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TEGEMEO INSTITUTE OF AGRICULTURAL POLICY AND DEVELOPMENT

The Development of Digital Services and their Utilization in Agriculture in Kenya

Technical Report

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The Tegemeo Institute of Agricultural Policy and Development is a Policy Research Institute under Egerton University with a mandate to undertake empirical research and analysis on contemporary economic and agricultural policy issues in Kenya. The institute is widely recognised as a centre of excellence in policy analysis on topical agricultural and food security issues of the day and in its wide dissemination of findings to government and other key stakeholders with a view to inform policy direction reliably and the decision-making processes. Tegemeo empirically based analytical work and its objective stance in reporting and dissemination of findings have, over the past decade, won the acceptance of government, the private sector, civil society, academia, and others interested in the performance of Kenya's agricultural sector.

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Abstract

Digital agriculture in Kenya has been developing rapidly and is helping farmers to increase their productivity and profitability. The paper summarises that the utilisation of digital tools is low despite high registrations. Low utilisation is due to a lack of trust in market platforms or tools providing market linkages, high costs of credit or high transaction costs to access credit and poor bundling of complementary services. Other challenges include high costs of technology, lack of access to information and services, and a lack of training and capacity building for farmers. The Kenyan government and other stakeholders are working to address these challenges and to continue to promote the use of digital technologies in the agriculture sector. Key intervention includes incentives for scaling up promising technologies, lowering acquisition costs for digital tools developers and investments in the supply of public goods, e.g., farmer registries.

1.Background

Kenya has seen rapid mobile phone subscription and penetration growth over the past decade. Mobile subscriptions stood at 65 million, representing 131% mobile phone penetration by June 2022 (Communications Authority of Kenya (CAK), 2022). As a result, the development of digital services has grown rapidly with the growth in mobile phone subscriptions. By the end of June 2022, Kenya had 60 million mobile phones connected to mobile networks, of which 55% were feature phones and 45% were smartphones (Communications Authority of Kenya (CAK), 2022). This has provided a fantastic background for the development of digital tools for both feature phones and smartphones.

The development and utilization of digital tools over the past decade have risen in sub-Saharan Africa and are now seen as a key driver of transformation. Kenya has been a leader in the region in developing and using digital tools. The development of mobile phone infrastructure, high-speed internet connectivity, and growth in mobile money services are key drivers for this growth.

Digital tools have targeted a range of services. However, the financial services leading in Kenya has led to the development of the fintech segment in the financial services sector. More recently, digital tools have been developed targeting the agriculture sector. The development of these tools has been critical in addressing core gaps within the agriculture sector. Initially, there was skepticism about the use of digital tools in agriculture. Several factors informed this. First, in Kenya, the average age of the farmer is about 55 years (Tegemeo Institute, 2015). These farmers are less likely to be tech-savvy enough to engage consistently in digital tools through smartphones and mobile phone apps. However, some of the tools have been simplified in the form of user-friendly apps. Also, there were doubts about the ownership of smartphones in rural areas and whether there would be adequate internet connectivity challenges in rural areas to support smartphone apps. However, Kenya has made great strides in the quality of internet connectivity in rural areas. Also, the costs of internet bundles have significantly come down, allowing most farmers access. Furthermore, the development of tools that rely on USSD codes allows farmers with feature phones to be included in using digital tools.

The range of digital tools serving the agricultural sector can be categorized by the services they provide or the technology they use. Several tools help farmers keep records of their costs and returns. These tools have helped provide essential information that was not existing before about the risks and profiles of these risks for farmers for the enterprises they engage in. previously, farmers relied on recall for such information, and have at times been inaccurate or left out critical information that could affect decision making (Infonet-Biovision, n.d.). Some digital tools provide critical extension information for various enterprises, filling a gap due to the collapse of public extension systems. Other tools revolve around marketing, providing market information, and linking producers to potential market outlets and actors. Besides, whereas the services described earlier rely on mobile phones, there are now more sophisticated technologies that have come into

use and rely on technologies such as the use of satellites, remote sensors, blockchains, and big data (Baumüller & Kieti, 2022).

Given this upsurge, it is important to understand, firstly, the types of digital technologies that are critical for enhancing productivity and profitability for smallholder farmers in Kenya. To achieve this, the effectiveness of these various digital tools in terms of reach, usage, and the translation of usage into actual outcomes, either productivity or profitability, are explored. Several studies have established a catalogue of tools and explored potential users to build a use case (Gatsby Africa, 2022; Abate, et al., 2023; Abay, et al., 2021; Kieti J. , Waema, Ndemo, & Omwansa, 2022; Kim, Shah, Gaskell, Prasann, & Luthra, Scaling Up Disruptive Agricultural Technologies in Africa, 2020). Further, the enabling environment that supports the development and utilisation of digital tools has been changing. This study also examines the dynamic policy landscape, including the evaluation of the policy and regulatory environment that currently exists, with a view of identifying the most enabling policy levers that are critical for further scale up of the use of digital technologies in agriculture.

This paper has the following objectives. First, we intend to build on the register of digital tools available for agriculture in Kenya as the number of increasing tools are rapidly increasing. Second, we want to combine the features used in previous studies to recategorize the tools and services offered through the digital tools and the targeted users. Third, we attempt to estimate farmers' adoption or utilisation of these tools, going beyond past studies and using real farmer data. Fourth, we shall look at the regulatory environment that supports digital tools and evaluate risks, challenges, and opportunities to develop the environment that will lead to greater utilisation of digital tools and the value they can bring to the sector.

The rest of the paper is organised as follows. Section two profiles the digital tools available in Kenya. Section three evaluates policy and regulatory frameworks supporting the introduction and utilisation of digital tools. Section four discusses the issues around adoption of digital tools, risks, challenges, and opportunities to deliver services while growing this segment. Section five concludes by drawing lessons for policy relevance.

2. Development of digital tools in SSA and Kenya

Kenya stands out in both the development of mobile phone subscriptions and internet connectivity. Figure 1 shows the growth in mobile phone and internet subscriptions in Kenya. In the past five years, there has been significant growth in the number of mobile phone subscribers and those accessing broadband and the internet through mobile phones. By the end of June 2022, the number of sim card subscriptions was 32.9 million feature phones and 26.8 million smartphones (Communications Authority of Kenya (CAK), 2022). The growth, especially in the number of smartphones and the growth in both data subscriptions using mobile phones and broadband internet connection, creates a solid foundation for penetration of digital tools. It is critical to emphasize that although the numbers are aggregate numbers for the country, penetration in rural areas has equally risen, although the available data is not disaggregated by region. The digital tools being developed are both apps based for smartphones and USSD codes for feature phones. The growth in these tools is not expected to disadvantage farmers not on smartphones.

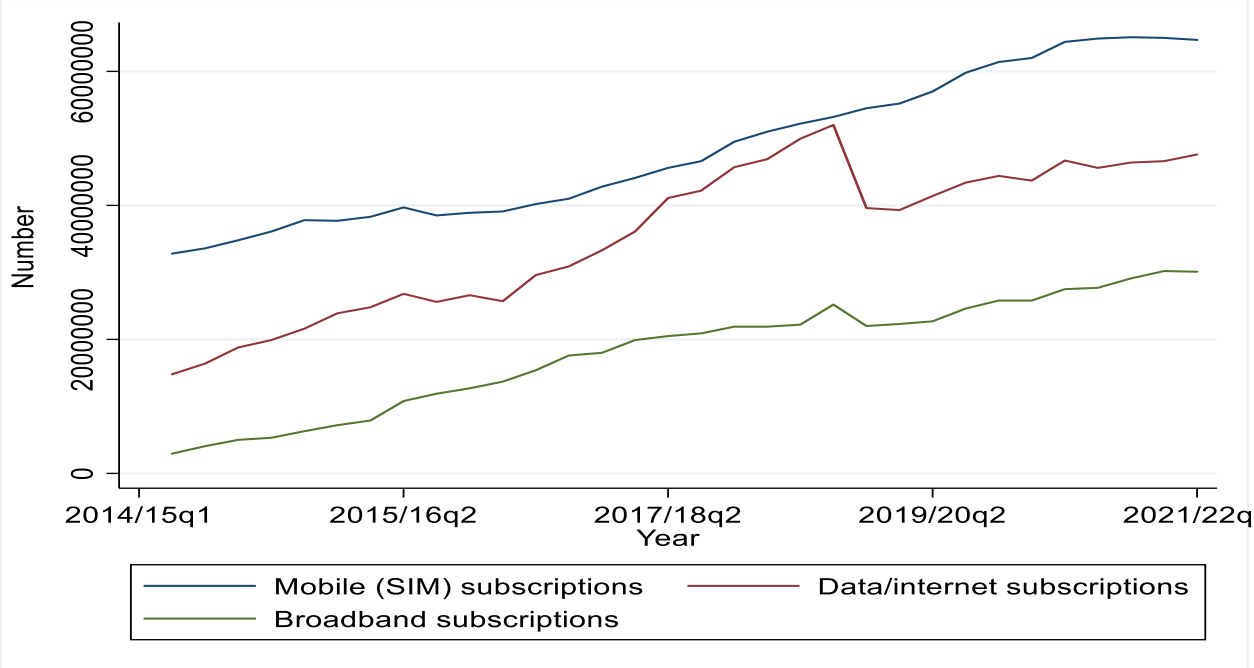

Figure 1: Trend in mobile phone and internet subscriptions in Kenya[3]

Source: Data from (Communications Authority of Kenya (CAK), 2022)

The number of digital tools in Sub-Saharan Africa (SSA) has increased exponentially over the past five years. Figure 2 shows the growth in the number of digital tools rolled out in SSA. Before 2000, there were about 10 tools available. The early-generation digital tools provided offline extension advisory and farmer information through audio and video via radio and television (Trendov, Varas, & Zeng, 2019). However, since 2015 there has been exponential growth in the number of tools in SSA, driven by rapid expansion of mobile phone connectivity in the region,

[3] In 2019, one of the major service providers revised their data to conform to the indicator definition.

expansion of internet services coverage and connections, availability of cheaper smartphones from China into the region, increase in data sharing among stakeholders in the region, donor support in the development of tools, increasing demand for digital solutions in the region and competition among developers to offer tailored services.

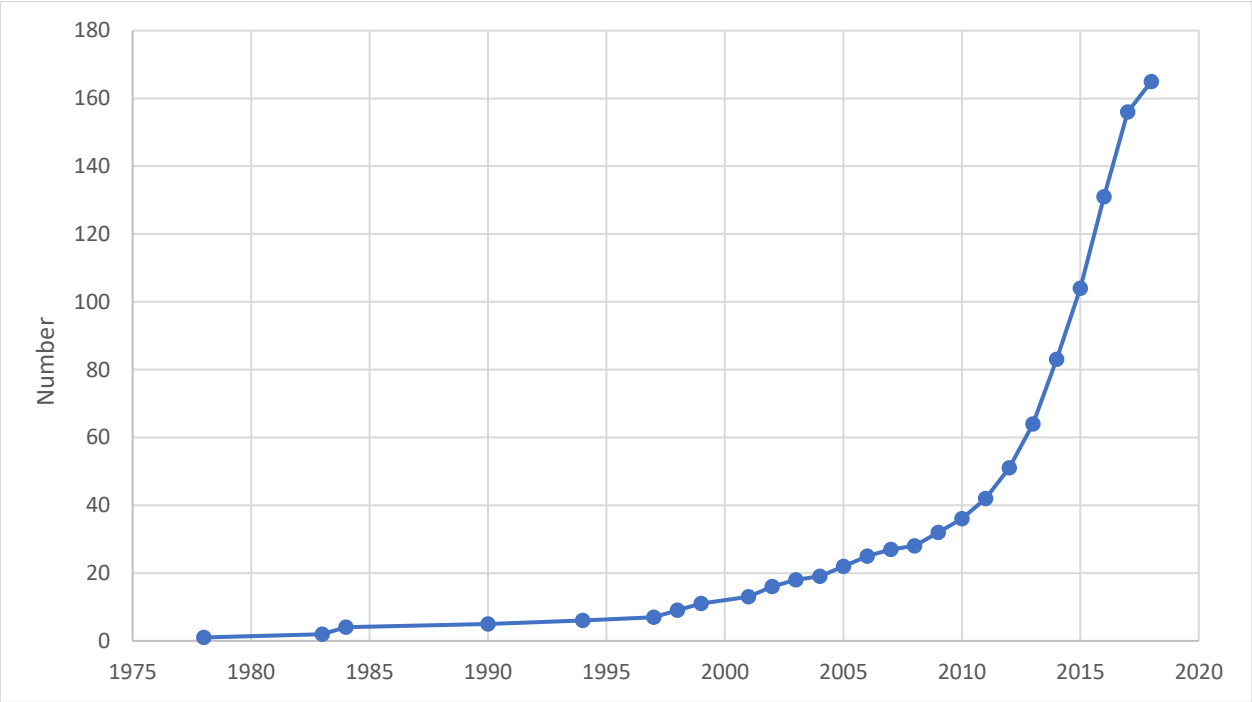

Figure 2: Scalable DATs in SSA

Source: (Trendov, Varas, & Zeng, 2019)

Digital tools have the potential to solve some of the key challenges facing the sector. Key among these challenges include raising agricultural productivity, enhancing market linkages, providing analytics to inform production and market decisions, enhancing access to financial services and credit, and enhancing aggregation, value addition, and agro processing. In Kenya, a low-hanging fruit is enhancing access to financial services and credit leveraging the growth of mobile money in Kenya.

Many of the tools currently available have been developed with support of grants from donor agencies. 58% of the revenues for digital app developers is donor grants (Gatsby Africa, 2022). The challenge for digital app developers in agriculture has been maintaining a sustainable utilization level of utilization to grow revenue for subscriptions for digital app services. As such, the central focus is the scalability of services offered, impact on users, and sustainability of the developers to continue to offer services. It is estimated that by 2020, Kenya had over 100 agriculture digital services, with about 20-30% of farmers using at least one digital technology (Gatsby Africa, 2022). Table 1 categorizes the main and subcategories of digital services offered in Kenya.

Table 1: Categories of digital services by use and sub use

Access to services		Access to markets		Access to assets
Digital Advisory	Financial services	Digital procurement	Agri E-commerce	Smart farming
Agri Village Advisory Services	Credit & loans	Digital records	Inputs	Smart shared assets
Smart Technology	Input financing	Digital records with payments	Outputs	Equipment monitoring
Weather information	Credit scoring	Digital records with traceability	Inputs & outputs	Livestock & fisheries management
Pest & disease management	Crowdfunding	Digital records with payments & traceability		
Product verification	Insurance			
Record keeping	Digital agri wallet			
	Savings			
	Accountability			

Adopted from (GSMA , 2020)

Most of the digital apps offer more than one service e.g., they provide advisory services, financial services and offer market linkages. However, in terms of services offered, majority of the tools offer digital extension services, financial services and promote agricultural E-commerce, especially linking producers with off takers such as traders. Most tools have also leverage mobile money in their models, facilitating linkages between input suppliers, producers, and off takers. The leveraging of mobile money is convenient for app developers as the infrastructure for mobile money is well developed, including in rural areas. Figure 3 shows the growth in mobile money agents who facilitate mobile money transactions in Kenya.

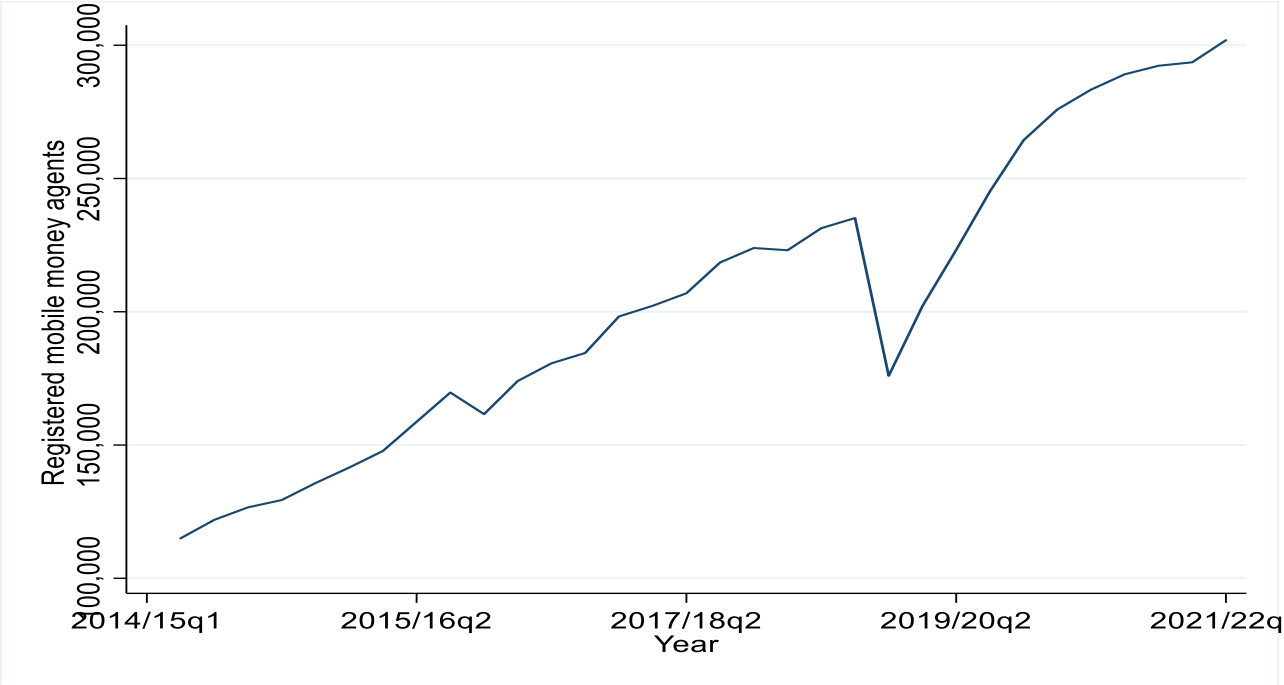

Figure 3: Trends in growth of mobile

3. Profile of digital tools in Kenya

Table 2 profiles agricultural digital tools in available in Kenya. Most of the tool's profiles have been developed with donor support, who provided grants that went into development of the tools. Most tools have tried to include feature phone users by providing USSD codes that allow farmers to send and receive SMS with specific advisories. The tools have also bundled the services and provide a bundle of services instead of single services. The advantage of bundled services is that they enhance the value for farmers. However, service providers would need to be very efficient to sustain quality services across the value chain.

Studies indicate mixed results on the success of the digital tools already in the market. The successful tools combine services ranging from input provision, extension and advisory services, market linkages, and financial services. The offering of bundled value chains confers more value to farmers and encourages farmers to continue utilisation of the tool during the crop cycle (Gatsby Africa, 2022). However, many digital tools providers face a very dynamic setting where innovations change very fast, must compete with public sector services, and may not benefit from integration with Research and Development to continually improve their offering and justify value to farmers. (Abate, et al., 2023). This leads to a lack of scaling for digital tools and face challenges being profitable if sufficient adopters of the tools are not achieved. Digital tools developers can improve customer royalty if they can demonstrate reliability of their tools both in terms of cost, complementarity of services, and efficiency of the tools (Kieti J. , Waema, Ndemo, & Omwansa, 2022).

4.Opportunities and risks for digital tools development and utilisation

The opportunities for scaling and enhancing utilization of digital tools lie in growing public-private partnerships to increase their value proposition. One of the main development areas has been using digital tools for agricultural extension services. For example, there are a number of mobile applications and platforms that provide farmers with access to information on weather, market prices, and best practices for crop management. However, to be effective, the developers rely heavily on the public sector to generate data and information that they can utilize to provide farmers with services. Without public investments, it is too expensive for digital tool developers to undertake this function. Furthermore, the non-rivalry and non-excludability of knowledge products qualify them for public investments through research. Additionally, there have been efforts to use digital tools to connect farmers with buyers and other value chain actors to increase their income and improve their livelihoods. However, this intervention can also benefit from public investments in farmer databases. When established through private investment, it is unlikely that it can be shared with other users, raising the costs for developers.

Another opportunity lies in precision agriculture, where technologies rely on GIS data and remote sensing technologies to map farms,collect soil, and crop health data, can help farmers optimize input applications such as fertilizer and water and management practices. However, remote sensing data remains expensive to developers, and the costs to farmers can be a barrier to adoption.

5.Conclusion

Overall, digital agriculture in Kenya has been developing rapidly, and it is helping farmers to increase their productivity and profitability. There are two categories of tools, network-oriented tools, i.e., used together with a number of stakeholders e.g., farmers, extension workers, input sellers and traders, and farmer-oriented tools that are just used at farm level. The tools can be used on smartphones via apps or on feature phones through USSD codes. The tools offer five categories of services i.e., digital extension and advisory services, financial services, digital procurement services, E-commerce services and asset management services.

Utilization of digital tools is low. Key reasons are a lack of utilization of the tools despite high registrations. Low utilization is due to lack of trust e.g., in market platforms or tools providing market linkages, high costs of credit or high transaction costs to access credit in the case of financial services, and poor bundling of complementary services offering in the packages. However, there are still many challenges to overcome, such as the high cost of technology, lack of access to information and services, and a lack of training and capacity building for farmers. The Kenyan government and other stakeholders are working to address these challenges, and to continue to promote the use of digital technologies in the agriculture sector. Key interventions include incentives for scaling up promising technologies, lowering acquisition costs for digital tools developers and investments in supply of public goods e.g., farmer registries.

Table 2: Available digital tools in Kenya

Name of tool	Method tool is disseminated	Services offered	Country tool is used	Developer	Target population	Payment Method
Aquarech App	Smart Phone App	Market Linkage and information	Kenya	Aquarech	small-scale fish farmers, traders, investors, input suppliers	App is free but services are paid
DigiCow app and Digital Vet	USSD Code and Phone App	Livestock inputs and veterinary services	Kenya	Farming tech Solutions	Dairy Farmers	App is free but services are paid
Community videos app	Smart Phone App	agricultural extension, data, and advisory services	Kenya[4]	Digital Green	Small-Scale farmers	Free
Hello Tractor	Smart Phone App	Mechanization management services and finance options	Kenya[5]	Hello Tractor	Farmers and Equipment dealers/owners	Subscription
Digital Agtech Platform, ONE network	Smart Phone App and Hardware	Market and smallholder farmer ecosystem linkage	Kenya[6]	Kuza	Farmers, traders,	Subscription
DIGISHOP app	USSD Code and App	Agroweather and advisory services	Kenya	Farmers pride	Farmers	Pay per product as it is a digital shop
MoA-INFO	SMS Based	personalized agricultural advice through their mobile phones	Kenya[7]	Precision Agriculture for Develeopment	Farmers	Free
Rainmaker Solar Irrigation system	Hardware and App Based	develops and offers solar-powered smart irrigation systems	Kenya	SunCulture	Farmers	Subscription or paid upfront

[4] Also offered in India, Ethiopia, Afghanistan, Bangladesh, Ghana, Guinea, Malawi, Mozambique, Niger, Senegal and Tanzania.

[55] Also offered in Nigeria, USA

[6] Also offered in India and Mozambique

[7] India, Rwanda, Pakistan

Farmshine App	Smart Phone App and USSD code	Market linkages	Kenya	Farmshine		Free to access platform.
M-Shamba platform online and mobile platform	App, USSD and SMS App	Market linkages Market linkages	Kenya Kenya, Uganda	M-Shamba TruTrade Africa	Farmers, buyers Farmers, aggregators, traders	Free to access platform. Free to access platform.
Acre Africa Insurance	USSD Code	Crop, livestock, and index insurance products	Kenya, Rwanda, Tanzania	ACRE Africa	Farmers	Subscription
Automated Credit Scoring	USSD Code	Offers Financial management services and automated credit scoring services	Kenya	Amtech	Financial service providers	Licensing to financial service providers
Apollo Agriculture Platform	USSD Code and Phone App	Finance, farm inputs, advice, insurance, and market access services	Kenya	Apollo Agriculture	Farmers	App is free but services are paid
Digifarm	USSD Code and Phone App	Finance and credit services, quality farm products and customized information on farming best practices.	Kenya	Safaricom	Farmers	App is free but services are paid
Pula Insurance	App	Agricultural insurance and digital services	Kenya[8]	Pula	Financial service providers	Licensing to financial service providers
AgriBORA Platform	App, USSD and SMS, Hardware	access to technology and data analytics	Kenya	AgriBORA	Government/ Service provides	Subscription

[8] Ethiopia, Malawi, Zambia, Mozambique, Tanzania, Madagascar, Rwanda, Uganda, Mali, Senegal, Nigeria, Ivory Coast, Ghana, Togo

AgroCares Scanner	Hardware paired with App	Monitoring of nutrients in soil, feed, and leaf and advisory services	Kenya + (Africa, Europe, Asia)	AgroCares	Farmers	Paid Upfront or Subscription
Satellite Information	App Based	geospatial consultancy services	Kenya + (Africa, Europe, Asia)	Oakar Services	Government/ Service provides	Licensing and Subscription
Soil Pal and farmsuite Data tools	Hardware paired with App	real-time soil testing service and data analytics	Kenya	UjiziKilimo	Farmers	Paid Upfront or Subscription
KALRO GAPs	Smart Phone App	Provide advice on inputs, site selection, land preparation, water management, conservation agriculture, climate-smart agriculture, sustainable agriculture, post-harvesting & marketing.	Kenya	KALRO	Farmers	Free
KITOVU Technology	Smartphone app	Advisory on crop choice, agronomy, marketing & connects them to effective storage, markets, and finance,	Kenya	Kitovu		
Virtual Agronomist		Virtual Agronomist helps smallholders apply the right amount of fertilizer and predict realistic crop yields.				

(Arifu)		Financial literacy services among farmers.		Akengo Kenya Company Limited
Juhudi Kilimo		Asset financing, technical assistance, and business training services	Kenya	Juhudi Kilimo
CAPTURE Solutions		transparency and traceability in an agribusiness environment		CAPTURE Solutions
FarmDrive		credit risk assessment using mobile phone data.		
AGIN Limited		Access to inputs, loans, insurance, farm market, climate, and farm information		
		credit to smallholder farmers	Kenya	Agrics Company Limited
Tulaa		Tulaa is a mobile lending and commerce platform for rural farmers.		
Agri-wallet	Smartphone	financial inclusion platform		Dodore

AgroHub	project monitoring, evaluation, data capturing, and reporting management information system.		
UjuziKilimo	real-time soil testing services.		
Agrocares	soil tests services	Kenya	Soilcares Company
Farmers Pride Africa	soil testing, farmer insurance, linkages to agro-dealers	Kenya	

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