

Digital Agriculture Platforms: Understanding Innovations in Rural Finance and Logistics in Uganda's Agri- food Sector

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LIST OF ACRONYMS

| | |
|--------|--|
| AIC | Agriculture Insurance Consortium |
| AVCF | Agri-food Value Chain |
| DARB | Digital Agricultural Reference Bureau |
| DII | Drought Index Insurance |
| EKYC | Electronically Know Your Customers |
| FGDs | Focus Group Discussions |
| GDP | Gross Domestic Product |
| HVAC | Heating Ventilation and Conditioning |
| ICT | Information Communication Technology |
| IVR | Interactive Voice Response |
| KII | Key Informant Interviews |
| MNO | Mobile Network Operator |
| MPI | Multi-Peril Insurance |
| NFP | National Fertilizer Policy |
| NITA-U | National Information Technology Authority-Uganda |
| ROSCAs | Rotational saving groups |
| SHF | Small Holder Farmers |
| SMES | Small and Medium Enterprises |
| SSA | Sub-Sahara Africa |
| UNCTAD | United Nations Conference on Trade and Development |
| VCs | Value Chains |
| VSCLA | Village savings and loan associations |
| WRS | Warehouse Receipt System |

EXECUTIVE SUMMARY

Agriculture is the mainstay of Uganda's economy, contributing about 25% of the GDP, a third of the export earnings and almost all the country's food requirements. Yet, the sector still faces various challenges that affect production and the income derived from it. Systemic issues impact smallholder farmers' livelihoods across markets, land, skills, and capital, with cross-cutting social exclusion issues. Effective application of digital agricultural technologies has emerged as a catalyst in addressing productivity and efficiency challenges and enhancing inclusiveness in agri-food systems. Digital technologies have shown potential to address bottlenecks in access to extension services, marketing systems, suitable financial products, reliable weather information, transport services and logistics as well as supply chain management. Scaling of digital agricultural technologies in Uganda is critical for improving productivity and addressing challenges in the agricultural sector. However, for scaling to be undertaken effectively and inclusively, there is need to address the barriers that limit the use of digital innovations for some populations. However, the issues surrounding scaling and inclusivity of digital services are not well understood. This study therefore sought to contribute to bridging this knowledge gap through an assessment of the existing digitally enabled innovative cross-value chain services to gain insights into how the services are addressing inefficiencies, creating opportunities for improving efficiency and inclusiveness as well as identifying promising innovations for scaling. Specifically, the study focused on innovations in finance and logistics for value chains. For finance, the study specifically looked at digital payments, credit, and insurance, while for logistics, the focus was on supply chain management, transportation, traceability, digital platforms for e-commerce, and (cold) storage across value chains.

The study used a qualitative approach to collect data in two phases: the first phase involved conducting an inception workshop followed with key informant interviews with 39 service providers and enablers. The second phase involved case studies using 12 Focus Group Discussions (FGDs), 12 individual interviews and a validation workshop. The findings show potential for digital agricultural innovations to address some of the challenges. Several benefits are associated with the current use of digital innovations including linking value chain actors with the enabling services (e.g., insurance companies, banks, government), increased access to markets, access to extension and advisory services including market and weather information and quality agri-inputs and tractor services, services such as credit and savings, agri-insurance, agri-trucking, Heating Ventilation and Conditioning (HVAC) and warehousing. The use of digital innovations has for instance enabled access to agri-insurance and digital loans or credit which was not possible before. However, there are some challenges with the use of digital finance and logistic services. For instance, the study identified challenges of access due low awareness and information due to limited digital literacy, social norms and power-relations that disadvantage some sections of the population such as the women and youth from access and some technology design issues that need to be addressed for effective and inclusive uptake and scaling. Additionally, the ICT infrastructure in Uganda is unevenly distributed with significant gaps between rural and urban connectivity. Communication infrastructure (e.g., network coverage and broadband services) is established in urban centers, but rural areas have poor or no connectivity. Limited access to electricity is a major cause of the discrepancies in urban-rural Internet use and mobile phone penetration rates in Uganda. Yet mobile technology is at the heart of the digital transformation in Uganda as in most parts of sub-Saharan Africa.

The study also identified some promising innovations that offer opportunities for scaling, following prioritization by stakeholders of the most significant challenges to scaling (low awareness of services and lack of information to support farmers to make a case for investing in digital services). These innovations have active SMEs and start-ups engaged in them and include digital input supplies and payments

bundled with agronomic advisories, e-market places for outputs bundled with digital payments services and logistics, and agricultural logistics services involving transport and warehousing services.

1 INTRODUCTION

Agriculture remains the main source of livelihood in sub-Saharan Africa (SSA). About 80% of the population in the region, with the majority residing in rural areas, is employed in the sector (Yeboah and Jayne 2018; Olaniyi 2018), contributing about 25% of the regional GDP (Schaffnit-Chatterjee, 2014). As such, any development intervention in the sector has the potential to directly impact the livelihoods of a large number of people. However, most agricultural value chains in the region are still underdeveloped. A multitude of studies highlight several challenges facing agricultural value chains in developing countries, including poor infrastructure, institutional voids, impediments to market access, and poor governance (Trienekens, 2011). Further challenges such as poor linkages with the global value chain, insecure land tenure, poor price policies and research, low productivity, dependency on agricultural imports, and the unfavorable environment in which the small-scale agribusiness actors operate, are highlighted by Schaffnit-Chatterjee (2014).

Like other countries in SSA, agriculture is the mainstay of Uganda's economy contributing about 25% of the GDP, a third of the export earnings, and almost all of the country's food requirements. The agricultural sector comprises cash crops (e.g., coffee, cotton, tea, and cocoa), food crops (e.g., maize, beans, and groundnuts), livestock (e.g., cattle, goats, and chicken), forestry, and fishing activities (Tricarico & Loukos, 2017). The sector employs at least 70% of the country's adult working population and more than half of the youth population. About 400,000 youths enter the labour market each year in Uganda, with agriculture being their most likely source of employment (Makumbi, 2018) and for the adult working population, about 70% of the women in Uganda are engaged in agriculture (IFC, 2016). As a source of employment for diverse population groups, approximately 75% of the households in Uganda depend on it for their livelihoods (Niras, 2022, World Bank, 2019).

Despite its importance, Uganda's agriculture sector is faced with various challenges that affect production and the incomes derived. Most of the population employed within the sector remains poor and is faced with persistently low economic returns. Like other developing countries, Uganda's agricultural value chains are still underdeveloped. For instance, the common bean value chain is constrained by among others, the lack of trust of buyers by farmers, the supply of poor-quality beans, price fluctuations, and high marketing costs (Muto and Yamano, 2009), yet it is the second most cultivated crop in the country after maize (Laroche *et al.*, 2015). Agricultural productivity remains low characterized by small farm sizes ranging from 0.8 to 1.6 hectares and largely engaged in semi-subsistence farming (World Bank, 2019). Fertilizer application and use of improved seed are also low compared to average application rates in neighboring countries. On average, Ugandan farmers apply 40% less fertilizer per hectare than farmers in neighboring countries (World Bank, 2019). Low fertilizer application rates are mainly driven by limited knowledge about proper fertilizer application rates, limited access to credit, and increased availability of counterfeit fertilizers in the market.

Systemic issues impact smallholder farmers' livelihoods across markets, land, skills, and capital, with cross-cutting social exclusion issues. Food supply chains often lack strategy and business capacity both in terms of physical assets and business skills. There is a general lack of inclusiveness in markets; low incentives for investments in sustainability and few reliable services to support business development and value-chain integration, especially for women and youth. In general, growth in agricultural

productivity and incomes mainly depends on exogenous factors, such as good weather and prices rather than productivity-enhancing factors, such as technology, training, irrigation, and farm-to-market infrastructure, rendering agricultural productivity and incomes susceptible to shocks (World Bank, 2021). Also, being a landlocked country, Uganda relies on expensive air freight for the export of its perishable produce (fresh fruits and vegetables, fish, and flowers) to destination markets, while other produce (including coffee, cocoa, dried and frozen fruits, etc.) are exported via the sea through the port of Mombasa in Kenya. Increased investment in storage, processing, and value additional infrastructure, can increase the use of cheaper alternative sea freight (GIZ, 2021).

Economic returns are further constrained by rampant social inequities affecting key players. For instance, women who participate actively in the pre-production, production, and harvest stages own only 27% of the registered land. Moreover, the land used by women is often fragmented into small plots, which contributes to low productivity as economies of scale through mechanization and produce aggregation systems cannot be leveraged (Ali et al., 2016; UN Women, UNDP, and UN Environment, 2018, Niras, 2022). In addition, less than 20% of them control production and revenue use (IFC, 2016) as their active participation in marketing is hindered by the distance to major markets, lack of information, household power dynamics and social norms in some communities (Ali et al., 2016; UN Women, UNDP, and UN Environment, 2018). They thus rely heavily on their male relatives for marketing support or middlemen who offer below-market-value prices. Besides, they are typically involved in lower-value food crop value chains like beans, potatoes, and vegetables while men are predominantly engaged in cash crop value chains (Ali et al., 2016; UN Women, UNDP, and UN Environment, 2018).

The challenges of low productivity and social exclusion in Uganda's agriculture sector are complex, and no single solution exists to address them. Yet, addressing them is urgent given factors such as rapid population growth and increased susceptibility to climate shocks. For instance, the young working population (15-64 years) in Uganda are projected to increase by 13 million people between 2017 and 2030 (World Bank, 2019b) thus it is critical to identify ways to make agriculture more productive to create more opportunities and more attractive for youth employment. A key challenge, however, is how to sustainably address the multiple constraints and transform agri-systems to efficiently deliver while generating decent livelihoods for all sector workers.

Effective application of digital agricultural technologies has emerged as a catalytic tool in addressing productivity and efficiency challenges and enhancing inclusiveness in agri-food systems. While digitalization of agriculture (Berman 2012) is the use of digital technologies to change agribusiness models and transform business processes) it is not a panacea to all agricultural problems, some technological developments, such as mobile phones and the internet can substantially reduce some of the challenges in agricultural value chains, especially those related to marketing, improve information flow, improve marketing of produce, and reduce transaction costs along the value chains (Trienekens (2011)). Banks and mobile payments also have the potential to increase the financial inclusion and empowerment of women and youth in agriculture. In addition, the use of digital tools can reduce leakages in input distribution, enhance produce aggregation, transport coordination and delivery of products along the value chains, and facilitate contract farming to guarantee farmer incomes (Deichman et al., 2016). This can achieve greater incomes for smallholder farmers, improve agricultural value chains for the benefit of both large and small agribusinesses, expand the economic inclusion of youth and women, and build climate resilience (Tsan et al., 2019; World Bank, 2020).

Further, by bundling different services, digital technologies tie together a wide array of VC actors and enablers needed to drive sustainable productivity and inclusiveness at the end of the last mile. They

can make upstream and downstream value chain linkages between actors more inclusive, and efficient, provide real-time data for decision-making, and spur increased efficiency in making payments and faster market identification (Deichman et al., 2016; Zhang, 2020). This way they support value chain actors to address the global growth in demand for increased information transparency and traceability of agricultural produce (UNCDF, 2021).

Focused on Uganda, studies have indicated that emerging digital technologies have shown potential to address bottlenecks in access to extension services, marketing systems, suitable financial products, reliable weather information, transport services and logistics as well as supply chain management (World Bank, 2020). Durai and Stella (2019) demonstrated that digital finance (Internet banking, mobile banking, mobile wallets (apps), credit card and debit card) have had a significant impact on financial inclusion through digital connectivity for Uganda's unbanked population, such as women, youth, and rural households (FSD Uganda, 2018)¹. Mobile money, for instance, has become the main driver of formal financial inclusion in Uganda, standing at 78% of the adult population (14.4 million people) (FSD Uganda, 2018)². Increased access to mobile phones and the low cost associated with deploying mobile money services have been instrumental in mobile money penetration. Mobile money services in the country are also growing at a fast pace with over 30.7 million registered customers and the transaction value of UGX. 79.8 trillion in 2020 compared to 0.6 million customers and transactions worth UGX. 133 billion in 2015 (Deloitte, 2022). Moreover, digital technologies have also been suggested among the options that can help make agriculture attractive and increase gainful youth employment in agriculture, if applied to primary production stages and further up the value chains in off-farm activities (NIRAS, 2022). As such interventions aimed at scaling digital agricultural technologies in Uganda are critical for improving productivity and addressing challenges in the agricultural sector.

For scaling to be undertaken effectively and inclusively, however, there is a need to address the barriers that have been found to limit the use of digital innovations for some populations. For instance, Antonio and Tuffley (2014), found that low digital literacy, limited ownership of smartphones, low access to internet connectivity, low numbers of unbanked small-scale producers, limited free time among women to access and use ICTs and social norms that favor men over women are among the factors that constrain use of digital technologies. Similarly, the Inclusive Digital Economy Scorecard (IDES), shows that 75 per cent of Ugandans who do not use the internet lack the skills to do so. Further, the Ugandan Rapid eTrade Assessment (2018) identified the cost of ICT adoption and maintenance and low capacity to manage e-commerce logistics as some of the key barriers for entrepreneurs to adopt e-commerce. In addition, most smallholder farmers, especially the women and youth, are still unbanked and trapped in a cycle of 80% cash use in everyday business operations and selling at very low prices which limits their ability to grow financially and generate formal financial histories that can facilitate easy access to credit, especially for women and youths. Understanding and addressing these issues, therefore, is crucial for inclusively scaling the technologies. Besides, there must be an understanding of the enabling environment involving policy and regulations that could affect the development and use of digital technologies.

This understanding is however limited as existing research has tended to focus more on the potential of digital agricultural technologies to improve productivity and address challenges in supply chains and less on inclusivity issues. Yet, this understanding is vital for informing the scaling of these innovations while ensuring that their social and economic benefits are shared inclusively. This scoping study, therefore, sought to contribute to bridging this knowledge gap through an assessment of the existing digitally enabled innovative services in cross-value chains to gain insight into how these are addressing ineffi-

ciencies, creating opportunities for improving efficiency and inclusiveness as well as identifying promising innovations for scaling. To our knowledge, none of the previous studies had examined the emerging innovative services in cross-value chains in Uganda. Specifically, the scoping study examined the policy environment in which the digitally enabled innovations operate, assessing the challenges and opportunities and drawing lessons for designing innovative services that increase employment and income opportunities within the agri-food sector, particularly among women and youth.

This scoping study was conducted under the CGIAR initiative on Rethinking Food Markets and Value Chains for Inclusion and Sustainability, which aims to transform value chains through policies that ensure the creation of efficient, inclusive value chains with equitable income sharing, greater job creation and adoption of sustainable practices among SMEs and smallholder farmers, especially women and youth. Among the existing innovative services, the scoping study focused on two types: (1) finance services and (2) logistics services. For value chain finance, the study specifically looked at digital payments, credit, and insurance, while for logistics, the focus was on supply chain management, transportation, traceability, digital platforms for e-commerce, and (cold) storage.

2 METHODOLOGY

This section presents the methods used for conducting the scoping study, including study objectives and questions, study design, data collection methods, study location, recruitment of the participants, the study implementation, data scripts collected, and analytical methods.

2.1 The objective of the study:

The objective of the scoping study was to understand how digitally enabled innovations in rural finance and logistics can address inefficiencies and missed opportunities and sustainably promote inclusiveness in agricultural value chains.

2.1.1 Research questions

Specifically, the study answered seven research questions:

1. What innovations in logistics and finance systems are currently in use along the agri-food sector value chains in Uganda?
2. What are the benefits of these innovations to value chain actors?
3. How are the innovations addressing gaps in financing and logistics?
4. What are the opportunities and challenges experienced with the existing innovations?
5. How can emerging innovations in cross-value chain services be designed to increase employment and income opportunities within the agri-food sector, particularly among women and youth?
6. What policies are in place to regulate the innovations and how are they enforced?
7. What are the most promising innovations or innovation packages in digital finance and logistics for scaling?

2.2 Research design

To answer the research questions, the study adopted a qualitative case study research design. This design was used to generate an in-depth and multi-faceted understanding of the complexities in the implementation and uptake of digital innovative services to guide the identification of the most promising innovations for scaling.

2.3 Data Collection Methods

Various data collection methods were used including literature review, meetings, value chain mapping exercises, key informant interviews, Focus Group Discussions (FGDs) and individual interviews. The use of various data collection methods enabled the collection of multiple lines of evidence that supported the triangulation of the data and enabled the development of a holistic picture of the existing digital innovative services. Checklists were developed to guide the data collection exercise.

2.3.1 Literature Review

This generated evidence that informs the design and implementation of the scoping study as well as supported the findings of the study. The reviewed literature included journal articles, project reports and websites of innovative service providers. The review was also useful for situating the study in a wider research and development context.

2.3.2 Meetings

Two meetings were held, the inception and validation meetings. The inception meeting was one initial activity preceding the social inquiry process and it was characterized by the inclusion of multiple stakeholders including the VC innovative service providers, value chain actors, research institutes, academia and government officials. The meeting went beyond merely introducing the activities and included VC mapping exercises that provided an overview of service providers along the VCs of focus thereby guiding the development of the initial list of the study participants. The validation meeting, involving different stakeholders who were visited during the scoping study, was conducted to validate the findings of the scoping study, increasing understanding of the opportunities and challenges in cross value chain innovations in the agri-food sector, and offering a platform for recommendations. A total of 27 stakeholders attended the inception meeting, while 38 participants attended the validation meeting.

2.3.3 Mapping exercise

Mapping exercises were done as part of the key informant interviews. Each key informant mapped the innovative services provided along a generic value chain. A visual aid showing the existing digital innovative services and the VC segments where they are concentrated was generated. This was followed by discussions that generated more information on various topics including, how the services are delivered, who has access to the services, women and youth involvement in the VCs, and the targeted value chains.

2.3.4 Key Informant Interviews (KIIs)

The key informants were selected based on their role in the provision of the identified innovative services as well as in the social and regulatory environment in which the services operate. The key informants included the proprietors of the companies providing the innovative services (*hereafter referred to*

as service providers) as well as the government officials, banks, Agri-Insurance companies, and export associations (*hereafter referred to as enablers*). The inception meeting participants were instrumental in identifying the first set of key informants. The snowballing sampling method was used to identify the other key informants that participated in the study. A total of 39 key informants participated in the interviews.

2.3.5 Focus Group Discussions and Individual Interviews

Focus group discussions were used in the exploration of the case studies and were conducted with the users (farmers) of the innovations segregated sex and age. Case studies were identified and selected from among the users/beneficiaries of the innovative services under study guided by the findings of the key informant interviews. The selection of the cases was based on the following criteria: 1) the category of the innovation (value chain finance and logistics); 2) the number of innovative services bundled; 3) the salient features of the innovation; 4) coverage (number of value chains targeted and geographical location); 5) gender and youth responsiveness; 6) sustainability; 7) size of the business; 8) clear future; and 9) level of scaling readiness. Three case studies were selected and are explored in section 3.7 of this report along with an explanation of how the criteria were applied. 12 FGDs were conducted with farmers. During case studies, 12 individual interviews were conducted with manufacturers of agro-inputs and the agro-input dealers (referred to as merchants).

2.4 Study location, respondents, recruitment of participants, and data collected.

KIIs and meetings were conducted in Kampala where most service providers are located, while FGDs and Individual Interviews were conducted in the greater Masaka and greater Mbarara regions following the area of operation of the selected case studies. The study respondents included the providers of innovative logistics and digital finance VC services, the users of the services including the farmers and agro-input manufacturers and merchants and the representatives from the enabling environment including government agencies as regulators. The study participants were recruited as follows: first, following a literature search, a list of about 50 firms providing innovative services in logistics and value chain finance in Uganda was compiled. From the list, about 35 service providers and enablers were purposively selected and invited to the inception meeting. At the inception meeting, a list of stakeholders was generated and recruited as key informants. A snowballing sampling method was used to identify other service providers who were missing on the original list; that is, each key informant was asked to identify other service providers that s/he had worked with or heard about. When the need to include other service providers arose, they were purposively selected from the generated list. Second, case studies were selected for further exploration. The recruitment of the cases was guided by the lists provided by some key informants. A total of 64 scripts were collected as shown in table 1.

Table 1: Summary of collected scripts.

| Data Collection Method | Participants category | Number |
|---|-----------------------------------|-----------|
| Inception and Validation workshops | Various stakeholders | 2 |
| Key informant interviews | Service providers | 32 |
| | Government officials | 7 |
| FGD | Farmer groups | 12 |
| Individual interviews | Input manufacturers and merchants | 12 |
| Total scripts | | 64 |

2.5 Analytical methods

Data was analyzed using thematic content analysis. The key themes of interest revolved around types and scope of existing innovations, benefits, opportunities, and challenges as well as sustainability for scaling.

3 RESULTS

This section presents the findings of the scoping study integrating the literature review and results of the social inquiry process. The section is organised based on the research questions (as indicated in 2.1.1).

3.1 Existing innovations in logistics and finance systems along the agri-food sector value chains in Uganda

3.1.1 The operation status of existing innovations

A review of literature on digital agricultural innovations in Uganda revealed that several digital platforms, Apps and websites exist. The scoping study found that some are active, and others are inactive. The digital platforms and service providers that were found active include: Mobi-pay by MobiPay AgroSys Ltd, M-Cash, aXiom Zorn Foundation, EzyAgric by Akorion Ltd, Farm pass by MasterCard, Layaway payment services by Agro supplies Ltd, M-OMulimisa, Uganda Warehouse Receipt System, Agri-Logistics Courier trucking services, Hamwe East Africa Limited, and City coolers. The inactive ones included Kuddu, Kilimo Mart, Agro Market Day, Natural storage solution, and Agrishare. For instance, Kuddu, a digital marketplace with unique auction mechanisms developed by Kola technologies Ltd, was inactive because it was a PhD project and others were donor-funded. A key informant noted:

Not many digital technologies and by the way, not only in agriculture but generally, are active because they are driven by interests outside the developers and users. Most of these are donor-funded and when they develop them, they do not look beyond the donor interests so once the funding ends, they

cannot be sustained. Many young people are into developing Apps not to start their businesses but to earn something through selling them and that is it..., **Government official.**

On average, the active service providers/digital platforms/Apps have been in operation for 5 years ranging from 1 to 9 years. A few platforms however, including M-Cash and Hamwe, have existed for longer, 12-16 years but reported years of inactivity within the period. As mentioned, most of the innovations had failed to scale and the key contributors to this failure included dependence on donor funding structured around specific project objectives, limited access to early-stage growth capital and low business development skills among the developers.

3.1.2 Innovative services available

From the key informant interviews, various digitally enabled services were found to be offered by the service providers. The services are offered in partnership with institutions such as banks for credit-payment-related services, insurance companies and the Agriculture Insurance Consortium (AIC) for insurance-related services and mobile network operators for savings and digital payments.

For the **finance category**, the available services include; digital savings and credit, digital payments for products, agro-inputs such as seed, fertilizers and agrochemicals and services such as tractor services, and agri-insurance. The digital finance platforms are regulated by the central bank, and they operate in collaboration with banks such as centenary bank, equity bank, opportunity bank and mobile telephone operators such as MTN and Airtel through the mobile money services. The M-Cash digital platform, for instance, provides farmers with an e-wallet system that is customized to other services such as agency banking and an e-voucher system. These services enable farmers to pay for subsidized agro inputs but also make other transactions such as payment for utilities. In offering this service, M-Cash collaborates with the united bank of Africa. The mobile layaway digital platform also allows farmers and agro-input merchants to make micro savings in smaller denominations ranging from UGX 2000 to 20,000 towards the purchase of their desired agro inputs which are delivered to them upon completion of payment.

For **agri-insurance**, the existing packages include; crop and micro health insurance policy, AgroSure which also includes the Drought Index Insurance (DII) and Multi-Peril Insurance (MPI) which offers subsidies for crops for smallholder and commercial farmers at 50% and 30% respectively, and subsidies for SMEs in poultry, cattle, piggery, and fishery. The DII covers drought and excessive rainfall and the MPI covers indemnity against physical loss or damage to growing crops directly by uncontrollable pests and diseases, drought, fire, lightening, malicious damage, earthquakes, riots and strikes, explosions, and windstorms. Premium rates for the DII and MPI range between 5 – 3.5% per annum. Working with the digital service providers, the insurance companies customize respective agri-insurance packages to meet the needs of the farmers and agro-SMEs. Some of the service providers that were offering digital agri-insurance include; M-Omulimisa, Hamwe, Digital Agricultural Reference Bureau (DARB) and the mobile layaway system.

For the **logistics category**, the study found services in the areas of storage and transport. For storage, the available services included; linkages to warehouses that use the e-receipt system and Heating Ventilation and Conditioning (HVAC) services while for transport, the study only found agri-trucking services. Explaining the innovative services offered during the interview, the key informant from agri-logistics noted:

We provide a platform for farmer organizations to find trucking services, make a request for the trucks and negotiate depending on the number of tones of the pulses available and initiate an order for the service. This is a new operation in Uganda.

Not many service providers were offering logistics services and for those that did there appeared to be a specialisation in the services offered and no bundling of services was found. For instance, City Coolers only offered HVAC systems, agri-logistics was into agri-trucking while the warehouse receipt system was into the regulation of warehousing. The limited number of service providers in the logistics category could be attributed to the findings of the literature review that highlighted the generally poor transport infrastructure in the country with most roads becoming inaccessible during the rainy season, making transportation of agricultural commodities to the market more challenging (Tricarico and Loukos, 2017). The review further showed that the infrastructure for produce storage and market sales, such as warehouses, are concentrated in a few urban and peri-urban locations with a few silo-type storage facilities owned by major processors/exporters, with most storage done at the household level using existing residential structures or traditional woven granaries (Laker-Ojok, 2014). Regarding the warehouse receipt system (WRS), the review found that while these are available to offer cleaning, drying, and storage services for uniformly graded produce (mostly maize and beans), their supervision is limited and utilization levels low (Laker-Ojok, 2014). These challenges are likely hindering investment in the logistics sector thus the limited number of innovative services in this category.

The existing innovative services have enabled digital market linkages among VC actors and enablers for agricultural products especially for agro inputs. In addition, most service providers in the finance category also offered the EKYC, e-extension and e-advisory, on their digital platforms. The FGDs and interviews with the farmers showed that e-extension was the most used service and agri-insurance the least used in the study areas.

We use e-extension a lot, almost in every stage of production. There are many digital platforms that provide extension information and in various forms, such as symptoms of plant diseases that help you to know what disease is affecting your crops and how to manage it. Some platforms even show crop-specific agronomic practices and the right inputs to use...the services that is least used is insurance, we are not even sure if there are some farmers that are using it here...FGD, male farmers, Kyana-mukaka, Masaka.

The **e-advisory services** include real-time weather information and market information. Weather information was only offered by the M-Omulimisa and Hamwe digital platforms. The innovative services were largely offered through systems built with an SMS interface, USSD for users without smart phones, mobile Apps for those with smart Apps and the web. For platforms such as MCash, users also utilize POS machines through MCash agents. E-advisory and e-extension services were largely provided through SMS and Audio IVR (Interactive Voice Response).

In line with the above, the literature review found that 50% of the apps in Uganda are production-and-exchange-related (whereby farmers gain production-related information, sometimes along with Artificial Intelligence (AI) and big data analytics support, generally at the pre-production and production stage of the value chain); this is followed by 20% in trading and sharing (marketplace matching, horizontal offers, information services, complex information services, production and harvest services, and sharing and knowledge exchange) and one for output exchange and single buyer-led, respectively. None of the apps reviewed (or that were known to the government/other app developers) related to guaranteed logistics and purchase (USAID, 2022). Survey data from the farmers suggest that the main incentive for registering on ag platforms is to find new buyers – a factor cited by 20% of ag-platform users. This is

followed by access to advisory/extension services and information on prices and weather (15.7%), obtaining working capital or loans (14.3%) and access to better inputs (14%). Between 2014 and 2017, Uganda reported a 12% growth in digital payments, the highest in the region, followed by Kenya at 10% (World Bank, 2020).

3.1.3 Target agri-food sector value chains

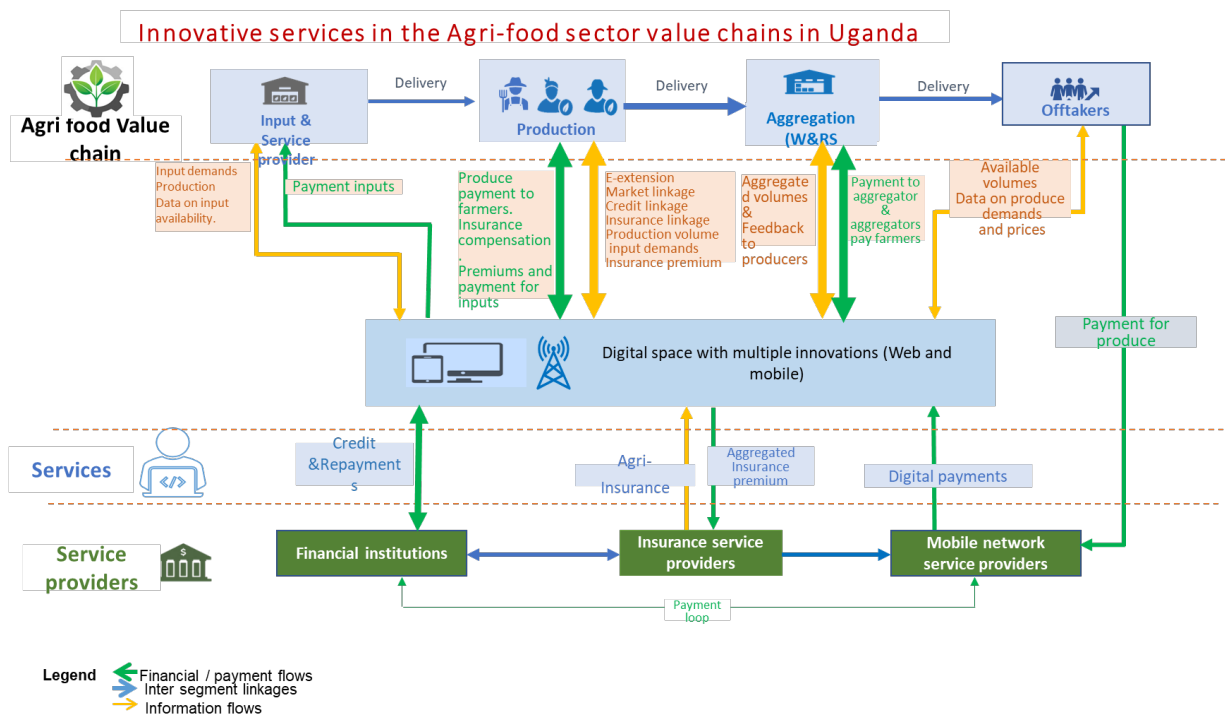
The findings of the study showed that both the value chain finance and logistics services operate in cross-value chains in the agri-food sector with some integrating crop and livestock value chains. Some innovations operate in similar value chains, such as perishable crop value chains while others operate in both the perishable and non-perishable value chains. For instance, City Coolers with the HVAC system innovation operate in crop and animal perishable products including; milk, fruits, vegetables, fish, and chicken value chains. For Agri-logistics, the value chains they operate in are determined by their purpose. In an interview with the agri-logistics representative, the key informant noted:

Our agri-trucking and courier services have been developed to aid quick, safe, and affordable transportation of Pulses Coffee being the major value chain, beans, maize, and soybeans. The reason is that they are less perishable compared to the other fruits and vegetables that require specialized cold trucks.

Similarly, the warehouse receipt system only targets specific value chains that have standards including coffee, milk, meat, beans, and rice for as long as they have storage mechanisms. On the other hand, dealing in agro-input supply and linkages, EzyAgric targets over 30 perishable and non-perishable crop and livestock value chains including; coffee, maize, tomatoes, chilli, bananas, cabbages, and livestock value chains to include; dairy, poultry, and piggery. Hamwe targets seven value chains including honey, sunflower, soya, beans, simsim and coffee.

3.1.4 The concentration of innovative services along the agri-food sector value chains

The study attempted to map the existing innovative services along a generic value chain to get an idea of the segments where they are operated and the value chain actors that are linked with these services. The results show that these services are mostly operating in the production segment targeting the farmers, and largely linking them to the agro-input segment. Digital platforms such as M-Cash, M-Omulimisa, the Digital Agricultural Reference Bureau (DARB), Agro Supply Ltd's mobile layaway platform, Hamwe's Buy and Sell digital platform and EzyAgric allow smallholder and commercial farmers, as well as the small-scale merchants subscribed to the platform to digitally purchase genuine agricultural inputs such as seed, fertilizers, agro-chemicals (pesticides and herbicides) and tools at an affordable price from certified bulk agro-input manufactures such as Bukoola and Grain pulse Ltd. The e-advisory, e-extension, agri-insurance and credit services were also largely targeted to smallholder and commercial farmers. Some of the platforms that offered e-extension include M-Cash, M-Omulimisa, DARB, Agro Supply Ltd's mobile layaway platform, Hamwe and EzyAgric. There were a few services that are extended to aggregation targeting off-takers. These services are provided by City Coolers Ltd, which deals in perishable products. For most produce aggregators, the services are largely the provision of market information focusing on available aggregation volumes. Farm Pass was the exception here as it in addition focused mainly on the output market. The existing services by value chain segment are illustrated in the figure below:



3.2 Benefits of the innovation to the agri-food sector value chains

The scoping study investigated the benefits that agri-food value chain actors derive from using the available digitally enabled digital services. Results from both the literature review and interviews with respondents revealed a wide array of benefits to farmers and agribusinesses in developing markets, fostering business performance improvements, increased financial inclusion, uptake of better agricultural practices and skills development; and allowing for more transparency and visibility for farmers (GSMA, 2017). Another benefit as revealed by the study relates to the linkages between and among the different value chain actors and support institutions. Specifically, the use of digital innovative services has: 1) increased access to markets for quality agro-inputs and services such as e-extension and agri-insurance; 2) Increased financial inclusion; logistics and traceability and profiling of VC actors. This section presents the benefits as observed by the innovative service providers, collaborators, agri-food value chain actors and the literature review.

3.2.1 Increased access to genuine, quality agro-input markets and services

Access to quality agro-input markets: The small-scale merchants of agro-input dealers as well as the farmers reported access to quality inputs to be a major benefit derived from using the technologies. This has largely been made possible because service providers/digital platforms such as Famunera, EzyAgric, Mykoop, MCash, M-OMulimisa, and Mastercard's FARM Pass that are involved in vending agro-inputs, directly link the farmers and small-scale merchants to reliable and certified manufacturers of these inputs. In addition to the linkages, the study also found that platforms such as EZYAgric also have access to information from genuine and reliable input suppliers. Platforms such as EZYAgric have also integrated a mechanism for accountability in case there are issues with the purchased inputs. In a key informant interview, a representative of one of the agro-input manufacturers using these platforms noted:

*The important thing for us is to see how we can help people get genuine agro-input product...I think counterfeits are one of the serious problems we have in this industry and even if you stepped out right now, it's very easy to come across one. And we thought working through EzyAgric and especially for people out there who want access but don't want to get into a market and get confused, EzyAgric provides an opportunity for them to purchase. It is traceable, and it is also easier to maintain quality through such channels because they also provide feedback on the products, **Key informant.***

Another key informant from an export association also noted:

*EzyAgric has helped farmer out growers' networks in the export crop value chains to get agro-inputs from genuine people. In case they get challenges with what has been supplied to them, they can trace back or report that the product delivered has some challenges and they are addressed. All this is possible because of ordering from genuine people, and this has been very helpful for the exporters, **Key informant.***

These digital linkages have greatly reduced the risk of obtaining counterfeit products by the users of these platforms as well as the clients of the agro-input merchants. This is an important benefit given the findings of a study that showed that the agricultural inputs sold at retail level in Uganda are often 'fake' or of very poor quality (Jakob Svensson and Tessa Bold, 2014). The merchants noted that access to quality inputs had enabled them to build trust among their clientele which in turn was helping them to develop their markets and fostering their business performance improvements. The merchants are also happy with the convenience associated with transacting on the digital platforms as indicated in the quote below:

*EzyAgric has saved us a lot...You place an order from your shop, and they deliver very good quality and genuine products, and you pay on delivery. This is very convenient, and their quality is guaranteed. Also, their prices are cheaper than those of wholesale traders in Masaka. I now only go to container village in Kampala when I need a lot and varied products, **A veterinary Centre merchant.***

Access to services: a range of services including those that were inaccessible to farmers like the agri-insurance services are now available through the digital platforms.

3.2.2 Insurance service

To insurance service actors, it was established that the innovations have created an existing linkage between farmers and insurance companies. The innovators blend and package insurance messages and products tailored to farmers in collaboration with insurance service providers.

*"..... We package an insurance service then collaborate with partners who are supposed to provide this service, collect the premium for us and get that service delivered to the target person..... **Key informant - Innovator**".*

To reinforce the assertions, the transition from cash transactions to mobile money allows for more secure, timely, and potentially less costly payments for farmers. Digital payments in turn can support the creation of an economic identity for farmers via transactional records from the sale of agricultural produce, which in conjunction with other data points (e.g., geolocation, farm size) open to full financial inclusion for farmers (access to credit, insurance and saving accounts). Similarly, the availability of digital

innovations has led to increased access to e-extension and advisory services thereby reducing transaction costs and time of accessing inputs and extension services.

Access to product market and market information

It was established that the digital platforms offer a one-stop centre where several value chain actors including financial institutions, insurance companies, input suppliers, producers, aggregators and off-takers aggregate data and access agri-food value chain-enabled information. Some digital platforms have a multitude of off-takers, for instance, MCash has at least 600 off-takers/traders who provide guaranteed and ready markets for farmer organizations such as cooperatives. Through such platforms, farmers have access to competitive markets which strengthen their negotiating power, reduce transaction costs and eliminate the reliance on traditional intermediaries. Enabling direct market access to farmers allows them to sell their products at better prices, hence increasing their income. The platforms allow farmers to transparently view prices, sell products, accept offers and connect with buyers. In addition to enabling these services for farmers, the platform creates new employment opportunities through farmer micro-collector agents to collect the produce.

Digital payments and financial service provision

The transition from cash transactions to digitally enabled services has allowed easy access to credit and digital payment services for more secure, timely and potentially less costly payments to farmers and farmer organizations. Digital payments in turn have supported the creation of an economic identity for farmers via transactional records from the sale of inputs, and agricultural produce, which in conjunction with other data points (e.g., geolocation, farm size) open to full financial inclusion for farmers (access to credit, insurance, and savings). Through innovations such as Farm Pass and YO! pay digital payment innovation hosted by CEDO, bulk and timely payments have been made to farmers and other value chain actors such as Agro input dealers and aggregators. It was established that the innovations provide for interactive operationalization where data can be migrated or exported from Farm Pass to YO! Pay for payments. The innovation also enables the service providers and host organizations to trace the financial recipients and conduct financial verifications and advances. This is evident in the narrative from the key informant.

“..... YO! pay and Farm Pass offers transparency because you get the messages, and you know who has received the money. It is safer than handling cash. Key informant”

“..... Carrying money in cash is risky but we used to call the VEAs to go the group, they would pick the money and first use them and tell the farmers that they have not yet paid us. But digital payments help us to pay the farmer individually because you might go out to the field and find people talking about CEDO badly that it does not pay them. Yet we paid them. But this digital platform has helped us that you are paying the farmer individually and on time.....” Key informant at CEDO”.

Cash, another digital payment platform links farmers, cooperatives and certified agro-input dealers that use the platforms to access quality inputs with pre-posted prices. The platform has at least 600 off-takers. Like the YO! Pay, the MCash platform support bulk payments to mobile money wallets and Bank accounts with transactions reaching out to over 1000 users in one batch. For cooperatives, this digital payment innovation supports the management of payrolls and the winning of allowances. Other platforms such as Bukoola, and EzyAgric use mobile network operators including MTN and Airtel money to receive payments for the inputs sold through their platforms.

From the perspective of financial institutions such as banks, it was established that the new and emerging innovations in value chain financing such as Cente mobile have reduced the service costs of the bank to farmers. Through the mobile Banking application and internet, farmers can make all transactions using their mobile app and digitally enabled devices with but not limited to agency banking and Mobile telecom supported (Mobile Money) services. In addition, financial institutions have also stepped up their role to collect the required data from farmers and reduced the transaction period for the credit products as emphasized and listed by the key informant.

*“...Under electronic financing, we have internet banking that uses a computer, smartphone, or other internet-connected devices. The main advantage here is easy account balance checking and convenience. The farmer does not need to go to the bank. Ease of paying and receiving money without necessarily going to the banking hall. A Farmer saves on transport costs. The service is secure, with no cash handling risk. The service is accessible 24 hours a day. Electronic bank statements are issued and require only access to the internet or banking network... **Key informant, Bank**”.*

Innovation such as MCash is regulated by the central Bank of Uganda which dictates prices hence guaranteeing the farmers of getting quality products without being cheated.

The innovation services have also provided opportunities for farmers to improve the post-harvest handling and management process through established systems such as the warehousing and receipt system where, individual farmers can access and utilize the services. Through the system, farmers can easily use the receipt system to access credit from financial institutions and use their products as collateral:

*“...The UWRS has a system through which quality is ensured by maintaining good post-harvest management. Produce received is weighed, cleaned, graded, and properly packaged before storage, ensuring that only quality product is stored, and procedures are in place to ensure that the quality of the product stays the same throughout storage in what is referred to as dependable commercial storage and warehousing...key informant **Warehousing and receipt system**. ”*

3.2.3 Data profiling and digitalization

Innovations in information profiling have eased data profiling and storage since most farmers have a tradition of memory and recall. As stressed by a key informant.

“ The information profiling tool here is used to collect information from customers and store it. Banks and clients require this information because farmers don't keep it. In this case, the bank uses this tool to collect authentic data which the Bank uses in decision-making. The bank is also able to manage its risk better for the customer when a knowledge bank is built for them. Under this, the bank takes care of two critical things. i) Affordability i.e., it is affordable to the customer, ii) Process - they are seamless so that appropriate products are given”

To ease farmer traceability in service provision, the innovations have provided an opportunity to aggregate and create evidence-based data on input service providers, producers, aggregators, and off-takers. A case in point, EzyAgric data from over 300,000 farmers, Layaway under Agro supplies limited has over 20,000 farmers and every year the number is doubling, every year most key performance actors are almost doubling, and the stockiest are also doubling each year. The availability of data on varied actors simplifies operations within the entire value chain. This was evident in the key informant interviews as highlighted in the narration.

*“..... EzyAgric helps us with two or three important; number 1; EzyAgric is helping us, especially in production. They are helping our farmers to capture data, and get the records done. You can feed in information and the information is stored. Number 2; you can trace back. Traceability is very very key for us in the export industry. In case something goes wrong even when everything is okay, you must look back to measure and look back and see what I do well so that you maintain it..... **Key informant**”.*

*“.....In case an order comes, people know that on these days, you have to go to Kampala, pick up the boxes and get the products; previously, people had to come to the office and pick up orders, but right now we have the phones which have the Apps, so we have most of the producers and the exporters on our WhatsApp group; information flows in, there’s the timely flow of information between producers and exporters..... **Key informant**”*

3.2.4 Logistics and traceability

It was established that transport, logistics and traceability services were being provided in collaboration with the EzyAgric innovation platform. To ease the logistical component, service providers such as Agri-Logistics courier and tracking services focus on low-cost tracking services for Agricultural commodities from farms and aggregation /warehouses in rural communities to the city consumer niches. The Agri warehousing component plays a central role as a digital marketplace where warehouse owners provide services according to the needs and time of the user. The most unique component is the collaboration that the innovation brings on board where the fleet owners now must work not in silos but as partners to ensure real-time tracking and tracing of agricultural produce movement during transit. The study established that the tracking and traceability innovation using the GPS software has been made easy especially where transport service providers own fleets and have the GPS installed as compared to where fleets are owned by third parties. In this regard, it was established that the current consumers of this innovation in the agri-food value chain include Rubanga cooperative society limited and Kibinge coffee cooperative society limited who consume about 55% while 45% is taken up by other institutionalized trading and aggregation agencies such as EM coffee traders, Gisha coffee limited to mention but a few. The innovation ensures the safe delivery of the transported produce as well as the traceability of its movements and source.

EzyAgric automatically captures farmer production details, seasonal transactions, and agricultural income data. These agricultural analytics are used by agribusinesses to provide better services and financial support (Catholic Relief Services (CRS), 2019). EzyAgric has over 60,000 registered farmers and has created over 480 jobs for youth in agriculture and ICT development (Krishnan et al., 2020)

In addition, SAP Rural Sourcing Management software digitally records information on producers, their farms, and communities at every level of the value chain and enables increased visibility, allowing parties to communicate with each other easily and quickly. Because of the software, palm oil farmers in Kalangala district can access the global market price for palm oil which enables them to accurately estimate their payment moreover since the transactions are digital, farmers get paid quickly (AGRA, 2019). Digital innovations have also shown great potential in fostering more inclusive participation in agriculture for disadvantaged groups. For instance, using GPS technology, Mercy corps has enabled refugees to access land outside settlements for farming by confirming the location and size of land holdings which incentivized landowners to allocate more land for refugees (CRS, 2019).

Also, E-Granary, a mobile platform, delivers economic and financial services to farmers in Rwanda and Uganda by creating a virtual space for brokering commercial partnerships and contracts between farmers, buyers, and input dealers in addition to connecting farmers with financial services at low transaction costs. The platform that is used by more than 38,000 farmers, almost half of which are women, works by securing supply contracts from large buyers and links them to producer co-operatives and community-based organizations that supply. The security of the contract enables producer organizations to get affordable credit, insurance, and certified inputs, protecting them against production risks like drought or pests and disease while leveraging their collective strength (GAFSP, 2021). AgriShare is another app that enables hiring or renting out agricultural resources between farmers and equipment manufacturers securely and with ease. It supports farmers to locate farming equipment in their areas and hire their farming equipment out to other farmers (<https://www.agrishare.app/>).

Further, major financial institutions have also come in to promote digital innovations aimed at increasing farmers' livelihoods. One Farm Platform operated by Stanbic Bank Uganda Limited is a data-driven digital solution that creates business linkages within the agribusiness ecosystem, especially between smallholder and enterprise service providers like banks, insurance companies, exporters, and manufacturers. The platform summarizes data relating to location, acreage, and inputs to prepare data profiles of the farmers which are then aggregated to estimate total production in each area and shared with off-takers or SMEs and other service providers. The platform users benefit through categories like **Lend** which is for credit, including farmer production loans and value chain financing, **protect**: which is savings and insurance currently weather-based index, and **Trade**: which is the linkage within the marketplace, allowing SMEs to tap into the out-grower database. It includes a digital marketplace, **growth** focuses on increased access to agronomic services and **Share**: which involves reaching out to communities with available food to feed the hungry (Business info hub, 2021). Other digital platforms used in agriculture in Uganda are summarized in Table A1 in the Appendix.

Digital financial services also enable electronic transactions including digital payments, and access to credit, savings, and insurance. While there are over 30.74 million registered mobile money accounts in Uganda that contribute to increased mobile money transactions¹, there are about 5 million registered accounts in traditional banks (GSMA Uganda, 2019; Deloitte, 2022). The accounts are linked to mobile money platforms, which provide peer-to-peer (P2P) remittances, and airtime top-ups, but have evolved to enable access to more complex financial products, such as savings, credit, insurance, and person-to-government (P2G) transactions (GSMA Uganda, 2019). These developments have led to an increase in digital commerce or e-commerce platforms like ride-hailing and courier services. However, the growth of digital entrepreneurship in Uganda is still in its early stages with few firms and public sector institutions embracing digital platforms. Uganda ranks 105 out of 152 countries in the e-commerce index of the United Nations Conference on Trade and Development (UNCTAD, 2018).

¹ Two mobile network operators (MNOs) (MTN and Airtel), account for more than 90% of all digital financial transactions, through their MoKash savings and loan service (MTN/Bank of Africa) and the Wewole microcredit service (Airtel/JUMO). Agent banking has also been introduced, and banks have been establishing their own agent networks to take advantage of mobile banking. Century Bank and Equity Bank have been pioneers in this, with other banks following (DFI, 2019)

3.3 How the innovations are addressing gaps in financing and logistics.

The results showed that innovations in Agri-food Value chain financing (AVCF) enable actors to capitalize on the strength and relationships within the agricultural value chains responsible for bringing agricultural products to the end users. While digital innovations simplify or accelerate communication, information sharing and financial transactions, expanding the digital frontier among agri-food value chain actors along the agricultural value chain from rural areas of production to aggregation and off taking, requires adopting new competencies and developing expertise in mobile and online platform development, interactive design, data capture, data management and analytics which are often lacking in the operational silos. In response to this need, agricultural value chain players have come up to exhibit a degree of openness to, and actively seek partnerships to leverage complementary skills and capabilities. This is evident in case scenarios where Grain pulse, Agri logistics courier services and Famunera partner with Ezy Agric to share and manage data.

The study revealed that there are multiple players involved in each offering at every value chain segment. These players include MNOs, third-party technology providers, service providers like insurance companies, financial institutions mainly Banks; transport and logistic companies, such as Blue Nile transporters, Amitrack, City Coolers that offer cold chain services and Agri tracking companies such as Agri logistics courier tracking services. All these require synergies to operate efficiently and effectively. To this notion, financial service providers have a significant role to play in the provision of financial services to various value chain segments in the agriculture sector. Should banks and insurance companies shun partnerships in favour of a “go it alone” approach to building and deploying their products, they may fall short of their commercial objectives because of the specialized skills and capabilities as well as the need to understand a complex sector.

Whereas mobile network operators with digitally enabled services form the basic blocks for Agri-food value chain financing and logistics, multiple innovations addressing gaps in the agri-food value chain segments have emerged. These include e-extension and advisory services for smallholder farmers, e-profiling of farmers to manage and store digitalized data on Agro inputs, production, aggregation/warehouse receipt system and off-taking. Some innovations have tools to create digital profiles for farmers, trace and track farms and product flow and provide timely analytical data. Actors within the Agri-food value chain systems interested in innovations can choose to operate with different service providers, such as specialized technology providers. MNOs have also started to cater to the needs of enterprise customers in the agriculture sector.

e-extension services: This study identified several innovations that provide e-extension and advisory services to farmers to increase access to information and productivity. It was established that the innovations leverage a wide range of technologies from mobile applications to USSD services to provide a variety of digital solutions that among others include connecting farmers to inputs providers and credit from financial institutions, provision of index-based agricultural insurance solutions to farmers and linking farmers to extension agents along the agri-food value chains. Results indicated that the service providers have established a value proposition that involves the use of USSD solutions for farmers without internet connections and accessibility, android-supported devices, mobile-based extension, voice calls and a remote managed digital solution to financial credit and payment options for smallholder farmers and other players in the agri-food value chain system.

Digital payment, credit, and financial service: It was established that the smallholder farmers (SHF) in Uganda operate in an informal nature. This makes them ineligible for formal financial services. SHF is characterized by poor business practices such as record keeping, and financial management that make creditworthiness assessments more challenging and a major obstacle in accessing finance from formal financial institutions. In addition, smallholders have low-valued traditional collateral assets to secure formal financing services for timely investments into their initiatives to enable them to grow. In addition, it was established that some barriers such as lack of formal IDs, low financial literacy and limited geographic access to formal financial institutions contribute to a sum of barriers that farmers face in the bid to access finance. To their rescue, a greater percentage survives through village savings and loan associations (VSLA), rotational saving groups (ROSCAs) and member-based cooperatives. Despite this, formal credit still forms an important requirement for farmers to significantly grow their businesses. These are being addressed through profiling of farmers and getting basic information through digitally enabled platforms like the Digital Agricultural Reference Bureau that offer linkages to financial institutions as well as those used by financial institutions such as Centenary bank.

Production data or the biodata of the farmers; across all innovations sampled, the results revealed that the gap is being addressed by the development of data collection applications that has GPS embedded in them. Purposely to gather information on acreages, cultivars, location of the fields, quantities and qualities being produced, and the management practices employed including the soil textual type. Some of those apps include production data in My KOOP, Farm Pass, EzyAgric, and DARB among others. All these are developed to make farmers bankable without collateral like car manuals and land to be able to access agricultural credits.

Market Gaps; The finding also showed that their digital innovations such as Mykoop DARB, EzyAgric, Farm Pass, Master card farmer network, and M-cash, among others provide a digital agricultural marketplace for inputs and produce for the agro-dealers, farmers, and the off-takers. In that, a farmer can search for inputs and purchase from the platform. The off-takers can aggregate the quantities of products available for off-take from the collection centres.

Payments; handling physical cash associated with the risks of loss, robbery and theft along the way is being addressed by digital payments. All the transactions can now be done either by use of mobile money or the e-wallet transfers like it is done by cash, YO! pay and Cente mobile where farmers access inputs digitally and make digital payments for the inputs. It also has a component of savings where the farmer can save for future purchases from their e-Wallet accounts. Additionally, the gap in information such as market information is also being addressed by innovations by making the digital space a one-stop centre for market information. With bundled services, financial institutions and logistics service providers find the linkages more appropriate and less cumbersome.

3.4 What are the opportunities and challenges experienced with the existing innovations?

Several challenges and opportunities were established along with innovations in the agri-food value chain system. These ranged from the design point of view to infrastructure challenges as shown in Table 2. Key among the challenges was the use of uncommon symbols and old information in the system that is not regularly updated. Besides, some digital platforms have long dropdown menus that make it difficult for the farmer to make selections. It also emerged that the language used on the platforms is mostly English, yet the great majority of potential and actual beneficiaries have basic education with

basic knowledge of their local languages. In terms of infrastructure, it was established that unstable mobile and internet networks affect the use of these digital platforms, especially in rural areas. Additionally, the high cost of running the servers and the inaccurate Geo physical locations of the farmers posed great challenges as indicated in the table below.

Table 2: Challenges experienced with the existing innovations.

| Design issues | Infrastructure Issues | Others |
|--|---|--|
| Uncommon symbols e.g., Cart symbol | Unstable internet and poor electricity distribution and access in the rural farming communities High costs of running the servers which are used to support the platform | Lack of trust hindering digital payments Limited knowledge about the use of USSD codes, mobile applications, and the low prevalence of smartphones in rural farming communities |
| Un updated Information especially Market Information | Inaccurate location Information-affecting weather information | Limited awareness of the available services by the farmers |
| Long drop-down lists and no filters-takes time to transact e.g., locate the name | Mobile money challenges transactions involving large sums of money as mobile money has limited amounts. | Delayed payments, and breakdown of the digital systems |
| Apps load for long | | Very few regular users which affects the sustainability of the platform |
| Limited language options-use of difficult English words | | |

The challenges highlighted in Table 2 were presented to stakeholders during the validation workshop for this scoping report. The stakeholders were then asked to list additional challenges not captured and rank them in order of need to address. The results of the ranking exercise are depicted in Table 3.

Table 3: Ranking of challenges in order of need to address.

| CHALLENGES | High need to address | Medium need to address | Low need to address |
|--|-----------------------------|-------------------------------|----------------------------|
| Infrastructural | | | |
| Mobile money challenges; transactions involving large sums of money | 11 | 3 | 3 |
| Inaccurate location information affecting weather information | 7 | 7 | 0 |
| Unstable internet | 7 | 4 | 8 |
| Design Issues | | | |
| Use of uncommon symbols e.g., cart symbols | 0 | 2 | 9 |
| Limited language options; Use of difficult English words. | 3 | 6 | 6 |
| Outdated information especially market information | 6 | 5 | 3 |
| Apps load for long | 9 | 9 | 1 |
| Others | | | |
| Past experiences; delayed and breakdown of system | 6 | 5 | 4 |
| Limited awareness of the available services by the farmers | 11 | 1 | 2 |
| Lack of trust hindering digital payments | 4 | 8 | 3 |
| Very few regular users; issues of sustainability | 6 | 9 | 1 |
| Industrial policy | 9 | 6 | 0 |
| Taxation policy | 9 | 6 | 0 |

The stakeholder reasons for the ranking of the challenges in Table 3 were as follows:

Taxation challenges: Multiple taxation seriously hampering the success of digital apps since URA doesn't understand how they operate, and it becomes hard to identify which of the digital services offered qualify for VAT, pay as you earn, and annual tax returns and which ones are tax exempt. This calls for a need for policy advocacy to harmonize taxation. Sadly, tax exemptions are given to big foreign investors ignoring local startups, yet taxation increases the cost of doing business. Poor tax policies are the major reason behind the collapse of most digital platforms.

Lack of an Industrial policy: Just getting trading licenses is hard since authorities find it hard to classify the type of business digital platforms. For instance, for the case of Agri-logistics this is always raised "Are you an agricultural trader? Are you a logistics company? What are you? because the KCCA industrial policy doesn't account for that."

"So even when filing tax returns, you have to file something for logistics, then file something for agriculture because the taxation policy also doesn't cater for that so we end up being taxed multiple times"
...Workshop participant

Transportation policy: Also, transportation policy doesn't cover the transportation of agricultural commodities, so drivers are never sure of which documentation to carry to inform officials that they are transporting agricultural commodities.

"Even the merchants are not sure of the quality requirements when dealing with agriculture produce and that is why you can find coffee being transported on open trucks leading to contamination."...Workshop participant

Mobile money challenges: High transaction costs increase the cost of doing business limiting the penetration of digital payment platforms.

"If you to transfer money from the bank account to your mobile money wallet, you can be charged about UGX 8000, yet you will have to incur extra costs when withdrawing the money from the mobile money wallet." ...Workshop participant

Due to high costs of mobile money transactions, farmers resort to handling hard cash and such are easily making unplanned expenditure in addition to the security risks associated with moving with large sums of money.

Use of uncommon symbols: Each app developer wants to appear unique so they end up creating many symbols for the same commodity moreover the numerous variations in similar local items like baskets that can be used as symbols creates a selection dilemma.

"Ministry needs to have a clear position on the symbols to use to represent the different agricultural tools." ...Workshop participant

Limited languages it is very expensive for the private developers to translate information into the many languages in Uganda and that is the reason why some have tried and focused on the major languages based on region.

Limited capacity phones Some phones cannot support certain applications and the use of some innovations.

“Some smartphones cannot support certain technologies “Even the lowest version of Android in ITEL cannot run an app efficiently. For example, if you try to initiate a payment but with several apps like WhatsApp, Facebook running in the background, the small storage on the phone is overstretched slowing the process down considerably.” ...Workshop participant

“App developers increasingly adopting more advanced technologies to increase security for the app users, and this calls for more sophisticated mobile devices for the apps to work efficiently” ... Workshop participant.

Other challenges highlighted by workshop participants include:

- Outdated information especially market information, this is because the cost of collecting market information is high leading to delayed updates on the mobile apps.
- Farmer’s demand accurate market information but only a few are willing to pay for that information.
- Developers normally copy symbols that are available on the big markets, for instance adopting symbols that are used on Amazon like carts to symbolize similar items on the local market. This poses challenges to farmers.
- Farmers can be aware of the digital app and are willing to use it but lack the capacity to purchase digital services offered by the app in the absence of a funder. As innovations are promoted on the farmers’ side, it is important create a mindset change to ensure that farmers embrace personally paying for digital services and avoid expecting external funding for those services.
- Some challenges are beyond the developers e.g., updating weather information might necessitate getting GPS coordinates to the parish level which is extremely expensive.
- Farmers only appreciate insurance when a calamity befalls them but are never interested before the calamity.
- Developed apps at times don’t work out in field as they do during development which call for constant improvements.

The literature review also revealed additional challenges: Among the existing e-commerce platforms, the majority cannot complete payment transactions digitally with most transactions ending up in cash-on-delivery or mobile money payments on delivery. The challenges contributing to this trend are low integration of e-commerce platforms with bank and card payment systems, lack of trust between vendors and buyers, and lack of efficient recourse mechanisms in incidences of fraud. Also, e-commerce is largely driven by internet usage which may explain its concentration within Kampala where smartphone concentration is highest. Managing these limitations will be important for the successful large-scale adoption of e-commerce across the country, and key pieces of legislation (especially on cybersecurity and cybercrime, data protection, and protection of critical information infrastructure) and their implementation will need to be strengthened (World Bank, 2020; Deloitte, 2022).

In addition, although there has been an increase in mobile money transactions, customer savings and lending within the banking and microfinance sector have not increased partly due to the poor savings culture in Uganda coupled with high-interest rates on existing services (Deloitte, 2022). The share of savings in GDP was 22.2% in 2020, having reduced from 22.7% in 2019 (Deloitte, 2022). In terms of remittances, mobile money has paved the way through the provision of basic money transfer and payment services to the unbanked population. This has caused a revolution by offering a safe, secure, and relatively cheap way of transferring funds. As a result, historical challenges, such as long waiting periods and high transfer fees have been reduced. Mobile money has had a positive and significant effect on remittances, which explains why mobile money currently dominates remittances in Uganda (Deloitte, 2022). In terms of insurance, insurance tech companies are very nascent and face challenges, such as low levels of awareness and uptake of their products, especially in rural areas (Deloitte, 2022). FSD Uganda (2018) found that about 11 million adults are uninsured (59% of the adult population) and 7.4 million adults (40%) rely on informal insurance, such as saving groups, burial societies, SACCOS and community health.

Around 20 million Ugandans have a mobile subscription, representing 44% of the population (Uganda GSMA, 2019). This is a much lower share compared to other African countries, such as South Africa (83%) and Kenya (87%) (Gillwald et al., 2019). Nearly half of all mobile subscribers (10 million Ugandans) accessed mobile internet services² by June 2018, which represents a penetration rate of about 23%, compared to less than 1% for fixed-line internet connections (Uganda GSMA, 2019; UNCTAD, 2018). A gender gap in internet use estimated at 25% exists between men and women and is mainly influenced by the lower socio-economic position and education levels of women (Gillwald et al., 2019). The poor internet penetration rate is reflected in the Inclusive Internet Index which ranks Uganda 83rd out of 100 countries (World Bank, 2020). Affordability remains one of the main barriers to mobile broadband use, with the most digitally excluded market segment in Uganda being female refugees (World Bank, 2020; Niras, 2022). Gaps in broadband access coupled with low smartphone penetration also limit the range of innovative digital solutions that can be delivered through mobile phones (Niras, 2022).

Apart from mobile phones, digital commerce platforms e.g., ride-hailing, and courier services have increased, but the growth of digital entrepreneurship in Uganda is still in its early stages with few private and public sector firms and institutions embracing digital platforms. The Ugandan Rapid eTrade Assessment (2018) conducted by United Nations Conference on Trade and Development (UNCTAD) identified the cost of ICT adoption and maintenance, low digital skills, and low capacity to manage e-commerce logistics as some of the key barriers for entrepreneurs to adopt e-commerce (UNCTAD, 2018). The majority of the few existing e-commerce platforms cannot complete payment transactions electronically with most transactions ending in cash-on-delivery or mobile money payments on delivery due to low integration of e-commerce platforms with bank and card payment systems, lack of trust between vendors and buyers as well as lack of efficient recourse mechanisms in incidences of fraud. Hence, various important pieces of legislation, for instance, on cybersecurity and cybercrime, and data protection need to be strengthened and enforced (World Bank, 2020; Niras, 2022).

² Of those who have access to the internet, social media consumption (83%), internet-based telephony (39.6%) and academic work (20.4%) are the leading use cases.

3.5 Opportunities for innovation expansion in the Agri-food sector

Since most of the rural farmers use non-android phones, there is an opportunity to popularize simple digital innovations that use USSD and SMS services. It was also established that there is a huge potential for untapped insurance services that providers and other market players can tap into. In terms of design, the innovation needs to be improved to become more user-friendly to bring on board more clients. There is an opportunity to leverage the existing innovations and MNOs to advocate for better internet and digital infrastructure in the catchment areas, besides the integration of insurance services into bundled services. The catchment area and potential clientele are big but need more awareness creation and marketing of the innovation. There is an opportunity to invest in cyber security in developing the innovation to become a more trusted venture for multiple players in the market such as financial institutions. Some potential partners need a thorough understanding of how the innovation contributes to the organization's development, an area that is still deficient. The digital market space is broad, and the innovation could be upgraded and expanded and customized to accommodate the entire value chain process.

The ICT infrastructure in Uganda is unevenly distributed with significant gaps between rural and urban connectivity. Communication infrastructure (e.g., network coverage and broadband services) is established in urban centres, but rural areas, especially the northern part of the country, and more than one million refugees and host communities have poor or no connectivity (World Bank, 2020). Limited access to electricity is a major cause of the discrepancies in urban–rural Internet use and mobile phone penetration rates in Uganda (Gillwald et al., 2019)³. Yet mobile technology is at the heart of the digital transformation in Uganda as in most parts of sub-Saharan Africa (Uganda GSMA, 2019). Other ICT tools are also used to access digital services, but they are not widely used as mobile phones. Mobile phones are the primary form of internet connectivity and have become a suitable medium of communication and a host of software applications through which various services from different sectors (agriculture, health, education, finance, and entertainment) are delivered.

3.6 Employment and income opportunities within the agri-food sector, particularly among women and youth.

In terms of Gender and uptake of digital payment services, the FSD Uganda (2018) found that men are more likely to use digital payments than women, as women are less likely to have digital payment accounts. In addition, women are less likely to learn how to use new technology than men and are also more likely to prefer dealing with people than technology when making payments. According to the study, women prefer cash to digital payments compared to men. The study also revealed that 47% of the youth in Uganda have a digital payment account, slightly more than 50% use a digital platform for remittances, about 30% use the platforms for the payment of goods and services, and less than 10% use a digital platform for bill payments.

³ Only 18% of households in Uganda have an electricity connection, with an urban–rural electricity gap of 85 percent (Gillwald et al., 2019). The cost of extending digital services to rural communities are prohibitive for the private sector because of the low purchasing power of rural communities on private sector products and services.⁴⁴

Financial services can be classified as formal or informal. Formal finance is capital or money sourced from banks and other formal financial intermediaries, while informal finance is money sourced from friends, family, relatives, or private moneylenders (Elston et al. 2016). In Uganda, the use of formal financial services is largely restricted to payments (53% of women versus 62% of men) and savings (15% of women versus 22% of men) services. Around 5% of Ugandans rely on formal credit (4% of women versus 5% of men), while only 1% of both men and women use formal insurance services (FSD Uganda, 2018). Most Ugandans rely on informal services for savings, credit, and insurance, with more women using informal financial services compared to men. For instance, 30% of women versus 24% of men use saving services, 24% of women versus 21% of men use credit services, and 43% of women versus 38% of men use insurance services (FSD Uganda, 2018). These payments, whether formal or informal typically takes place in cash or digitally.

The barriers to accessing formal financial services include lack of formal identification, low financial and digital literacy, limited access to formal financial institutions, limited affordability of services, insufficient money to justify the use of formal services, and high cost of mobile devices are among barriers to accessing formal financial services (FSD Uganda, 2021). The perception that financial services are expensive is also a key barrier to financial inclusion for both males and females (FSD Uganda, 2018). Nearly a third of financially excluded men and excluded women believe that financial services are expensive. Other barriers cited included travel distance and a lack of belief in the value offered by financial services.

3.7 The policy environment for innovative services

The literature review found that there is high-level policy recognition of the importance of the digital economy and the need to create a conducive enabling environment. For instance, the National Information and Communication Technology (ICT) Policy (2014) aims to transform Uganda into a knowledge society by 2025, with ICT at the centre of all aspects of life (MoICT and NG, 2014). Uganda's National Development Plan III also envisions digital transformation as a crucial enabler and amplifier of inclusive social and economic growth (NDP III, 2020). In 2019, Uganda's GDP grew by 6.5% and while the ICT sector itself accounted for about 2% of GDP, it was a key driver of growth across the wider economy through its role in financial inclusion, expansion of digital services and products, and access to productivity-enhancing technologies and platforms (World Bank, 2020). Uganda's Vision 2040 also identifies ICT among the key fundamentals and an opportunity to spur Uganda into a modern and prosperous country. Uganda also has the Digital Uganda Vision, which aims to align ICT investments in various sectors to improve the country's ICT infrastructure for purposes of attracting investors and transforming Uganda into a digitally enabled society that is innovative, productive, and competitive (Gillwald et al., 2019). The Digital Uganda Vision provides a primary framework that responds to the national Vision 2040 by providing a unified ICT policy direction (Gillwald et al., 2019). Some of the main pieces of legislation passed to support the development of the digital environment in Uganda include the National Information Technology Authority - Uganda (NITA-U) Act 2009, Electronic Signatures Act 2011, Electronic Transactions Act 2011, Computer Misuse Act 2011, Uganda Communications Act 2013, Access to Information Act 2005, Data Protection and Privacy Bill 2019, National Payment Systems Bill 2020, Approval of 'communal access' licensing category (World Bank, 2020).

The interviews revealed that the development and implementation of innovative services are guided by agriculture, trade, and ICT Policies. The Ministry of Information and Communications Technology

through the Uganda national council of science and technology, Uganda communications service oversees the national science and technology agenda, especially areas of research and innovation in Uganda. It, therefore, plays an important role in the implementation of ICT policy in the areas of the innovation field under its mandate. The ICT policy on agriculture provides for the systematic sharing and dissemination of information on agriculture, animal husbandry, fisheries, forestry, and food security using ICTs. This is to provide ready access to comprehensive, up-to-date, and detailed knowledge and information, particularly in rural areas; and Promote Public-Private Partnerships to maximize the use of ICTs as an instrument to improve the whole agricultural value chain, both in quantity and quality.

“..... In linking farmers to agro-inputs such as fertilizers, we are cognizant of what the fertilizer policy provides, and we just follow that for example issues of quality, Innovative service provider.....”

The other one is the Uganda National Fertilizer Policy (NFP) which brings together all related fragmented regulations into a single and comprehensive policy framework on fertilizer. In the past, the Government served as the central agency responsible for fertilizer importation and delivery to designated points in the country, until the liberalization policy was adopted in 1990. During this period and thereafter, there have been policy and regulatory frameworks to control agricultural chemicals. Currently, the law in place is the Agricultural Chemical (Control) Act, 2006, which controls and regulates the manufacture, storage, distribution, and trade in, use, importation, and exportation of agricultural chemicals. Besides the National fertilizer policy, there is also the cooperative act and regulations that regulate the operations of farmer organizations and most especially cooperatives in Uganda under the ministry of trade, industry, and cooperatives. The innovations are also governed and regulated through the Warehouse Receipt System Act of 2006 (WRS Act, 2006) and regulations there of 2007. Section 3 of the WRS Act, 2006. Last but not the least, the interaction with MNOs is guided and regulated by the National Payment Systems Act. According to these laws, the Bank of Uganda assumed full responsibility and mandate over the regulation of mobile money services in Uganda. Therefore, any transactions via MNOs must be conducted within the regulatory framework.

3.8 Promising innovations or innovation packages for scaling

The scoping study collected data to test the criteria suggested for the identification of promising innovations for scaling. In this section, we explain the suggested criteria and based on the collected data show how the innovations considered to be promising compare with the rest. The 9-part criteria included: 1) Category of the innovation; 2) No. of services bundled on the digital platform; 3) Salient features of the innovations; 4) No. of agri-food value chains and geographical of operation; 5) Gender and Youth responsiveness; 6) Sustainability; 7) Size of the business; 8) Clear future; and 9) Level of scaling readiness. In the following subsections we discuss these criteria.

3.8.1 Category of the innovations

This criterion links to the objective of the work package that seeks to identify innovations in the two categories of: 1) finance and 2) logistics. It sought to ensure that the promising innovations are in these categories. Based on the literature review, it was established that the innovations in the finance category can be further broken down into those focusing on the agricultural inputs side of the value chains and those focusing on the output side. This criterion thus, was useful in ensuring that the identification and eventual selection of the potential promising innovations considered these categories and the sub-

categories therein. The scoping study identified innovations in all the suggested categories and sub-categories and with the majority of the existing innovations focusing on the agricultural input side. The innovations in the logistics category were fewest with each having a uniqueness with regard to the services they offered. The existence of multiple innovations in the category of finance made comparability possible.

3.8.2 Number of innovative services bundled.

With a focus on innovations that bundle various services, this criterion seeks to assess the diversity of services that can be accessed on a single digital platform. The findings show that most of the digital platforms included in the study bundled various services. On average, the platforms bundled 3 services ranging from 1-7 services. The value chain finance innovations bundled more services compared to the logistics innovations in which the highest bundled services were 3. The services that were considered during selection in the value chain finance category included; digital payments, agri-insurance, savings, and credit, e-extension, e-advisory, e-KYC and market linkages. For the logistics the considered services were; HVAC system, agri-trucking, warehouse e-receipt system and linkages to warehouses. Based on these results, this selection criterion ensured selection of promising digital platforms that bundle at least 4 (above average) in the value chain finance category and at least 2 services in the logistics category.

3.8.3 Salient features of the innovations

This criterion considers the uniqueness of the innovations, and it arose from the questions such as, “*how is an innovation described in the context of the study?*”, “*What qualifies a service to be considered innovative?*” To try and integrate answers to these questions in the selection criteria, the scoping study sought to ascertain from the service providers the features that they consider salient about their innovations. With this question, the service providers were required to examine and rate their innovations vis-à-vis other similar innovations and identify the features that make their innovations unique. A list of diverse features was listed by the service providers ranging from system design characteristics, work principles and the mode of operation (Table 4). In general, the innovations in the logistics category identified their uniqueness in terms of their mode of operation. Given the diversity generated and challenges of comparing the innovations based on the salient features, this criterion was not emphasized in the selection of the potential promising innovations.

Table 4: Salient features of the existing innovations

| System Design | Conceptualization/ Guiding principles | Mode of operations |
|---|--|--|
| The layaway payment system –convenient saving for seed | Farmer-centric thinking | Affordability of services |
| Linking physical agronomy trainings with the digital e-learning platforms | Business mind | Delivery of end-to end services-collaboration with research and other institutions |
| Number of services bundled and accessed. mechanisms-languages available | | Reliable services, swift and less bureaucracy |
| E-receipt system | | |
| Real-time tracking and tracing of fleets | | |
| Profiling production data-targeted | | |
| E-wallet customized to services like agent banking, e-voucher | | |
| Ability to accommodate huge traffic | | |
| Auctioning mechanism-truthful bidding using algorithms | | |

3.8.4 Agri-food value chains and geographical area of operation

This criterion draws from the study objectives that focus on innovations in the cross-agri-food sector value chains. It seeks to qualify the promising innovations based on the number of agri-food sector value chains that they operate in. The criterion on geographical area of operation, seeks to ascertain the scope or coverage of operation and to provide a basis for verifying other criterion such as that on scaling readiness. The scoping study found some innovations (largely not bundling many services) operating in single crop value chains targeting largely the farmers and on a much smaller scale. Most of the innovations were bundling an average of three services and operating in an average of five agri-food sector value chains, ranging from 4 to 30 value chains. Based on these results, the criterion on the number of agri-food value chains considers innovations targeting at least 6 (above average) value chains to be promising. Regarding the geographical coverage, the scoping study found that geographical coverage for the bundled innovations ranged between 3 and 57 districts. The average number of districts operated in was 14. The innovations that were operating under government support were operating a significantly higher number of districts. For instance, MCash was operating in as many as 57 districts across the different regions. The discussion during the feedback workshop with stakeholders also advised that this criterion be considered with caution as some developers have no power over the geographical coverage of the innovations since this is mostly influenced by the funders and partners. As such, the criterion on geographical coverage considered selection of innovations operating in at least 10 districts.

3.8.5 Gender and Youth responsiveness

Given the social equity objectives of the work package with particular focus on youth and women inclusion, this criterion considered innovations that made deliberate effort to ensure uptake by users including women and /or youth. The scoping study showed that most of the innovations did not make any deliberate effort to integrate women and youth as their focus was business. During the feedback meeting, discussions around women and youth integration revealed mixed feelings with some participants being pessimistic and while other were optimistic. On one hand, some reported working with the youth as agents but as a default, no deliberate action was taken while the other reported challenges. For instance, one participant noted that dealing with youths was challenging given that they are very mobile which makes it hard to trace them during subsequent meetings. The youth were also noted to be unreliable being susceptible to taking up new enterprises at any time without notice which can disqualify earlier agreements you had with them and sometimes cause financial loss.

You can leave gadgets like phones with the youth as agents but by the time you return, you are told that they got job in another location, and they went with the phone. It becomes very difficult to trace them as they can even move to regions that are very far like Arua, meeting participant.

Regarding the women one respondent noted that they have found it very hard to recruit women even when they set to work with them for instance as agents. One of the hinderances relates to cultural norms that limit their mobility and decision-making abilities. Another feedback meeting participant also noted,

In most instances, it is the men who control resources and make decisions on resource utilization at household level and as private developers, we are inclined to develop products that meet the needs of this segment before thinking of the needs of other users.

In consideration of these results, the criterion on gender and youth responsiveness was not emphasized in the selection of the promising innovations.

3.8.6 Sustainability of the innovations

For this criterion, sustainability is considered as the ability of the innovation to be self-reliant, make profits for the expansion of the innovation and improvement of its efficiency and effectiveness. This criterion rates the innovations in terms of how the innovations make money to be self-sustaining. The scoping study identified 4 models that were being used by the innovations including. 1) commission-based model; 2) payment for and subscription services model; 3) donor/government support and 4) combination of models. The operations of the commission-based model include acting as agent banks and earning a percentage on every transaction carried out. The percentages earned as commission range from 2 to 30 %, depending on the service offered. Some innovations offer marketing services for agro-based partners/dealers and insurance companies to generate revenues, and for instance for every Kg of inputs sold through the digital platform, the service provider earns a commission of between UGX 500 to 1000. Also, when an insurance policy is sold, the service provider earns a commission from the insurance company. For the logistics service providers, a commission is earned from linking the fleet owners with the customers. One service provider noted:

We earn a 20% margin from the fleet owner because we're giving them business by connecting them to the customer.

Another service provider explained,

We get our percentage when farmers make orders, for example, for tractor hire service, let's say a tractor hire is 80,000 in Oyam, we give the owner a charge of 70,000 or 75000. We then use the 5000 to give a commission to the digital agents who got the orders, and we give some little money to the cooperatives and we as HAMWE, we take about 50%

For the innovation operating on grants, they largely rely on donor support to cover their expenses, and when the grants are no longer available, the innovations come to a halt. Some innovations were found to be self-funding- the proprietors investing to ensure sustainability and effective flow of operations. Other innovations were operating on subsidy-based model where they enter a contract with other development partners, who meet part of the cost of the services given to the farmers, and the farmers also pay the remaining portion.

One thing we do is share costs with these organizations so that we can get some small money to keep offering these services, and that's basically how we survive.

With the payment/ subscription model, the innovations charge the users for the services they access. Payments are largely made in form of monthly or weekly subscriptions. Examples of paid for services include weather information, market information, and extension services in form of online audio-visual training. Some innovations such as M-Omulimisa are directly engaged in business through buying and selling inputs to farmers, and the profits from the business are used to sustain the innovation. Some innovations were found to be using a combination of these models, for instance innovations such as M-cash were benefiting from government support but also had a business arm that was commission-based. Considering these findings, this criterion considered innovations that were commission-based, operating on the payment/subscription model, proprietor funded and engaged in business to be sustainable and thus qualifying to be rated as promising for scaling.

3.8.7 Size of the business

This criterion assesses the capital investment of the innovations alongside the number of people that are employed by the innovation companies and the number of clients registered on their digital platforms. The scoping study found that capital investments for the innovations ranges from USD 7000 to 2.5 million (table 3). For the staffing, the range is between 4 and including the field agents. The innovations have between 1000 and 5000 registered clients with some reporting daily site visit of about 200 clients. However, some service providers were not comfortable providing information on their capital investments.

Table 5: Capital investments for innovations

| Innovative Services | | Capital investment level |
|---------------------|--------------------------|--|
| 1 | M-Cash | Over 1.4 billion UGX |
| 2 | Kuddu | based on research grants and was yielding over USD. 2million. |
| 3 | Axiom Zorn | |
| 4 | EzyAgric | started from zero then went to 50,000, then declined to 20,000 then came back to 100,000, went to 200,000, then went to 2 million now right now we are talking about 5 million dollars |
| 5 | M-Omulimisa | |
| 6 | Agri-logistics | The business investment has grown up to \$ 50000. And this comes through a Venture Capitalist funds. The human Resource team is made up of 4 members now |
| 7 | Agro-supply | |
| 8 | City Coolers | The Construction of a cold room requires a minimum of UGX 50 million and that's for a small room. For hire services, the company normally put a charge of ugx 50/= per Kg per day for clients who have big quantities and those with small quantities, they are usually charged UGX 70 per kg per day. |
| 9 | Hamwe East Africa | The company invested around US\$.600,000 in 2021 alone. Service cost ranges from 2% to 30% depending on the volume of orders made. |
| 10 | Warehouse receipt system | |
| 11 | Mastercard | The mastercard team is made up of 8 people that are focused on the development of the product |

3.8.8 Clear future

This criterion considers the future for the service providers as an indication of commitment and willingness to grow and improve the innovations. The results identify various ambitions of ranging from growing the number of employees to growing the capital investments of the innovations. Some of the future included: expanding the services offered to cover the whole value chain. For instance, some innovations currently offering services in the production and Agro-inputs segments of the value chains, had plans of onboarding the off-takers and traders on a platonic basis. Some had plans of scaling out the innovations to other regions and districts.

We want to cover more farmers, recruit more village agents, and cover a wider market. We hope to cross the border since we have achieved tremendous visibility in Rwanda, Ghana, and Zambia

The innovations whose plans were in alignment with the objectives of the work package were considered promising for scaling.

3.8.9 Level of scaling readiness

Scaling readiness was assessed based on a 5-point scale described in table 4 below. The innovators were asked to rank their innovations on this scale and majority ranked themselves to be at stage 4 and a few at stage 2. The criteria sought to identify innovations at scale 4 for piloting. The results of the self-ranking were checked against the other criteria.

Table 6: Scaling Readiness Scale

| Scaling level (1-5) | Description of the scale |
|---------------------|-------------------------------|
| 1 | Conceiving of the ideas |
| 2 | Design of the idea |
| 3 | Proofing/ Piloting |
| 4 | Beyond the Piloting |
| 5 | Nationally available to serve |

Table 5 summarizes how the innovations fared against the suggested criteria.

Table 7: Innovations against the criteria

| | Category of innovation | No. of services bundled | No. of Value Chains | Salient features | Gender and Youth Responsiveness | Geographical area | Sustainability | Size of the business | Clear Future | Level of Scaling Readiness |
|--------------|------------------------|-------------------------|---------------------|---------------------|---------------------------------|-------------------|-----------------------------------|----------------------|------------------------------|----------------------------|
| MCash | VC Finance | 1 | 5 | E-Wallet | No | 57 | Government support and commission | Over UGX 1.4 billion | Increase number of services | 5 |
| Kudu | VC Finance | 2 | 10 | Auctioning Platform | No | 37 | Donor support | Over USD 2 million | increase capital investments | 2 |

| | | | | | | | | | | |
|--------------------------------|------------|---|---|---|-----|----|----------------------------------|---|---|---|
| aXiom Zorn | VC Finance | 5 | 6 | End to end Service Delivery | No | 24 | Payments/Subscription Commission | Have a team of 28 permanent staff and working with about 2500 agents across the country | Increase number of customers served Increase geographical area of coverage | 5 |
| City Coolers | Logistics | 3 | 5 | Reliable and less bureaucratic services | No | 3 | Payments for services | Medium sized company with about 10 staff | Increase number of services Increase geographical area of coverage | 5 |
| Agro Supply (U) Limited | VC Finance | 6 | 5 | Layaway Payment System | Yes | 18 | Payments | Agro Supply is a medium sized business working with over 20,000 farmers | Increase number of clients served Increase geographical area of coverage | 5 |

| | | | | | | | | | | |
|--|------------|---|---|---|----|----|--|--|---|---|
| M-Omulisa | VC Finance | 5 | 4 | Bundle several services necessary for the farmers | No | 7 | Commission Government support Payment/Subscription | Between USD 70,000 to 100,000. | Increase geographical area coverage | 5 |
| e-receipt system | VC Finance | 4 | 9 | E-Warehouse Receipt | No | 10 | Government Support Fees | We cover Nationwide. Access markets, farmers, and traders. | Increase geographical area coverage | 5 |
| Agri-Logistics Courier trucking services. | Logistics | 3 | 4 | Offer reliable and affordable agri-food trucking for all value chains | No | 27 | Commission Donor support | The investment has grown up to \$ 50000 and this is coming through a VC (Venture Capitalist) funds. The Human Resource team is | Improve on the efficiency Increase capital investment | 3 |

| | | | | | | | | | | |
|---------------------|--------------------------|---|----|--|----|----|-------------------------------|--|---|---|
| | | | | | | | | made up of 4 members currently/ | | |
| Buy and sell | VC Finance and Logistics | 3 | 7 | Complete profiling records of all farmers; crops grown , inputs used, credit information | No | 12 | Commission Government support | About \$600000 | Increase geographical area coverage | 4 |
| Ezy Agric | VC Finance and Logistics | 3 | 30 | End to end Service Delivery | No | 19 | Commission | We have 300,000 farmers and every year numbers are doubling. over 200 people visit our app daily. we have over 10,000 people who | Increase capital increased number of clients served | 4 |

| | | | | | | | | | | |
|------------------------------|-----------------|---|---|--------------|----|----|---------------------------------------|--|---|---|
| | | | | | | | | visit our app monthl y | | |
| Mas- ter card | VC Fi- nance | 1 | 2 | Farm Pass | No | 10 | Commis- sion Donor sup- port | Invest- ment wise I can't tell you the fig- ure be- cause that's above me as well. There is a whole devel- op- ment team of about 7-8 people | In- crease the num- ber of clients served | 4 |

4 CONCLUSIONS

The study reveals that there are several digital agricultural innovations in Uganda, these include several digital platforms, Apps, and websites, some of which are active and others, inactive. Some of the inactive ones were attributed to academic projects that lapsed on completion of the studies or had been donor-led and funded interventions that failed to be sustained beyond the funding among other reasons. Some failed due to lack of capital and skills of developers to grow beyond conceptualization stages.

Several digitally enabled services were offered by service providers in partnership with other institutions. For example, with banks for credit-payment-related services, insurance companies and the Agriculture Insurance Consortium (AIC) for insurance-related services and mobile network operators for savings and digital payments. Most of the digital service providers offer bundled services, ranging from 2 to 7 services.

Results also showed that both the value chain finance and logistics innovative services operate in cross-value chains in the agri-food sector with some integrating crop and livestock value chain. Some operate in similar value chains such as perishable crop value chains while others operate in both the perishable and non-perishable value chains.

The study mapped existing digital services along a generic value chain and results show that many of the services were mostly operating in the production segment targeting the farmers and largely linking them to the agro-input segment. There were a few services that extended to aggregation targeting off-takers and these services largely involved provision of market information focusing on available aggregation volumes.

The study revealed wide array of benefits to farmers and agribusinesses in developing markets, fostering business performance improvements, and increased financial inclusion, uptake of better agricultural practices and skills development; and allowing for more transparency and visibility for farmers. Others included linkages both between and among the different value chain actors and support institutions. Specifically, the use of digital innovative services had: 1) increased access to markets for quality agro-inputs and services such as e-extension and agri-insurance; 2) increased financial inclusion; logistics and traceability and profiling of VC actors.

Several challenges and opportunities were established along with innovations in the agri-food value chain system. There is an opportunity to popularize simple digital innovations that use USSD and SMS services. There is a potential for untapped insurance services that providers and other market players can tap into. The design of the innovations can be improved to become more user-friendly to bring on board more clients. There is an opportunity to leverage the existing innovations and MNOs to advocate for better internet and digital infrastructure in the catchment areas, besides the integration of insurance services into bundled services. The catchment area and potential clientele are big but need more awareness creation and marketing of the innovation.

The study also indicates that women and youth inclusion are still major challenges in the digital services sector with youth and women under-represented. This potentially negatively affected the employment and income opportunity from the digital economy to this sector of the population. In addition, awareness of the digital services among potential clients is still low, similarly, understanding the benefits of the services by the potential users is limited.

Several digital services show weak financial sustainability models as they rely on government and other donor funding as the principal source of funds. However, a number have strong business models based on profitable service provision models and financing plans. The scalability of the services is highly dependent on the sustainability of the digital services.

Recommendations

- There is need for the developers of the mobile application to reach out to the farmers and create awareness on what services the different apps offer and what advantages accrue to the farmers who decide to use the App as a way of increasing adoption and creating awareness and increasing demand for the services.
- There is need to support digital literacy activities because most farmers lack the basic skills in using mobile gadgets beyond receiving and making calls.
- Gender is never an underlying issue during the design and operation of mobile digital platforms which calls for efforts to sensitize developers on gender issues with regards to digital platforms. Identifying more avenues for the digital platforms to involve the youth and the women beyond just being agents would support scaling the services.
- Developers need to look at past experiences and feedback to design solutions that give the user better experiences.
- Agricultural digital platforms should consider using change agents at village or parish level to promote their innovations in a more cost-effective way.

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APPENDIX

Table A1

| Key area | Innovation | Description of agricultural innovations |
|------------------|------------|---|
| Digital payments | Xente | Xente is a cross-platform mobile app that allows anyone with a mobile phone and a mobile number to transact with each other conveniently and securely. Its uses include e-commerce, remittance, and bill payments. It allows prepayment using digital payment methods like mobile money or bank cards. It allows seamless, super-fast bank payments to domestic and international bank accounts. The app also allows customers to buy now and pay later or pay in instalments. It enables businesses to manage their expenses and |

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| | | <p>make payments faster and efficiently and offers credit to SMEs. The unique aspect of Xente is its positioning as m-commerce and FinTech firm with a relevant product offering for the consumer and business segments. It provides APIs that businesses may use in their websites or apps to collect money from mobile wallets.</p> <p>https://xente.co No agricultural link</p> |
| | Farm Pass-Mastercard | <p>The Mastercard Farm Pass digitizes agricultural value chains, payments, and workflows by enabling a digital rural ecosystem of agriculture supply chain which includes all participants from farmers, buyers, agri-input dealers, extension workers among others.</p> <p>https://unffe.org.ug/project/mastercard-farmer-network-mfn/</p> |
| | MobiPay AgroSys Ltd | <p>a) Digital payments: Mobipay Digital payments offer a range of services for advancing financial services i.e., bulk payments (for salaries, wages, goods, and services); agency banking and mobile money agency.</p> <p>b) Digital marketing platform: AgPlus is a digital platform that enables middlemen and traders in the informal sector to digitally purchase and pay farmers. They use the featured phone (Katoki) and mobile money services to transact using USSD. This enables the players to keep digital records of their activities and manage the risk of moving with physical cash.</p> <p>c) Agents and Sales Monitoring Platform (Duba): Duba is a web and USSD based application that allows project implementers to track sales and allows recording of sales and making orders it is also used to monitor the agents performing the sales</p> <p>It also offers: Agent's sales and monitoring system; Agro base – agro value chain MIS; e-learning platform; e-voucher platform; IVR and SACCO system.</p> <p>https://mobipayagrosys.com/</p> |
| | Agro Supply | <p>Digital platform for financing agricultural technologies through mobile micro-savings.</p> <p>Input purchase: platform allows farmers to use their mobile phones to purchase seeds and fertilizer and other farm tools in small increments without taking credit, farmers can make small payment toward their farming need for the coming season digitally using mobile money or using scratch card sold within the community by Agro Supply Agent.</p> |

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| | | <p>Input supply: Agro Supply delivers input to farmers</p> <p>Agricultural training: Farmers receive training throughout the season on modern agricultural techniques, training is done both digitally through SMS and an AI system and in person through the network of our village Agents spread across Uganda.</p> <p>Market facilitation: Farmers to large buyers, who provide our farmers with better price than the middlemen and teach farmers about market fluctuations and post-harvest handling</p> <p>https://agrosupplyltd.com/</p> |
| | EzyAgric | <p>Digital marketplace for purchase of agro-inputs from credible suppliers with just a push of a button. It also helps with farm records and analysis of farm profitability, customized and collateral free digital agricultural credit, or loans; extension and advisory services; and market linkage.</p> <p>https://about.ezyagric.com/; https://ezyagric.com/</p> |
| | AgriShare | <p>AgriShare is an app to hire or rent out agricultural resources between farmers and equipment manufacturers securely and with ease.</p> <p>https://www.agrishare.app/</p> |
| | Famunera | <p>Digital marketplace for inputs and outputs. Provides e-commerce services.</p> <p>https://www.famunera.com/</p> |
| | M-Omulimisa | <p>M-Omulimisa is a company that leverages mobile technology, farmer networks, and partnerships to provide a bundle of agriculture-related services to smallholder farmers. Services include group input loans, mobile-based extension, market and weather information services, agricultural insurance, and mobile learning.</p> <p>https://m-omulimisa.com/</p> |
| | Kilimomart | <p>Digital or online marketplace for agricultural products</p> <p>https://kilimomart.com/</p> |
| | Agri-Logistics | <p>Digital platform for agricultural logistics.</p> <p>Agri-Logistics is a tech-enabled agri-commodity aggregator, providing agricultural commodity courier, trucking, and warehousing services.</p> <p>https://www.agri-logistics.org/</p> |
| | Agro Market Day | <p>Digital marketplace for agricultural produce</p> <p>http://www.agromarketday.com/</p> |

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| | Yo! payments | <p>Yo! Payments provides businesses with a secure and convenient interface through which customers can manage mobile payments from multiple providers. It makes use of various mobile platforms, such as mobile money, SMS, USSD, and IVR to accept mobile money payments through point-of-sale devices, mobile applications, or the web. Other services offered include pay bills, collections, money transfers, and other e-money services to individuals, banks, non-bank corporations, government, and NGOs. It is the largest payment aggregator in Uganda, it digitizes agricultural value chains and works with MNO such as MTN, Airtel and the United Nations Capital Development Fund (UNCDF) mobile money for the poor (MM4P) Uganda program. For instance, it digitizes company payments to farmers, develops hybrid system of payments that accommodate both mobile money and cash payments.</p> <p>http://yo.co.ug/wp-content/uploads/2021/04/YoUganda-Agri-Digitization-Brochure-Digital-Paths-1.pdf</p> |
| | Dusupay | <p>Dusupay provides payments infrastructure that enables businesses to accept and make payments in and out of Africa. Its application integrates with MNO payments platforms in many countries in Africa to enable transfer of money for promoting intra-African trade. It is typically a business to business (B2B) business model that targets forex trading, betting companies, money remittances, e-commerce, and tours and travels. It provides cross-border mobile money transfers for B2B.</p> <p>https://www.dusupay.com/</p> <p>No clear link to agric valuechains</p> |
| | Ezeemoney | <p>Ezeemoney a payment aggregator that facilitates (digital) payments into customer mobile wallets across multiple MNOs and converts to multiple payment instruments, such as mobile wallets and bank account. This allows customers to choose how they wish to receive payments. Other services offered include bill payments, collections, points of sale, money transfers, and other e-money services to banks, non-bank corporations, the government, and NGOs.</p> <p>http://ezeemoney.co.ug/</p> <p>No clear link to agric valuechains (The focus is also on rural finance)</p> |

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| Lending | Numida | Numida provides digital microfinance or credit to semiformal micro and small businesses with digital working capital loans of \$100-\$5000 disbursed via mobile money. https://numida.com/ |
| | Borrocracy | Borrocracy is a digital financial platform that helps the underserved borrowers have access to affordable loans. It uses an inbuilt proprietary algorithm to evaluate borrowers and connect them to accredited financial service providers. https://vc4a.com/ventures/borrocracy/ |
| | Akello banker | Akello banker offers bundled services to farmers including digital payment services, and digital loans for agricultural inputs and output linkages. http://akellobanker.com/ |
| | Jumo | Jumo offers digital banking, digital credit. It uses artificial intelligence and machine learning to build accurate credit scores and targeted financial products for people who don't have a formal financial identity, collateral, or credit record. https://jumo.world/ |
| | Axiom Zorn | Axiom Zorn offers the following services: enterprise analytics and business intelligence; market linkages; credit scoring (vetting of unbanked communities for financial access by leveraging on their farmer level and household economic data to rank potential borrowers.); crop Insurance; fertilizer optimization tool; and digital payment systems and warehousing receipts. https://axiom-zorn.com/ |
| | Nampya Farmers Market | Formal digital marketplace for agrifood. It links farmers and food retailers. https://www.nampyafarmersmarket.com/ |
| | MSACCO | MSACCO enables customers access, assess and choose the most appropriate and affordable financial services digitally. They are able to grow personal savings, access affordable credit, and earn income in form annual dividends, by opening an account with any of the leading SACCOs and MFIs in the country of their residence. Regardless of what digital channel a customer prefers to use, (USSD, Mobile App), MSACCO gives a seamless user experience. https://fltug.com/msacco/ Because of the way they are structured, conventional SACCOs make borrowing for farmers very expensive. There is an urgent need to enhance the capacity of SACCOs to serve rural farmer com- |

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| | | <p>munities through simple and affordable self-service digital channels. By automating 300 SACCOs through a digital platform, FLT has made borrowing dramatically cheaper for smallholder farmers.</p> <p>https://ruralsolutionsportal.org/en/-/39585602-16</p> |
| | Emata | <p>Emata partners with cooperatives and aggregators to digitise their day-to-day operations for free with its MIS system. It uses alternative credit scoring algorithms to identify good farmers and offer them loans they can afford. Farmers receive affordable, digital loans via Mobile Money to invest in the productivity of their farms.</p> <p>https://www.emata.ug/</p> |
| | Akaboxi | <p>Akaboxi is a digital financial inclusion system that enables smallholder farmers in a community to manage and monitor their savings together. It provides communities with the most secure way of keeping smallholder farmers savings that are kept in boxes to be managed and monitored by use of Digitalized Financial Inclusion system – That replaces the rudimentary way of keeping money in boxes and in people’s homes to a more secure, reliable, and easy to monitor savings and transactions. AkaboxiFund is microfinance that is used to enable smallholder farmers to have access to micro-funding</p> <p>https://www.close-the-gap.org/what-we-do/investment-strategy/akaboxi</p> <p>https://www.akaboxii.com/</p> |
| | Pula | <p>Pula is an agricultural insurance and technology company that designs and delivers innovative agricultural insurance and digital products to help smallholder farmers endure yield risks, improve their farming practices, and bolster their incomes over time.</p> <p>https://www.pula-advisors.com/</p> |
| | Kazi Food Logistics Ltd | <p>Offers cold storage services, stock management and handing.</p> <p>https://www.kazifoodlogistics.com/</p> |
| | Sky logistics | <p>Regional logistics and supply chain management. Offers road transportation or distribution, warehousing, customs clearance and brokerage etc.</p> <p>http://www.skylogisticsug.com/</p> |
| | Drazo logistics | <p>Global and regional logistics and supply chain management including transport, warehousing and distribution services. https://drazo.com/</p> |

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| | Bollere Logistics | Global and regional logistics and supply chain management and transport services. https://www.bollere-logistics.com/en/country/uganda/ |
| | K & M Transporters | Offers transport and logistics services. https://www.kandmtransporters.com/ |
| | MAERSK | Offers transportation, cold storage, supply chain and logistics services https://www.maersk.com/ |
| | UPSTREAM LIMITED | Transport and logistics, warehousing, packaging https://mitchellcottsgroup.com/upstreamlimited/ |
| | Uganda Co-operative Transport Union | Transport and Logistics, warehousing, packaging https://uctu.co.ug/ |
| | JK Continental | Transport and Logistics, warehousing, packaging http://www.jkcontinental.co.ug/ |
| International company no details of operations in Uganda | Agrivest Shipping DMCC | Transport and Logistics, warehousing, packaging https://www.agrivestshipping.com/ |
| | Flutterwave | Digital payment services https://flutterwave.com/ug/ |
| | Kudu | Digital or online marketplace for agricultural products https://www.kudu.ug/ |
| | Bro Group | Transportation, warehousing, and distribution https://bro-group.com/ |
| | CEVA Logistics | Transport and logistics services https://www.cevalogistics.com/en/africa |
| | DHL Uganda | Transport and logistics, warehousing, and distribution services https://www.dhl.com/ug-en/home.html |
| | Freight in time | Transport and logistics, warehousing, and cold storage http://freightintime.co.ug/ |
| | Logistics Plus | Transport and logistics, warehousing and distribution, supply chain management https://www.logisticsplus.com/directory/our-locations/uganda-kampala/ |

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| | Musita Investments | Offers transport and logistics services |
| | Uganda Warehouse Receipt System Authority | Storage https://www.uwrsa.go.ug/ |
| | NITA Uganda | Digital support |
| | City Coolers Engineering Ltd | Cold storage https://www.citycoolers.co.ug/ |
| | Natural Storage Solutions Pvt. Ltd | Cold storage https://www.nsspl.in/cold-storage-business-in-uganda/ |

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