked solutions help deliver more value to farmers while supporting service providers, NGOs and commercial partners to build more sustainable business models. In both the UK and Brazil, this approach has proven far more successful than standalone tech deployment.

6. Opportunities for precision technology and data

From this scoping exercise, the most promising opportunities for precision and digital agriculture are those that meet three conditions:

1. They address **specific technical constraints** (e.g., poor water use, pest mismanagement).
2. They are **adaptable to low-infrastructure contexts** (e.g., offline apps, solar power).
3. They have been **proven elsewhere** and are ready for localisation.

Technologies with high relevance and feasibility include:

- **Capacitive soil sensors** to guide irrigation and reduce crop stress
- **Mobile pest prediction and notification platforms** based on local weather and crop models
- **Geo-referenced fertiliser planners** with variable dose recommendations
- **Drone imagery for field-level pest, disease, or nutrient mapping**
- **Smart storage solutions** for temperature-sensitive or pest-prone produce
- **Digital transaction systems** for secure payments, record-keeping, and traceability

7. Recommendations and next steps

Through this Scoping Project, we saw clear opportunities to support the development of practical, locally relevant technology solutions in areas such as smallholder irrigation, early pest detection, and post-harvest management. These opportunities emerged directly from the knowledge shared by stakeholders in Ghana and Nigeria and were shaped through the networks established between partners in the UK, Brazil, and Africa. The knowledge exchange activities helped to surface a wide range of real-world challenges while also highlighting where existing technologies—particularly those already in use in Brazil and the UK—could be adapted or co-developed to meet local needs. There is strong potential to build on this by supporting collaborative development work, enabling access to context-specific data, and exploring business models that make these technologies more accessible. Rather than offering prescriptive solutions, our role going forward could be to help create the conditions for these partnerships and innovations to thrive—bringing together the right people, insights, and technical foundations to move from scoping to action.

8. Harnessing UK and Brazilian expertise and transformational change in Nigeria and Ghana

UK expertise in digital agriculture and precision farming

The UK has a strong ecosystem of agri-tech companies, research institutions, and government-backed initiatives focused on advancing digital farming. UK innovations in satellite imaging, remote sensing, and data-driven decision-making can help Nigerian and Ghanaian farmers optimise resource use, monitor crop health, and improve yields. Additionally, precision engineering technologies—such as autonomous machinery and AI-powered farm management platforms can drive efficiency in both large-scale and smallholder farming. The UK's expertise in agricultural finance and digital platforms for market access can also empower farmers by providing better access to credit, insurance, and fair pricing.

Brazil’s strength in tropical agriculture and smart farming

Brazil has extensive experience in adapting precision agriculture to tropical climates, making its technologies particularly relevant for Nigeria and Ghana. Innovations in soil health management, climate-smart irrigation, and advanced crop breeding techniques can enhance productivity in similar agroecological conditions. Additionally, Brazil's leadership in low-cost, scalable precision farming solutions such as smart irrigation systems, sensor-based soil analysis, and drone technology, can help smallholder farmers in Nigeria and Ghana improve efficiency and sustainability.

Barriers and creating transformational change

While the potential for agri-tech adoption in both Nigeria and Ghana is immense, achieving

transformational change in these markets requires a strategic understanding of their differing business environments. One of the critical factors influencing business operations is security, which has a direct impact on agricultural supply chains, investment confidence, and overall market viability.

In Nigeria, security challenges—including rural instability, theft, and political uncertainty—pose significant hurdles for agricultural development. These risks necessitate increased spending on security measures, insurance, and operational risk management, ultimately influencing the cost-effectiveness of agri-tech initiatives. Addressing these issues requires collaborative efforts between the public and private sectors to implement innovative solutions that enhance security and business resilience.

Conversely, Ghana presents a more stable business climate, as evidenced by the presence of several British businesses met on the visit that have successfully established and expanded their agricultural initiatives there. The relative stability of Ghana's regulatory environment, security conditions, and investment infrastructure seemed to make it a more attractive destination for UK businesses looking to deploy agri-tech solutions in West Africa.

Transformational change in the region hinges on fostering resilient and adaptable business models that consider these market dynamics. By leveraging insights from both Nigeria and Ghana, stakeholders can develop targeted strategies that mitigate risks, enhance operational security, and create sustainable agricultural solutions. Policymakers, investors, and agri-tech innovators must work collaboratively to drive change, ensuring that security and business resilience are at the forefront of agricultural development efforts in Nigeria and Ghana.

9. Conclusion

Agricultural transformation in Nigeria and Ghana hinges on the widespread adoption of affordable, accessible, and scalable agri-tech solutions. Addressing key challenges including climate change, soil degradation, limited mechanisation, and fragmented value chains requires cost-effective innovations that directly benefit smallholder farmers while driving efficiencies in commercial agribusiness.

Key pillars for success

Cost-effective and scalable innovations
To ensure broad adoption, agri-tech solutions must be tailored to the financial realities of farmers in Nigeria and Ghana. Technologies such as precision irrigation, remote sensing, mobile-based advisory services, and AI-powered farm management tools must be affordable and adaptable to different farming scales. Public-private partnerships and innovative financing models, such as pay-as-you-go and microcredit schemes, will be crucial in reducing financial barriers.

Farmer engagement and capacity building
Successful adoption of agri-tech requires strong farmer engagement through training programs, extension services, and digital literacy initiatives. Localised knowledge transfer, delivered through both digital platforms and community-based extension officers, will help farmers maximise the benefits of new technologies. Strengthening cooperatives and farmer networks can also enhance collective bargaining power and market access.

Integrated and context-specific solutions
Rather than isolated technological interventions, the sector must prioritise integrated solutions that combine multiple innovations to address productivity, sustainability, and market access challenges. For example, combining precision agriculture tools with soil health management strategies and climate-smart practices can significantly improve resilience and yields.

The role of international collaboration
Collaboration between UK and Brazilian agri-tech providers, research institutions, and local stakeholders in Nigeria and Ghana presents a unique opportunity to co-develop regionally relevant solutions. The UK's expertise in digital agriculture and precision farming, combined with Brazil's success in tropical agriculture and large-scale production systems, creates a complementary knowledge base.

By fostering cross-border partnerships, stakeholders can co-design solutions tailored to the specific climate challenges in Nigeria and Ghana agriculture. Joint research initiatives, technology trials, and policy dialogues will ensure the effective implementation and sustainable scaling of these technologies.

A path to long-term sustainability

To achieve long-term sustainability and resilience, the transformation of Nigeria and Ghana's agriculture must be underpinned by:

- Investment in infrastructure
- Policy support and regulatory frameworks that encourage innovation
- Stronger market linkages to enhance farmer incomes and agribusiness growth
- Commitment to climate resilience, ensuring that solutions align with sustainability goals

By leveraging international expertise and fostering dynamic partnerships, Nigeria and Ghana can accelerate their agricultural transformation, ensuring food security, economic growth, and sustainable livelihoods for millions of farmers.

A note on definitions

Digital agriculture and **Precision farming** represent advanced agricultural technologies that leverage data, connectivity, and cutting-edge tools to optimise farming practices.

Here follows a breakdown of the types of technologies involved:

9.1 Digital agriculture

Digital agriculture refers to the integration of digital technologies across the entire agricultural value chain. It encompasses:

9.1.1 Data collection and analysis:

9.1.1.1 IoT Devices: Sensors for soil, weather and crop monitoring.

9.1.1.2 Satellite imaging and remote sensing: High-resolution imagery for large-scale monitoring.

9.1.1.3 Big data analytics: Aggregating and analysing data for trends and insights.

9.1.2 Software and platforms:

9.1.2.1 Farm Management Information Systems (FMIS): Tools for planning, monitoring and optimising farming operations.

9.1.2.2 Mobile apps: For tracking weather, market prices, pests alert and more.

9.1.3 Connectivity:

9.1.3.1 5G/LoRa Networks: Reliable data transmission in rural areas.

9.1.3.2 Cloud computing: Centralised data storage and access.

9.1.4 Artificial intelligence and machine learning:

9.1.4.1 Predictive analytics for yield forecasting, pest outbreaks, or disease risks.

9.1.4.2 Decision support systems to optimise resource use.

9.1.5 Blockchain:

9.1.5.1 Ensures transparency and traceability in the supply chain.

9.2 Precision Farming

Precision farming is a subset of digital agriculture focusing on optimising inputs and outputs on a micro-scale. Technologies include:

9.2.1 GPS and GNSS Technology:

9.2.1.1 For accurate field mapping, machinery guidance, and variable rate application (VRA).

9.2.2 Variable Rate Technology (VRT):

9.2.2.1 Adjusts inputs (e.g., seeds, fertilizers, water) based on site-specific conditions.

9.2.3 Sensors and IoT Devices:

9.2.3.1 Soil sensors: Measure moisture, pH and nutrient levels.

9.2.3.2 Crop sensors: Monitor plant health using NDVI or thermal imaging.

9.2.4 Drones and UAVs:

9.2.4.1 For crop scouting, spraying and field mapping.

9.2.5 Robotics and Automation:

9.2.5.1 Autonomous tractors, robotic weeders, and harvesters.

9.2.6 Precision Irrigation Systems:

9.2.6.1 Drip or sprinkler systems controlled by real-time data on weather and soil moisture.

9.2.7 Decision Support Systems (DSS):

9.2.7.1 Software that uses data to provide actionable recommendations.

Both digital agriculture and precision farming aim to enhance productivity, reduce waste, and make agriculture more sustainable. While digital agriculture focuses on system-wide improvements, precision farming hones in on site-specific interventions. Together, they represent the future of smart farming.