USAID Digital Agriculture Ecosystem Assessment - Uganda

Date: April 2022

Contents

USAID Digital Agriculture Ecosystem Assessment

List of Acronyms

AML	Anti-Money Laundering
API	Application Programming Interface
B2G	Business-to-Government
CA	Conservative Agriculture
CFT	Countering the Financing of Terrorism
D4Ag	Digital for Agriculture
DAES	Directorate of Agricultural Extension Services
D2FTF	Digital Development for Feed the Future
DFID	Department for International Development (now FCDO)
DFS	Digital Financial Services
EABL	East Africa Breweries Limited
EU	European Union
FAO	Food and Agriculture Organization
FCDO	Foreign, Commonwealth and Development Office
FITSPA	Financial Technologies Service Providers Association
FSDU	Financial Sector Deepening Uganda
FtF	Feed the Future
GBI	USAID-NetHope Global Broadband and Innovations Alliance (GBI)
GDP	Gross Domestic Product
GSMA	Global System for Mobile Communications
G2P	Government-to-Person
GoU	Government of Uganda
IAM	Inclusive Agriculture Markets
UBA	Uganda Bankers Association
ICAN	Integrated Community Agriculture and Nutrition Activity
ICT	Information and Communications Technology
IDES	Inclusive Digital Economy Scorecard
IFC	International Finance Corporation
IMF	International Monetary Fund
IoT	Internet of Things
IVR	Interactive Voice Recognition
JICA	Japanese International Cooperation Agency
KfW	Kreditanstalt Für Wiederaufbau (German Development Bank)
KOICA	Korean International Cooperation Agency
LIC	Low Income Country

MAAIF	Ministry of Agriculture Animal Industry and Fisheries		**SHF**	Smallholder Farmer
MDAs	Ministries, Departments, Agencies		**SIA**	Strategic Investments Activity
MIS	Mobile Management Information System		**SIDA**	Swedish International Development Cooperation Agency
MNO	Mobile Network Operator		**SSA**	Sub-Saharan Africa
MoICT & NG	Ministry of Information and Communication Technology and National Guidance		**STEM**	Science, Technology, Engineering and Mathematics
MSMEs	Micro Small and Medium Enterprises		**TWG**	Technical Working Group
NaCRRI	National Crops Resources Research Institute		**UBOS**	Uganda Bureau of Statistics
NARO	National Agriculture Research Organization		**UCC**	Uganda Communications Commission
NFASS	National Food and Agricultural Statistics System		**UNADA**	Uganda National Agro-dealers Association
NGO	Non-Government Organization		**UNBS**	Uganda National Bureau of Standards
NIRA	National Identification and Registration Authority		**UNMA**	Uganda National Meteorological Association
NITA-U	National Information Technology Authority - Uganda		**U-NIEWS**	Uganda National Integrated Early Warning Systems
P2G	Person-to-Government		**USAID**	United States Agency for International Development
PAYGo	Pay-as-you-go		**USTA**	Uganda Seed Trade Association
RAN	Resilient Africa Network		**VSLA**	Village Savings and Loan Association
RFIDS	Radio Frequency Identification		**YLA**	Youth Leadership in Agriculture
RHC	Refugee and Host Communities		**YSB**	Yunus Social Business
SACCO	Savings and Credit Cooperative Organization		**ZARDI**	Zonal Agricultural Research and Development Institute
			ZOI	Zone of Influence

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Definitions

D4Ag Solutions: Products and services that utilise digital tools, digital channels, or digitally enabled data analytics (e.g., machine learning/ AI) to deliver information, advice, farming input linkages, market access, logistics support, financial services, and decision-making tools directly to smallholder farmers or to other intermediaries of smallholder value chains, including extension agents, agro-dealers, agribusinesses, financial service providers and policymakers.[1]

Electronic Money (e-Money): A type of monetary value electronically recorded and generally understood to have the following attributes: (1) issued upon receipt of funds; (2) stored electronically; (3) accepted as a means of payment by parties other than the issuer; and (4) redeemable for cash.[2]

Electronic Payments: Payments made via electronic channels, including mobile and Internet channels, using infrastructure such as mobile phones, computers, electronic cards, and PoS devices.[3]

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[1] Closing the Potential- Performance Divide in Ugandan Agriculture. World Bank, 2018.

[2] Guide to the Use of Digital Financial Services in Agriculture. USAID, 2019.

[3] Guide to the Use of Digital Financial Services in Agriculture. USAID, 2019.

FinTech: The International Monetary Fund (IMF) uses the definition: "the broad interpretation of fintech to describe the advances in technology that have the potential to transform the provision of financial services spurring the development of new business models, applications, processes and products".[4]

Interoperability: The ability of systems and applications to communicate and share data in a seamless manner, without additional effort from the end user.

Know Your Customer (KYC): Rules related to AML/CFT which require providers to carry out procedures to identify a customer.

mAgri: Stands for 'mobile technologies in/for agriculture' and which limits its scope to the mobile ICT's, e.g. mobile networks, (smart-) phones, tablets etc.

Mobile Money (m-money): A mobile-based service facilitating electronic transfers and other transactional and non-transactional financial services using mobile networks. A mobile money issuer may, depending on local law and the business model, be an MNO or a third party such as a bank. Often used synonymously with "mobile financial services."[5]

Mobile Banking: Mobile banking is a service in which a mobile phone is used to access financial services. When customers access a bank account via a mobile phone and can sometimes initiate transactions.

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[4] IMF Policy Paper: The Bali Fintech Agenda, 2018.
[5] Guide to the Use of Digital Financial Services in Agriculture. USAID, 2019.

Executive Summary

Uganda is highly dependent on agriculture for economic output and employment. The agriculture sector contributes about 23.7 percent of Uganda's GDP, 31 percent of its export earnings and all food requirements.[6] Uganda's population is predominantly rural, with 82 percent residing in rural areas. Driven by rapid population growth and limited employment opportunities, the agriculture sector still employs about 75 percent of the workforce and 55 percent of youth. The Uganda Bureau of Statistics (UBOS) identified that between 2016 and 2020, there was an 8 percent increase in households participating in subsistence agriculture with an additional number of households turning to agriculture during the Covid-19 pandemic (see Figures 1 & 2). Uganda also has an ageing farmer profile with 55 percent of farming heads of households over age 40 and 20 percent over age 60. Although agricultural incomes have increased, this progress has been dependent 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 incomes susceptible to shocks.[7] Digital solutions can potentially address key agriculture sector bottlenecks such as low uptake of improved agriculture inputs, limited access to suitable financial products and low access to reliable weather information among others.

Like many Low-Income Countries (LICs), Uganda's agricultural productivity is plagued by a poor extension services infrastructure, proliferation of counterfeit and low-quality inputs, poor aggregation and marketing systems, and climate change susceptibility, to name a few. The Government of Uganda (GoU) has recognized the value of digital technologies for the agriculture sector development. The National Information and Communications Technology Policy (2014), National Development Plan III and the draft Digital Uganda Vision are some of the policy and strategy areas that highlight the need to develop and accelerate ICT adoption and use in agriculture.

Uganda has one of the world's youngest populations with 54 percent of the population below 18 years old.[8] The World Bank estimates that Uganda's working-age population (15-64 years) will increase by 13 million people between 2017 and 2030. For approximately 800,000 youths entering the labor force each year, agriculture will most likely be their first job. With the projected population growth and reliance on agriculture, the government must identify ways to make agriculture an attractive employment sector to mitigate against rapid and unsustainable rural-urban migration. Digital technologies applied to primary production stages and further up the value chains in off-farm activities can potentially increase gainful youth employment in agriculture.

While digital tools offer opportunities to revitalize the agricultural sector, in Uganda **physical telecommunications infrastructure is unevenly distributed across regions with significant gaps between rural and urban connectivity.** The population and geographic coverage by mobile infrastructure were 83 percent and 44 percent respectively in 2018, with circa 50 percent 3G or 4G coverage.[9] Broadband access also remains relatively low with only 0.028 fixed broadband subscriptions per 100 people in Uganda compared to 0.5 across SSA.[10] Uganda has one of the lowest (14 percent) internet penetration rates among 10 African peer countries.[11]

Although there is an active digital innovation community in Uganda, predominantly clustered around Kampala, the start-up community has struggled to offer products and services with strong value propositions and sound revenue models relevant to the agriculture sector. The developer community has created over 80 digital agriculture technology solutions, the majority of which have failed to scale. Key contributors to this failure include dependence on donor funding

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[6] Uganda Country Commercial Guide, 2021. International Trade Administration. https://www.trade.gov/country-commercial-guides/Uganda-agricultural-sector.

[7] Uganda Systematic Country Diagnostic Update. World Bank 2021.

[8] The Uganda National Household Survey 2019/20, Uganda Bureau of Statistics, 2021

[9] The State of ICT in Uganda. Research ICT Africa,2019.

[10] Uganda Economic Update, 15th Edition, Digital Solutions in A Time of Crisis. World Bank, 2020.

[11] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

structured around specific project objectives, limited access to early-stage growth capital and low business development skills among the developer.

The percentage growth of digital payments in Uganda (2014–2017) is the highest in the region at 12 percent, followed by Kenya with 10 percent.[12] However, adults living in rural areas are significantly less likely to use internet-based payment products/services such as mobile banking apps. 49 percent of rural adults compared to 24 percent of urban adults rely only on cash for payments.[13] There is a need for continuous innovation around digital financial services that provide turnkey digital solutions for rural people working in the agricultural sector.

The Uganda ICT Policy of 2014 acknowledges the inadequate digital capacity of professionals in both public and private sectors, and the low digital literacy of the general population.[14] Digital skills and literacy are one of the five core foundational building blocks for a successful and inclusive digital economy. Digital skills constitute technology and business skills for building or running a start-up enterprise, while digital literacy encompasses several competencies to access, use, manage and create digital information and digital tools.[15] According to the Inclusive Digital Economy Scorecard (IDES), Uganda has a digital literacy score of 20 percent[16] with 75 percent of Ugandans who do not use the internet reporting that they lack the skills to do so.[17] The use of the internet is a good proxy for digital skills availability in the general population.[18] For women, youth and persons with disabilities, the ability to use digital tools in agriculture can increase their participation along various stages of agriculture value chains, enable them to diversify their agricultural activities and thereby increase their economic security and personal empowerment.

Overall, digital infrastructure access gaps in rural areas, low access to digital tools and low access to finance for digital technology adoption by agribusinesses have contributed to the low adoption of digital technologies in the agriculture sector. The digital agriculture sector requires significant ecosystem development which can be achieved by putting in place solutions that increase access to finance for technology start-ups and incentivize individual farmers' and agribusinesses' adoption of digital technologies.

The following recommendations, over the short, medium and long-term, have been identified to accelerate further the development of the digital agriculture ecosystem.

Short and Medium-term Recommendations

Recommendation 1: Establish a digital innovation in agriculture interagency working group to drive an ecosystem development approach for the adoption and sustainable scaling of digital technologies in agriculture. The technical working group can be an efficient platform for knowledge transfer across programs. Transparency of developments across programs can inform decision making with regards to continuity and mitigate against disruptions when project cycles close out. The members of the Technical Working Group (TWA) would be an amalgam of representatives from: development partners (FCDO, GiZ, JICA, SIDA, EU); GoU (MAAIF, MoICT & NG, NITA-U); Research Institutions (Makerere University, IFPRI); Agtech and Fintech Associations (FITSPA); Telecommunications Service Stakeholders (UCC, MNOs, NetHope, GSMA); and Innovation / Start-up Accelerator Hubs (Hive Colab, Design Hub, Innovation Village).

Recommendation 2: Further develop existing programs that build upon USAID Uganda's previous efforts towards development of scalable and sustainable e-Extension platforms to

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[12] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[13] FinScope Gender and Youth Analysis in Uganda. FSDU, 2018.

[14] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

[15] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

[16] Inclusive Digital Economy Scorecard Report. UNCDF, 2021.

[17] State of mobile internet connectivity 2020, GSMA, 2020

[18] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

ensure quality and timely agriculture information and advisory service delivery. USAID Uganda should provide technical and financial assistance to stakeholders working in the e-Extension space to facilitate the iteration, testing and learning necessary for the development of sustainable e-Extension platforms. Through the existing innovation hubs, start-ups and established companies will be better capacitated to iterate, refine and scale business models of viable technology solutions already on the market. In addition, this will improve the private sector's offering of embedded services (i.e. extension, payment, financing, information, logistics, and business support) solutions leading to increased adoption, awareness and knowledge of digital technologies across market segments including SHFs.

Recommendation 3: Provide technical and financial assistance to stakeholders working on the development of commercially viable digital aggregation and marketing platforms to adopt global best practices in building platforms with sound and scalable revenue models. By supporting the development of commercially viable digital marketplaces, USAID can significantly accelerate national agriculture market systems that would secure and increase farmers' and agribusinesses' incomes, whilst also supporting an increase in youth and women's gainful participation in the agriculture sector.

Long-term Recommendations

Recommendation 4: Building on the successes of the FtF Uganda Agricultural Inputs Activity (2013-2018), USAID Uganda should develop a follow-on activity to continue the development of a digital certified input distribution ecosystem for greater consistency and efficiency in input quality monitoring and access to genuine products. The proposed activity should create synergies with other development partner activities focusing on addressing quality input distribution. As a starting point, USAID, in collaboration with local partners, could embark on developing and improving open data infrastructure with robust privacy and security safeguards for use by FtF programs as well as other USAID funded projects in agriculture. The implementation of this recommendation will largely be driven by the principles for digital development as well as the framework for responsible data usage (co)developed by USAID to ensure that the digital ecosystem meets global standards and regulations.

Recommendation 5: Develop agriculture data infrastructure to become a foundational pillar for the acceleration of research and innovation, dissemination of information and generation of informed policies in the agricultural sector. A core element of this will be assessing the scalability of the e- verification (Kakasa) and Ag-verify platforms to identify areas that require critical support from USAID in collaboration with MAAIF, UNBS and the private sector seed quality verification consortium (Heartland Global, Chemiphar and UgoCert). USAID Uganda can drive the dialogue to catalyse organization and standardization of agriculture data collection, storage, processing and sharing.

Recommendation 6: Establish a Digital Technologies for Agriculture Innovation Hub to accelerate start-up innovation and sustainable business model development for scaling adoption of digital technologies in agriculture as an extension of the PACE Initiative, or as part of the Feed the Future Innovation Lab work in Uganda. The digital agriculture innovation hub should be established as a one stop center for digital agriculture innovation incubation, acceleration and scale. Ideally, the hub should be established in partnership with key members of the interagency technical working group (See Recommendation 1) to ensure the buy-in and sustainability of the hub.

1. Introduction to the assessment

In its ongoing support of several Missions, the Bureau for Resilience and Food Security (RFS) facilitated a Digital Agriculture Ecosystem Assessment for USAID Uganda in November 2021 to build a knowledge base to inform the Missions' digital agriculture activities and investment. Through this assessment, the research team seeks to gain insights into the opportunities and challenges faced by digital agriculture service providers, farmer incentives for using digital agriculture applications as well as what has worked and/or failed in previous programs designed to increase adoption of digital technologies in the sector. The assessment will also include a review of the regulatory framework that supports investment in digital infrastructure and digital applications in the agriculture sector as well as recommendations on how to support the growth of digital agriculture service providers. Interventions that can address barriers to adoption of digital opportunities in the agricultural sector.

This report could be used by stakeholders working to progress the development of the digital agriculture ecosystem in Uganda as an enabler to increasing agriculture productivity, farmers' incomes and household food security.

This report is organized into the following sections:
1. Introduction to the assessment
2. Overview of Agriculture in Uganda
3. Uganda's Digital Ecosystem
4. Digital Agriculture Ecosystem
5. USAID Programming: an overview of lessons learned
6. Recommendations
7. Conclusion

1.1 Methodology

This report outlines major findings of the USAID Uganda digital agriculture ecosystem assessment conducted from October 2021 to April 2022. Key Informant Interviews (KII), Focus Group Discussions (FGDs) and an extensive review and analysis of secondary data sources were conducted to gather insights on the digital agriculture ecosystem.

The interviews were transcribed and clustered according to the following categories: government agencies, the private sector, NGOs, academic institutions, and donor agencies, with key informants strategically selected from each category.

To gain better insights into the experiences of famers with digital technologies, FGDs were held in Zirobwe District. A total of 41 men and women engaged in the agriculture value chain (farmers, extension services agents, traders, processors, and input dealers) were interviewed. Zirobwe district was selected due to the available variety of crop value chains (maize, horticulture, fruits, sweet potatoes), animal husbandry (rabbits, chicken, goats, cattle), presence of a mix of primary production and agro processing. Given the travel restrictions imposed by COVID-19 lockdown measures, Zirobwe was also an easily accessible rural village in which to conduct the FGDs.

2. Overview of Agriculture in Uganda

Uganda is highly dependent on agriculture for economic output and employment. The agriculture sector contributes some 23.7 percent of Uganda's GDP and 31 percent of its export earnings.[19] Uganda's population is predominantly rural, with 82 percent residing in rural areas, and is constrained by rapid growth in young adults with limited employment opportunities. As the sector that creates most jobs, agriculture still employs about 75 percent of the workforce and 55 percent of youth. The Uganda Bureau of Statistics (UBOS) identified that between 2016 and 2020, there was an 8 percent increase in households participating in subsistence agriculture with an additional number of

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[19] Uganda Country Commercial Guide, 2021. International Trade Administration. https://www.trade.gov/country-commercial-guides/Uganda-agricultural-sector.

households turning to agriculture during the Covid-19 pandemic (see Figures 1 & 2). Uganda also has an ageing farmer profile with 55 percent of farming heads of households over age 40 and 20 percent over the age of 60. Although agricultural incomes have increased, this progress has been dependent on exogenous factors such as good weather and prices rather than productivity-enhancing factors like technology, training, irrigation, and farm-to-market infrastructure, which in turn renders incomes susceptible to shocks.[20] Digital solutions can potentially address key agriculture sector bottlenecks such as low uptake of improved agriculture inputs, limited access to suitable financial products and low access to reliable weather information among others.
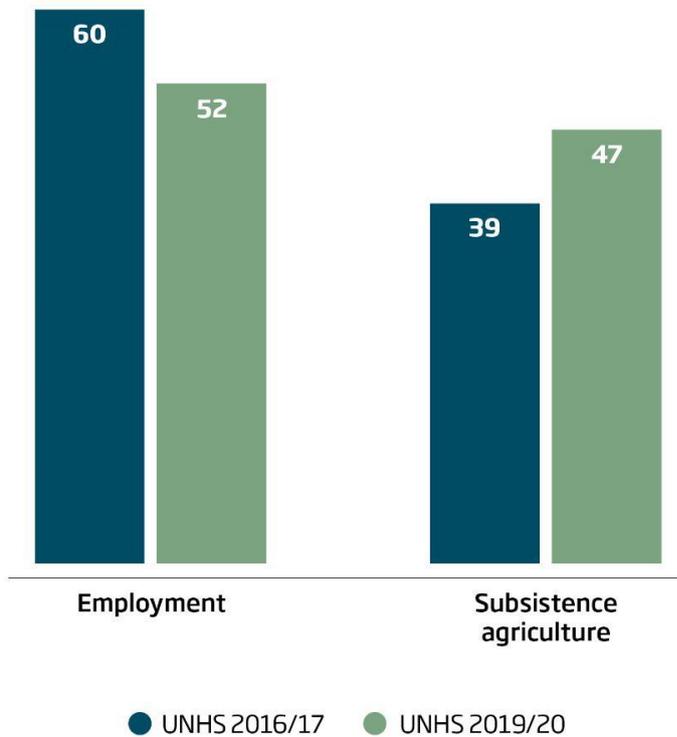
Source: The Uganda National Household Survey 2019/20.

Figure 1: Forms of Employment

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[20] Uganda Systematic Country Diagnostic Update. World Bank 2021.
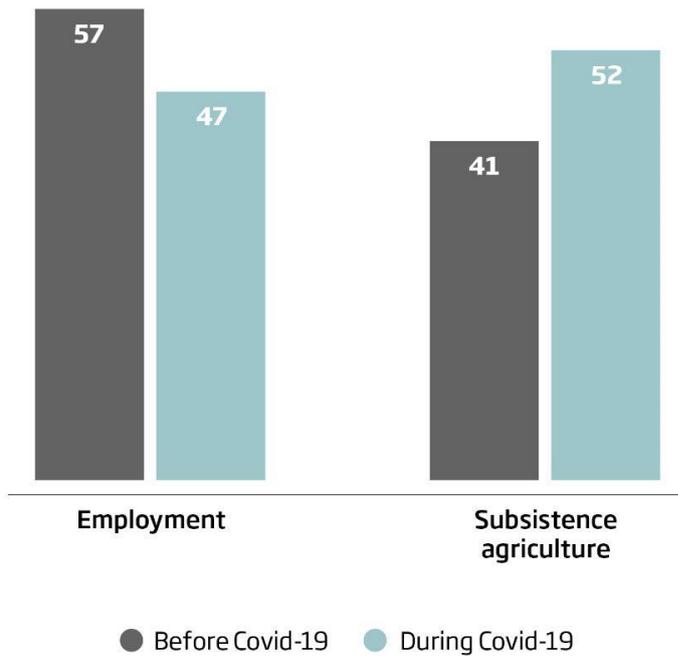
Source: The Uganda National Household Survey 2019/20.

Figure 2: Effect of Covid on Forms of Employment

Agriculture production occupies half of Uganda's land area with farm sizes varying across regions. There are very few commercial farmsteads, with the majority of smallholder farmers (approximately 3 million or 85 percent of farming households) operating on an average farm size in the range of 0.8 to 1.6 ha engaging in subsistence farming with low levels of productivity.[21] As shown in Figure 3, the greatest density of smallholders is concentrated in the Western and Eastern regions. Moreover, nearly a quarter (23 percent) are found in the Northern region, where national statistics reveal the country's highest poverty levels. The smallest share of smallholders is in the Central region (16 percent), which is Uganda's most economically prosperous area.[22] Men are three times more likely to be the head of a smallholder farming household as women (77 percent men vs. 23 percent women)[23] (Figure 4). Both cash crops (coffee, tea, sugar, cotton, maize) and food crops (beans, plantains, sweet potatoes) are produced by smallholder farmers. With small fragmented farming areas, the economies of scale accrued from commercialized agriculture cannot be enjoyed by Uganda's smallholder farmers. However, digital solutions can provide innovative solutions to maximising agriculture resource application to improve productivity.

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[21] Unlocking Agriculture Finance and Insurance in Uganda: The Financial Sector's Role in Agricultural Transformation, World Bank. 2019.

[22] Uganda CGAP smallholder household survey report 2019.

[23] Uganda CGAP smallholder household survey report 2019.
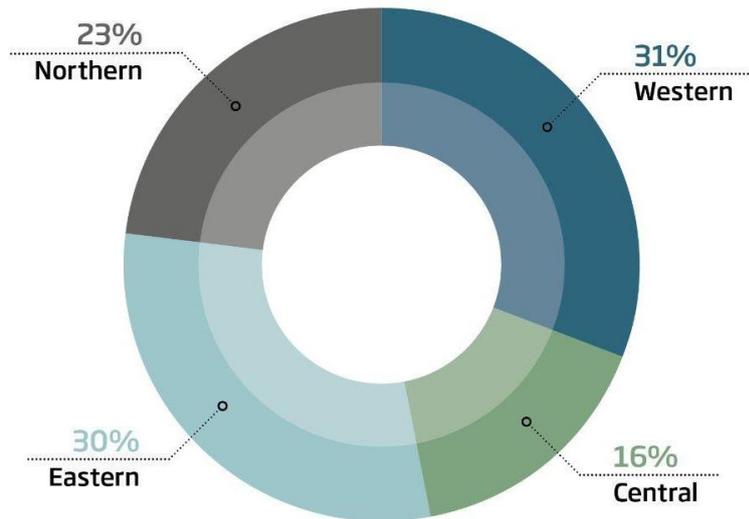
Figure 3: Farming Region

Figure 4: Gender of head of household

Crop farmers, pastoralists and fishermen have been hit hard by the impacts of climate change, human environmental degradation and overfishing. Uganda is losing over two percent of its forest cover and wetlands annually in addition to rapid degradation of rangelands.[24] Uganda's agriculture is primarily rain fed with negligible adoption of irrigation. As of 2017, only about 7000 ha of cultivated land was under formal irrigation - about 1.2 percent of an estimated irrigation potential of 600,000 ha.[25] The failure to adopt climate smart agriculture practices is due to low education levels, individual

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[24] Uganda National Adaptation Plan for the Agriculture Sector, 2018.

[25] Closing the Potential- Performance Divide in Ugandan Agriculture. World Bank, 2018.

attitudes towards change, limited access to quality extension service, limited assets, and financial resources as well as limited risk-taking capacity to adopt these technologies.[26]

Improved seed use and fertilizer application remains low in comparison to average application by regional neighbors. Ugandan farmers apply approximately 40 percent less fertilizer per ha than peer countries.[27] Fertilizer use in Uganda is at 2–3 kg/ha versus the target of 50 kg/ha set by the Comprehensive Africa Agriculture Development Programme.[28] Farmer focus group discussions revealed that this situation is driven by poor access to credit, inadequate knowledge on proper fertilizer application and proliferation of counterfeit fertilizers in the market that discourage farmers' adoption.

Although 70 percent of women are engaged in agriculture in Uganda, only 27 percent of registered land is owned by women, with less than 20 percent of them having control of outputs and proceeds from their efforts.[29] Often land used by women is fragmented and distributed over wide areas which contributes to low productivity since they cannot leverage economies of scale brought on by mechanisation and produce aggregation systems.

Women's labor participation is typically present along the value chain predominantly in the pre-production, production, and harvest stages, after which point women are excluded from the marketing and sales functions (Figure 5). This exclusion contributes to reduced agency over household incomes and expenditures. Women's participation in marketing and sales activities is restricted by distances to markets, lack of information, household power dynamics and social norms in some communities. As such, they are heavily dependent on their male relatives for marketing support or middlemen who offer below market value prices. In addition, women are typically involved in less structured and lower value food crop value chains like beans, potatoes, and vegetables whereas men are predominantly engaged in cash crop value chains.
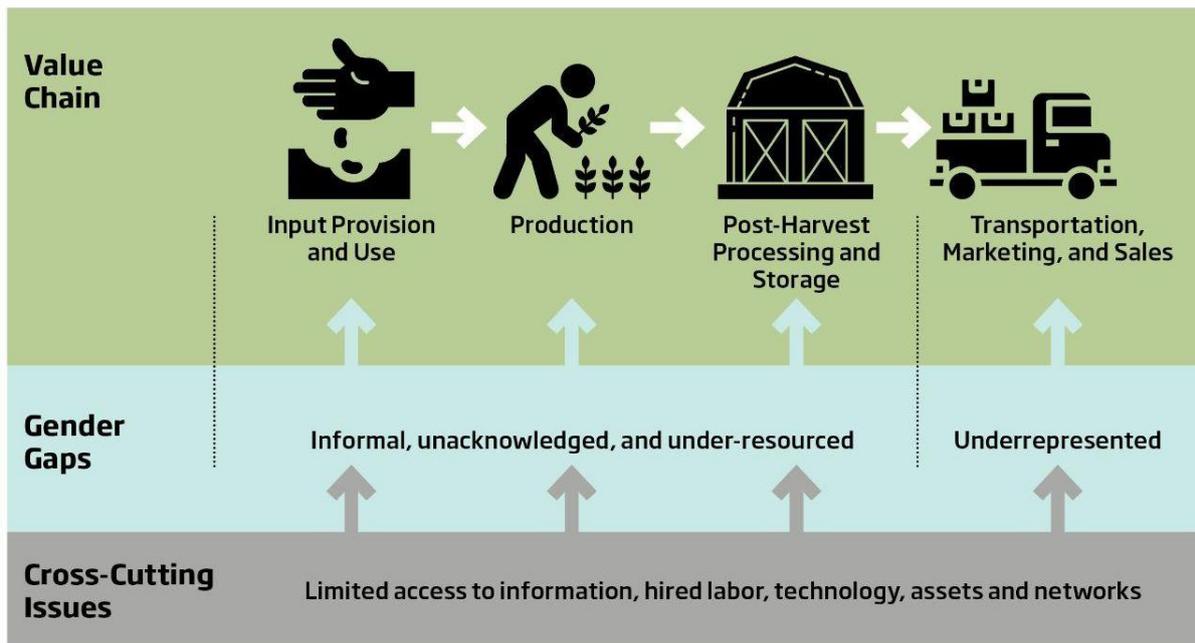
Source: Investing in Women along Agribusiness Value Chains, IFC 2016.

Figure 5: Overview of Gender Gaps in Agribusiness Value Chains.

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[26] Uganda National Adaptation Plan for the Agriculture Sector, 2018.

[27] Toward Scaled-Up and Sustainable Agriculture Finance and Insurance in Uganda. World Bank, 2019.

[28] Toward Scaled-Up and Sustainable Agriculture Finance and Insurance in Uganda. World Bank, 2019.

[29] Uganda Country Partnership Framework (2016-2021). IFC, January 2016

Female smallholder farmers in Uganda also struggle to secure timely labor, whether it be for hire or their own due to affordability constraints as well as time demanded by household responsibilities. Farmer FGDs revealed that it is common to see women's production activities such as land preparation, sowing and weeding occurring past the ideal time in the production cycle leading to consistently low productivity.

Due to access to information barriers and affordability constraints, women use fewer non-labor inputs and get lower returns on the inputs they use. The USAID Feed the Future (FtF) Zone of Influence (ZOI) interim assessment report (2015) found that male farmers (17.7 percent) were more likely to purchase seeds from an agriculture inputs dealer than female farmers (10.7 percent), more male farmers (6.2 percent) than female farmers (2.4 percent) applied fertilizer mid-crop for beans and more male (5.8 percent) than female (2.3 percent) maize farmers applied herbicides for the control of weeds.[30] Women's access to extension services is also limited by misalignment of women's availability for training sessions and the work hours within which extension workers operate.

Uganda has one of the world's youngest populations with 54 percent of the population below 18 years old.[31] The World Bank estimates that Uganda's working-age population (15-64 years) will increase by 13 million people between 2017 and 2030. For approximately 800,000 youths entering the labor force each year, agriculture most likely be their first job. Recognizing that 85-95 percent of young people employed in agriculture stay in agriculture, labor movements out of agriculture, from rural to urban areas and from informality to formality are very rare in Uganda.[32] As such, the government must invest in development strategies that increase youth productivity and income growth in agriculture. Digital technologies have the potential to increase youth knowledge in agricultural best practices, increase access to profitable off - farm activities and markets as well as access to finance for agriculture investments. With limited employment opportunities and a perception among youth that farming is a menial occupation - some areas, especially in the north of the country, are gradually experiencing rising farm labor shortages due to youth migration to urban areas.[33] A survey among young Ugandans from both urban and rural areas revealed that although youth are very entrepreneurial, with the majority aspiring to start their own business, only 12 percent of survey respondents wanted to become farmers.[34]

A wide set of public and private stakeholders offering a range of products and services interact with smallholder farmer production activities in Uganda. They include input dealers, financial service providers, transport and marketing agents, development partners, government extension workers, farmer associations and traders. By leveraging digital tools, upstream and downstream value chain linkages between these actors can be made more efficient with enhanced real time data for decision making, increased payments efficiency and faster market identification for example. Digital tools can also reduce leakages along the value chain in the agriculture input distribution and produce aggregation space as well as facilitate contract farming to secure and create predictability around farmer incomes. Digital tools also support agriculture value chain actors to address the global growth in demand for increased information transparency and traceability of agriculture produce.

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[30] Feed the Future Uganda 2015 Zone of Influence Interim Assessment Report. USAID, 2015.

[31] The Uganda National Household Survey 2019/20, Uganda Bureau of Statistics, 2021

[32] Uganda Jobs Strategy for Inclusive Growth, World Bank 2019.

[33] World Bank in Uganda report 2019, World Bank, 2020

[34] The Uganda Youth Survey Report, Aga Khan University, 2016.

Table 1: Agriculture Sector Players

Type	Stakeholder	Examples	Description	Input	Production	Storage	Distribution	Marketing
Private Sector	Input dealers (seed, fertilizer etc), Agriculture dealers	Feil Uganda, Bukoola Chemicals, AgPloutos, East Africa Seeds	International and local companies	✓				
	Traders	Ngetta Tropical Holdings, Agroways, Mukwano industries	Farmers sell to traders either at the farm-gate or local markets. Some engage in contract farming			✓	✓	✓
	Banks	Equity Bank, Centenary Bank. Etc	Offer credit facilities for inputs, production, processing	✓	✓		✓	
Development Agencies, NGOs	Development Institutions, Social Enterprises	USAID, EU, FCDO, Etc	Provide technical and financial resources to address agriculture market systems development and food security	✓	✓	✓	✓	✓
Farmers Associations	Farmer co-operatives, Farmers association	UNFFE, Uganda Cooperative Alliance, UCSCU, Bugisu Cooperative Union	Co-operatives and associations facilitate aggregation activities, access to markets and access to inputs. In some cases, they offer credit as well.	✓	✓	✓	✓	✓
Government	Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Trade, Industry and Cooperative		The government offers agricultural advisory/extension service		✓		✓	

3. Uganda's Digital Ecosystem

A digital ecosystem comprises the stakeholders, systems, and enabling environments that together empower people and communities to use digital technology to gain access to services, engage with each other, or pursue economic opportunities.[35] The World Bank's Digital Economy for Africa framework identifies five key foundational building blocks for the development of a successful and inclusive digital economy: Digital Infrastructure; Digital Government Platforms; Digital Financial Services; Digital Entrepreneurship; and Digital Skills.[36] This section provides a high-level background of the national digital ecosystem.
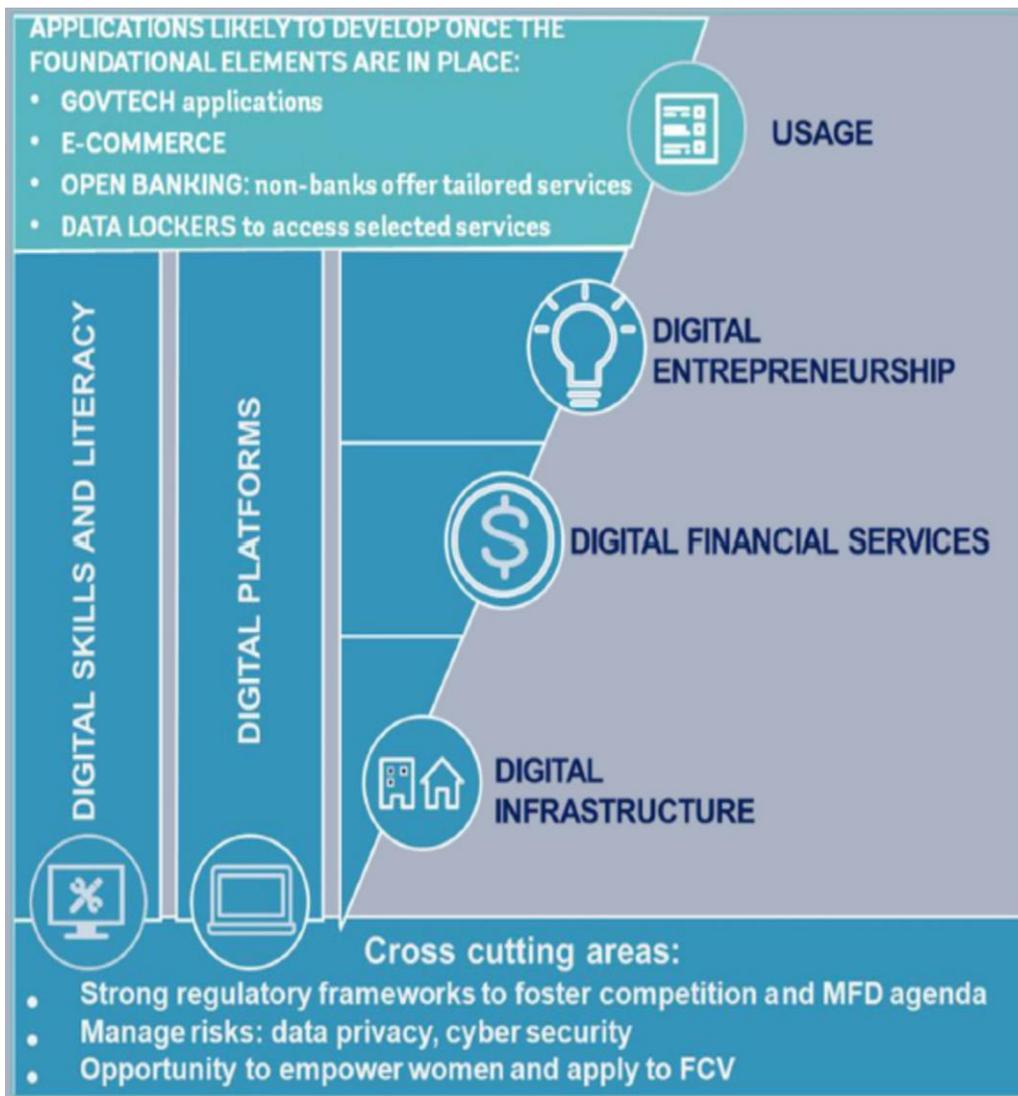
Source: Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

Figure 6: Key Components of the Digital Economy Ecosystem.

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[35] USAID Digital Strategy 2020-2024, USAID, 2020

[36] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

3.1 Digital Infrastructure

Uganda has identified digital transformation as a key driver that will enable the transition of Uganda's economy under the National Development Plan III. Through the draft "Digital Uganda Vision 2019" strategy, the government aims to "transform Uganda into a digitally-enabled society that is innovative, productive and competitive."[37] There has been growth in the ICT sector although it remains minimal at two percent contribution to GDP.[38] This growth can be attributed to increased investment by the Government and private sector in the national backbone fibre infrastructure, improvements in the policy and regulatory environment and increased penetration of active mobile phone subscription which is driving rapid uptake of mobile enabled digital services. Uganda's ranking in the International Telecommunications Union's (ITU) ICT Development Index (IDI), used to monitor and compare developments in ICT between countries and over time, has improved from 158 to 152 out of 176 countries between 2016 and 2017. Unfortunately the country's competitiveness has, however, not kept the same pace on the World Economic Forum's Network Readiness Index, a measure of the degree of readiness of countries to take advantage of opportunities offered by ICT, where it has slipped from 108 in 2010 to 110 in 2019.[39]

Physical telecommunications infrastructure is the backbone for modern communications connectivity that enables technology platforms to communicate with each other. In Uganda, the distribution of this infrastructure is uneven with significant gaps between rural and urban connectivity (Figure 7). Communications infrastructure is limited to key urban centers, while rural areas, particularly the northern region of the country, as well as the country's one million or more refugees and host communities (RHCs), have limited or no connectivity.[40] The population and geographic coverage for mobile infrastructure was at 83 percent and 44 percent respectively in 2018, with only about 50 percent 3G and/or 4G coverage.[41] Broadband access is relatively low with only 0.028 fixed broadband subscriptions per 100 people in Uganda compared to 0.5 in SSA.[42] Uganda also has one of the lowest (14 percent) internet penetration rates among 10 African peer countries.[43] Key informant interviews revealed that the private sector finds the cost of extending digital services to rural communities prohibitive, because of the low purchasing power of rural communities to spend on private sector products and services.[44] The telecommunications market is dominated by two private sector players, MTN and Airtel.

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[37] Draft Digital Uganda Vision.

[38] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[39] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[40] Survey by Research ICT Africa as part of a Global South After Access Survey conducted between 2017 and 2018.

[41] The State of ICT in Uganda. Research ICT Africa,2019.

[42] Uganda Economic Update, 15th Edition, Digital Solutions in A Time of Crisis. World Bank, 2020.

[43] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[44] Mobile Network Operator Interview. Conducted by NIRAS LTS, December 2021.
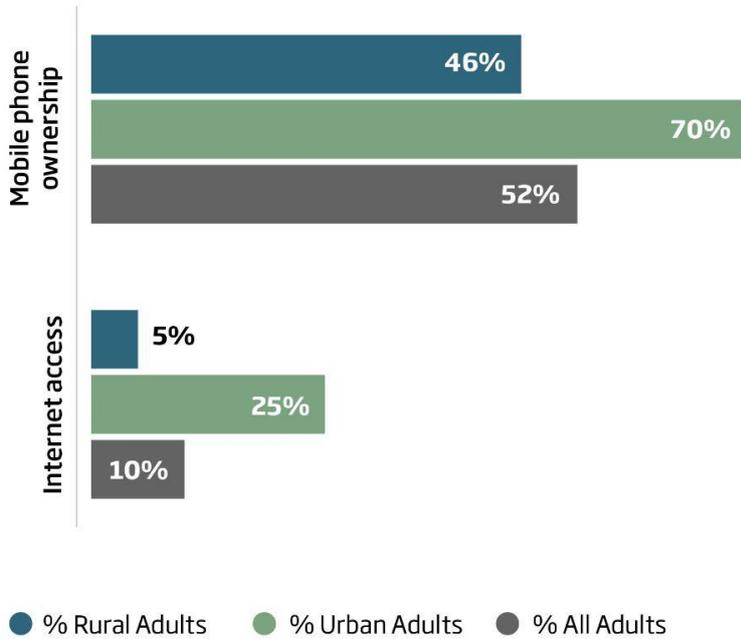
Source: FinScope 2018- Topline Findings Report.

Figure 7: Rural - Urban Disparity in Mobile Phone Ownership and Internet Access.

In Uganda, as in most of sub-Saharan Africa, mobile phones have become a suitable channel for communication, and host a range of software applications (apps) through which a myriad of services from different sectors (health, education, finance, entertainment, education) are delivered. Around 29.1 million Ugandans have a mobile subscription, representing 69 percent of the population, with 85 percent of new connections in the third quarter of 2021 being data enabled.[45] With the growth in household mobile phone household penetration, the mobile phone has become the predominant household ICT asset (Figure 8). At the end of September 2021, total internet subscriptions had for the first time crossed the 22 million mark, translating into a broadband penetration rate of 52%*.[46]

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[45] Market Performance Report 3Q21. Uganda Communications Commission, 2021.
* There might be incidents of multiple SIM connections to an individual user
[46] Market Performance Report 3Q21. Uganda Communications Commission, 2021,
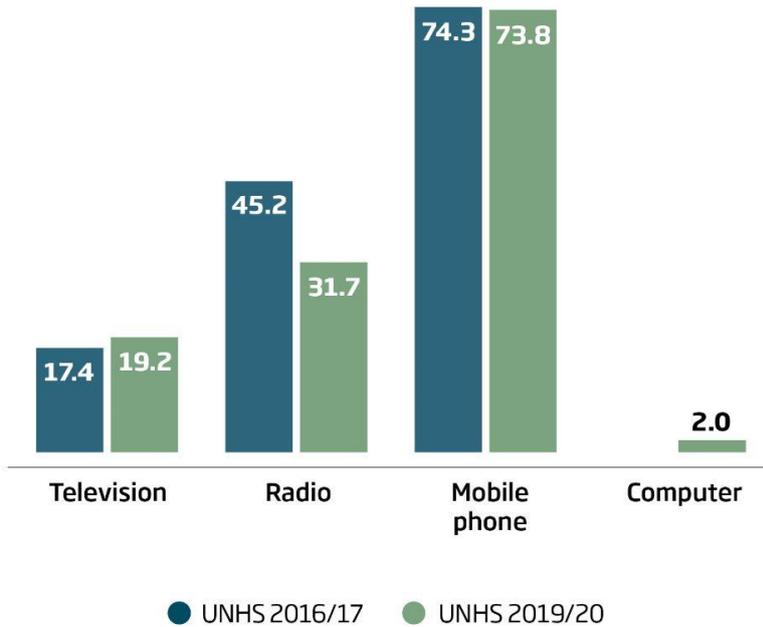
Source: The Uganda National Household Survey 2019/20.

Figure 8: Proportion of Households with ICT assets

Uganda ranks 83 out of 100 countries on the Inclusive Internet Index, with the gender gap in internet use being estimated at 25 percent between men and women, influenced by the lower socio-economic position and education levels of women.[47] Male adults are more likely to have access to the internet (13 percent; 1.1 million) than female adults (8 percent; 0.8 million). Of those who have access to the internet, social media consumption (83 percent), internet-based telephony (39.6 percent) and academic work (20.4 percent) are the leading use cases (Figure 9). As of September 2021, the share of feature phones grew from 58 percent to 60 percent whereas both smartphone and basic phone share of network-connected phones continued to fall.[48] Gaps in broadband access coupled with low smartphone penetration limits the range of innovative digital solutions that can be delivered through the mobile phone channel.

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[47] The State of ICT in Uganda. Research ICT Africa,2019.

[48] Market Performance Report 3Q21. Uganda Communications Commission, 2021,

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Category	Value
Online shopping	2.7
Betting	3.0
Online gaming	2.5
Health related information	9.6
Internet based telephoning	39.6
Business	16.4
Academic work	20.4
Social networking	83.0
Yes	2.1
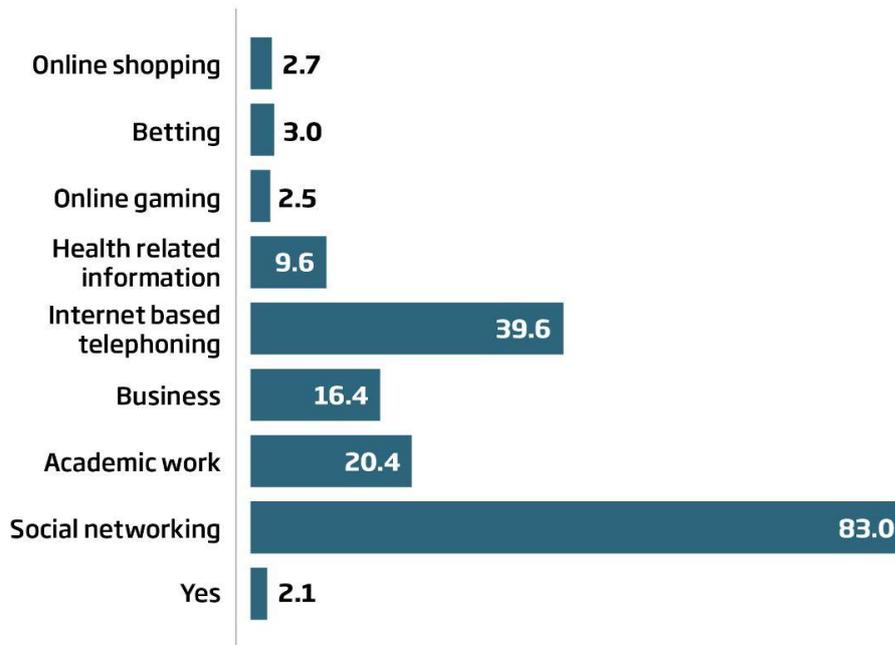
Source: The Uganda National Household Survey 2019/20

Figure 9: Use of Internet

Despite the growth in data enabled mobile phone penetration, affordability remains one of the main barriers for mobile broadband use. According to the ITU, the cost of basic mobile broadband services (5GB of mobile data) was at 41.5% of GNI per capita in 2019, in contrast to the UN Broadband Commission's target of 2 percent, making data consumption prohibitively expensive for most Ugandans.[49] Internet use among individuals earning more than US$ 1,000 per month is very high (almost 100 percent), but it drops significantly in lower income brackets: among people earning less than US$ 100 per month, only 11 percent use the Internet.[50]

The most digitally excluded market segment in Uganda is female refugees. Uganda is the largest refugee hosting country in Africa with about 1.1 million refugees. Female refugees face considerable obstacles to device access and ownership than those in host communities. Figure 10 shows that female refugees are less likely to own a phone and when they do, they are less likely to own smartphones compared to male refugees. The prevalence of women borrowing phones is an important consideration for project design when planning to digitize agriculture in refugee settlements.

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[49] ICT Price Baskets (IPB), ITU 2019.https://www.itu.int/net4/ITU-D/ipb/index.html
[50] Uganda Digital Acceleration Program, Project Information Document. The World Bank, 2021.

BIDI BIDI

KIZIBA

● No access   ● Borrows   ● Owns: Basic phone   ● Owns: Feature phone   ● Owns: Smart phone
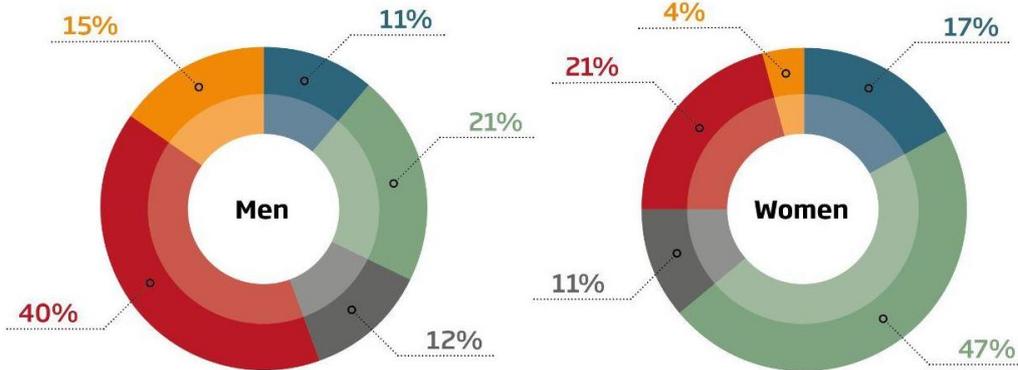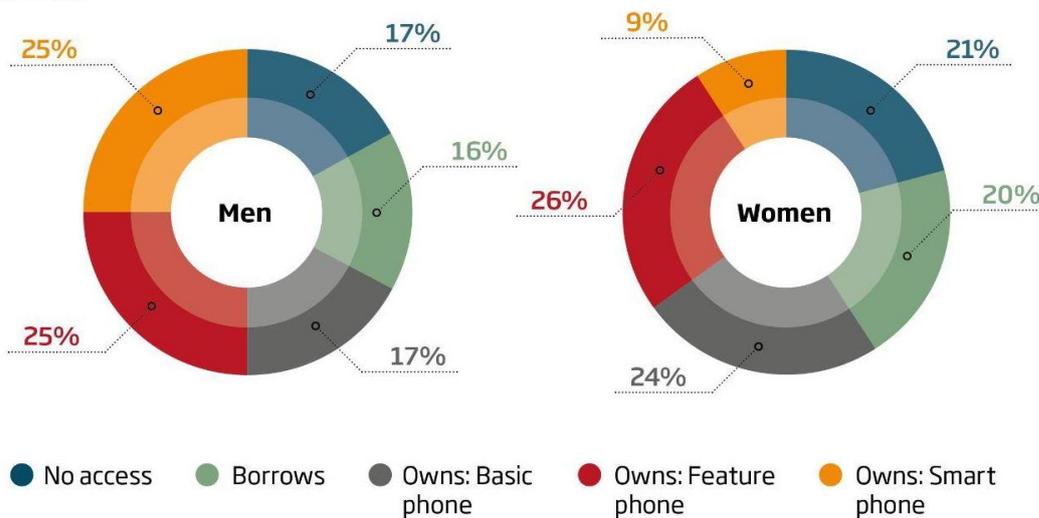
Source: The digital lives of refugees, GSMA, 2019

Base: all respondents (Bidi Bidi: 755 | Women: 449, Men: 306) (Kiziba: 727 | Women: 430, Men: 297)
Q: What type of mobile phone handset(s) do you own? (Smart / Feature / Basic)
Q: Do you use someone else's phone? (Yes)

Figure 10: Mobile Phone access by type and by gender in BidiBidi and Kiziba Refugee Settlements.

3.2 Digital Government Platforms

The use of digital public platforms in Uganda continues to grow as the country increases efforts to digitize public services. Uganda performed impressively on the 2018 UN e-Government Development Index, ranking 16 out of 54 African countries. The Government of Uganda's (GoU's) ongoing efforts to digitize government services and payments to improve efficiency, service delivery and public sector management, provides an opportunity for digital technology and services development and adoption in the agriculture sector. To meet its Vision 2040,[51] the Ministry of Information and Communication Technology and National Guidance (MoICT & NG) established the National Information Technology Authority (NITA-U) to coordinate and monitor the implementation of the National IT Strategy. The eCitizen portal set up by NITA-U hosts a number of government

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[51] Vision 2040 aims for "a transformed Ugandan society from a peasant to a modern and prosperous country within 30 years." ICT has been identified as a key enabler cutting across all sectors for social economic growth and development.
    (http://www.npa.go.ug/wp-content/uploads/2021/02/VISION-2040.pdf)

services online and allows access to services such as eTax, business registration, trading licence registration and social security statements among others. NITA-U is also involved in setting up government e-Payment gateway to facilitate electronic payments for Person-to-Government (P2G), Business-to-Government (B2G) as well as for Government-to-Person (G2P).

GOU recently announced the Fourth Industrial Revolution Initiative (4IR) which underscores the role of FinTech and accordingly, the MOICT has set up a fund to support innovation in FinTech development. Use of emerging technologies in the agricultural sector in Uganda, such as: the Internet of Things (IoT), Big Data, drones, and remote sensors for precision agriculture; blockchain for land registration/management; and real time weather forecasting using aerial images from drones and/or satellites have been identified as business cases for 4IR support in Uganda.

Unfortunately, non-interoperable digital platforms across Ministries, Departments and Agencies (MDAs) have contributed to inefficiency, poor customer experience and low uptake of online services by businesses and individuals. Given the rural-urban telecommunications gaps, most of the government e-services are not accessible by rural enterprises. Further, the need for manual procedures along with e-procedures for the same services discourages citizens since most processes cannot be completed digitally end to end and the digital sections create additional burden.

3.3 Digital Financial Services

Digital financial services have accelerated the rate of financial inclusion for Uganda's unbanked and poor citizens such as women, youth, and rural dwellers. The FinScope survey (2018) reveals that about 78 percent of Ugandan adults (14.4 million) are financially included, with 22 percent (4.2 million) financially excluded (Figure 11). There does exist a significant rural – urban inclusion gap with 25 percent of adults in rural areas excluded, compared to only 14 percent in urban areas. The reasons contributing to this disparity include access to physical financial access points, low digital and financial literacy, and limited access to mobile phones for digital financial services. For example, a lower percentage of women own mobile devices – with (46 percent; 4.6 million) female adults owning a mobile device compared to (58 percent; 5 million) of male adults.
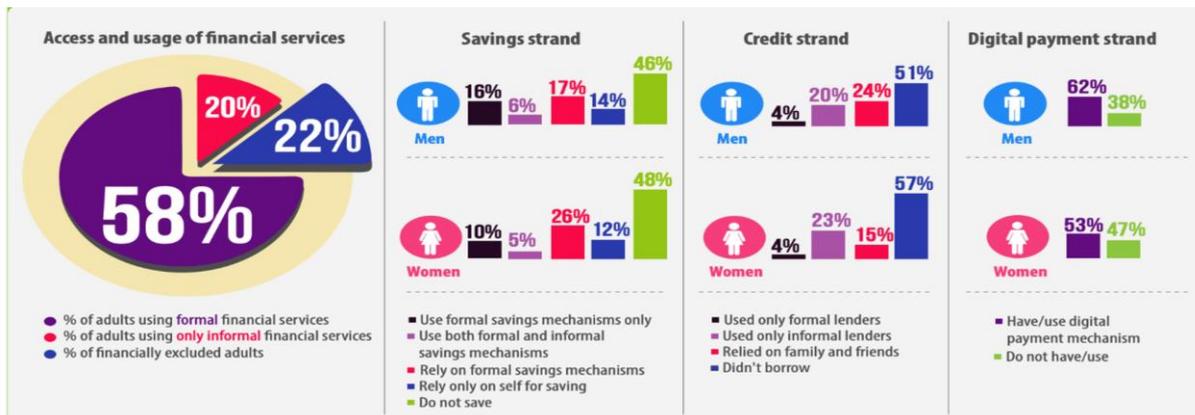
Source: Analysis of status of financial inclusion for women and youth. FSDU, 2018

Figure 11: Financial Inclusion in Uganda

The percentage growth of digital payments in Uganda (2014–2017) is the highest in the region at 12 percent, followed by Kenya at 10 percent.[52] However, adults living in rural areas are significantly less likely to use internet-based payment products/services (such as mobile banking apps). 49 percent of rural adults compared to 24 percent of urban adults rely only on cash for payments.[53]

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[52] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.
[53] FinScope Gender and Youth Analysis in Uganda. FSDU, 2018.

Mobile money has been a major driver of financial inclusion in Uganda. As of September 2021, there were 32.3 million registered mobile money accounts with 21.3 million (66 percent) being 90-day active[54] users.[55] Mobile money is by far the primary finance channel of choice by women (Figure 12) because it removes the burden of travel and increases women's privacy with regards to financial transactions for those women not relying on shared mobile devices.

Service	% Females	% Males
Mobile money services	52%	61%
Bank services	10%	13%
SACCO services	4%	5%
MFI services	2%	2%
Pension services	1%	3%
Insurance services	1%	1%
Cooperative services	0%	1%
Capital market services	0%	0%

● % Females   ● % Males
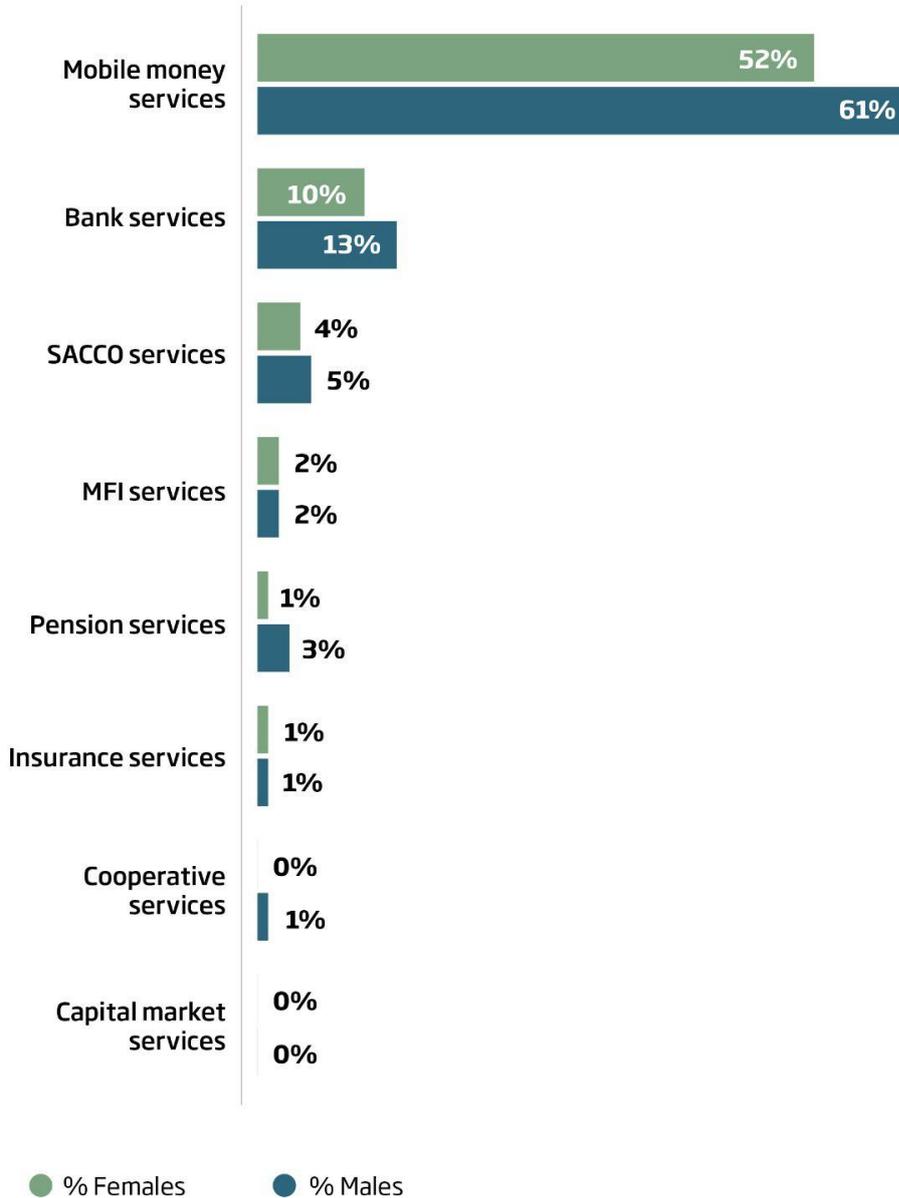
Source: FinScope Gender and Youth Analysis in Uganda. FSDU, 2018.

Figure 12: Uptake of formal financial services per provider by gender.

The cost barrier for mobile money access from low income groups has been heightened by the recent introduction of a 0.5 percent surcharge on the value of withdrawal transactions on top

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[54] The total number of mobile money accounts that made at least one Mobile Financial Service (MFS) transaction in the 90 days preceding 30th September 2021.
[55] Market Performance Report 3Q21. Uganda Communications Commission, 2021,

of high excise duties (12 percent) and VAT charges (18 percent), which constitute about 30 percent of mobile money retail charges, in addition to a universal service levy of two percent over and above relatively high company taxes.[56] As noted above, cost of devices, energy sources for charging devices and the cost of internet are often cited as the key barriers to access.

Box 1: Women's Barriers to Using DFS.

Most women who are financially excluded reside in rural areas (87 percent). They are predominantly young, with 62 percent under the age of 36. 86 percent have attained at most primary school education, and the majority rely on economic activities that provide them with income on an irregular basis.[57] Lack of formal ID, low financial literacy and limited geographic access to formal financial institutions are barriers to women owning formal financial accounts. Unbanked women rely on VSLAs to access credit for emergency expenses and consumption smoothing. Women cite affordability of services, awareness, insufficient money to justify use of formal services, lack of understanding/digital literacy, and cost of mobile devices as barriers to accessing formal financial services.[58] On the supply side, the private sector often states that the business case for serving low-income communities is weak. Given poor road networks and telecommunications connectivity challenges, the cost of establishing physical access points is not sustainable in most remote locations where the majority of financially excluded women reside.

Access to suitable financial products and services remains a major bottleneck for many women-owned agriculture enterprises, especially at the growth stage. Their capital needs are larger than their primary source of credit SACCOs, farmer cooperatives and Village Savings and Loans Associations (VSLAs) but smaller than values considered attractive for commercial banks.

Collaboration with the private sector to develop business models that increase women's access to, and usage of mobile phones is necessary. Community financial literacy capacity building and sensitization to demystify and dispel misconceptions around women's phone ownership is also necessary.

3.4 Digital Entrepreneurship

Although there has been an increase in digital commerce platforms like ride hailing and courier services, 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).[59] Despite Uganda being among the pioneers of mobile payments platforms in Africa, which are a key enabler for e-commerce, the Ugandan Rapid eTrade Assessment (2018) conducted by 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.

Of the few existing e-commerce platforms, the majority cannot complete payment transactions digitally with most transactions terminating in cash-on-delivery or mobile money payments on delivery. Desk research revealed that the key challenges contributing to this trend are the 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. Key pieces of legislation (discussed in detail in section 4.1.2.4) and their implementation - especially on cybersecurity and cybercrime, data protection, and protection of critical information infrastructure (CII) - need to be strengthened.[60]

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[56] The State of ICT in Uganda. Research ICT Africa,2019.

[57] FinScope Gender and Youth Analysis in Uganda. FSDU, 2018.

[58] Gender Barriers to Access and Use of Financial Services by Women in Uganda. FSDU,2021.

[59] Uganda Rapid eTrade Readiness Assessment, UNCTAD, 2018.

[60] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.

3.5 Digital Skills

The limited access to the internet and digital devices in rural areas, contributes to the rural-urban digital literacy gap and exacerbates SHF digital exclusion especially for women. Digital training and the continual dissemination of training materials are among the most critical components in promoting adoption of digital tools. Development partners are playing a vital role in increasing SHF digital literacy. UNCDF, for example, is implementing the "Digital Community Entrepreneurs" Program to enhance digital literacy with a focus on agriculture value chains. By incorporating digital literacy enhancement activities into existing and future USAID FtF activities, SHF digital literacy can be accelerated in the FtF zones of influence.

Lack of a national digital skills framework that guides government policies, programs, curriculum and standards for digital skills, inadequate connectivity and equipment at schools, and strong leadership on digital skills development have constrained national digital skills development. The government's imposition of taxes on used equipment like computers, computer parts, printers and copiers restricts the adoption of ICT by learning institutions which would otherwise accelerate digital skill adoption as well as MSMEs uptake of digital solutions. Skills gaps are particularly stark between men and women. For every 10 men in Science, Technology, Engineering and Mathematics (STEM), there is less than four women and, by the time the four are in the 5th year of their career, most leave the labor force to focus on domestic responsibilities.[61] Even among the employed population, more women than men possess no formal education: 6.2 percent versus 4.4 percent respectively; and two-thirds of young women in employment lack a trade, technical skills, or specialization.[62]

4. Digital Agriculture Ecosystem

In this section we share highlights of the current digital agriculture ecosystem, challenges, and recommendations. We highlight areas in which USAID/Uganda can leverage its expertise to enhance the digital agriculture ecosystem. With regards to specific programming interventions, the research team identified key agriculture sector bottlenecks where digital technology application would have a significant impact on resolving respective challenges, provide an incentive for digital technology adoption and greatly advance digital agriculture ecosystem development. The incorporation of recommendations into currently running FtF activities calls for respective program teams to evaluate their feasibility.

In our assessment, we took into consideration the USAID Digital Ecosystem Framework (Figure 13) - like the World Bank Digital Ecosystem Framework referenced in section 3 - to align key ecosystem development pillars with recommendations. The USAID Digital Ecosystem Framework identifies three core pillars necessary for building a sustainable and enabling digital environment:[63]
1. Digital Infrastructure and Adoption
2. Digital Society, Rights and Governance
3. Digital Economy.

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[61] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.
[62] Digital Economy for Africa (DE4A) Uganda Country Assessment. World Bank, 2021.
[63] USAID Digital Strategy 2020-2024, USAID 2020

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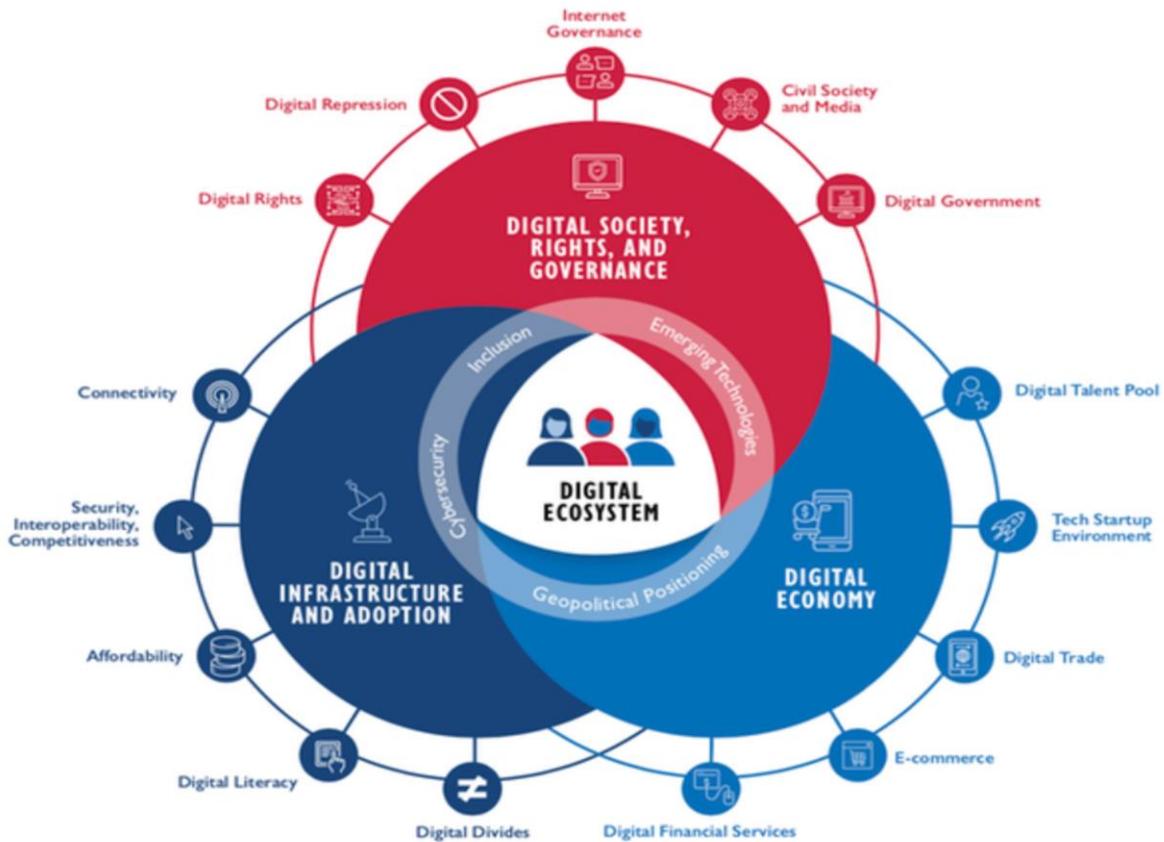
Source: New USAID Digital Ecosystem Framework for International Development. ICTworks, 2020.

Figure 13: USAID Digital Strategy (2020-2024) Ecosystem Pillars & Cross-Cutting Topics.

This report provides recommendations for addressing agriculture sector bottlenecks in two of the core USAID Digital Strategy Ecosystem pillars - Digital Infrastructure and Adoption and Digital Economy. Although there are several high priority agriculture digitalization bottlenecks that USAID programs could address, presented below are recommendations that meet the following criteria:

A. Immediate intervention could accelerate the shift in agriculture ecosystem digitalization.
B. Significant technical and financial resources have been expended by other stakeholders and the additional effort from USAID would potentially accelerate the impact of digital technology adoption and utilization to materialize productivity gains.
C. Interventions would build on the successes driven by the various Feed the Future program activities.
D. Digitization efforts that would drive increased inclusion of youth, women, people with disabilities and refugee participation and productivity.
E. Digitalization developments that would improve mechanisms for unlocking access to finance, particularly value chain financing and crowd funding.

4.1 State of the Ecosystem

Digitalization of agriculture is possible in an enabling environment that provides suitable infrastructure, effective institutions, implementable policies, and supports services for the sector. A robust digital agriculture ecosystem is built upon three interconnected elements (Figure 14); Enabling Environment, Digital Agriculture Infrastructure (digital stack), and Digital Agriculture Solutions Use Cases.
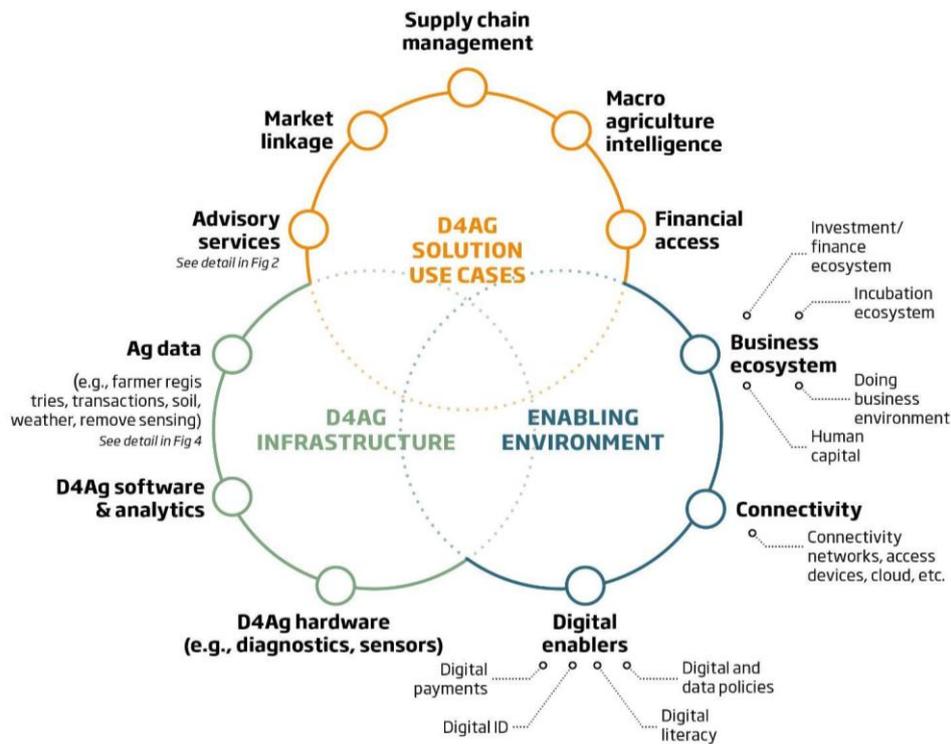
Source: The Digitalization of African Agriculture Report, CTA, 2019.

Figure 14: D4Ag Ecosystem

The digital agriculture ecosystem in Uganda is growing rapidly with the development of innovative digital platforms by local providers and a few international players.

Box 2: Agriculture Platforms in Uganda

Globally, ag-platform delivery is structured around five models.
1. The production and exchange model consists of three scopes: backward exchange, horizontal offers and information services, 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.
2. Output exchange occurs midstream in the value chain, consisting of three scopes: forward exchange, post-harvest and information services. This is an auction-based model, wherein farmers are provided information on crop prices and on logistic prices to transport products, as well as post-harvest services such as grading and packaging.
3. Trading and sharing consists of five scopes: marketplace matching, horizontal offers, information services, complex information services, production and harvest services, and sharing and knowledge exchange. This model covers the full value chain, as it includes services from the pre-production stage to the output sale.
4. Guarantee purchase and logistics consists of two scopes; guaranteed purchase and prices, and information services. In this case, Ag-platform firms act as intermediaries and buyers, by taking the onus of loss onto themselves. They provide farmers with contracts, along with a guarantee of purchase at specific market defined prices.
5. The single buyer-led (integrated) model works within a completely vertically integrated value chain, wherein the main off-taker, be it a processor or a retailer, directly controls the entire value chain and there is already a predetermined market.

In Uganda, 50% of the apps are production-and-exchange-related; this is followed by 20% in trading and sharing and one for output exchange and single buyer-led, respectively. None of the apps reviewed (or that were known to government/other app developers) related to guaranteed logistics and purchase. Overall, the results suggest that adoption rates increased most in production and exchange models because of relatively low costs and the lower complexity of product and capabilities required. Much of the change in trading and sharing models was driven by significant support from donors, the hands-on approach of the Ag-platform staff and the significant expansion of the app in urban and peri-urban farming. This led to a high rate of adoption despite its higher costs and capabilities. Trading and sharing platforms showed the most improvement in terms of productivity, value addition/diversification, number of jobs created and gender inclusion; it was followed in this by production and exchange, single buyer-led and output exchange.

Source: Platforms in Agricultural Value Chains: Emergence of New Business Models. ODI, 2020.

Successful development of the above mentioned platforms is dependent on the functioning of the Digital for Agriculture pillars shown in Figure 14 and explained in detail in the following sections.

4.1.2 Enabling Environment

Enabling Environment generally encompasses connectivity infrastructure, policy, and regulation, enabling partners that provide solutions like DFS, digital literacy and the business ecosystem within which solutions are developed and scaled. To improve the innovation business ecosystem, there has been significant investment by the Government of Uganda and development partners in the establishment and growth of innovation hubs and start-up business incubators and accelerators.

4.1.2.1 Investment/Finance Ecosystem

For many tech companies in the agriculture sector, limited growth stage financing restricts their ability to scale. Although many potentially fit-for-purpose products have been tested, agriculture technology and financial technology players lack the requisite funding required for scaling these products. A business development manager at one of the innovation hubs cited limited local capital, institutional investment, and venture capital financing as key challenges to scaling local digital solutions. Traditional financial institutions do not understand the business models of technology companies and are more comfortable extending credit for physical assets such as computers and not,

for example, working capital. Most early-stage solutions are financed by founders bootstrapping (building a company from personal finances or operating revenues of the young company) which is insufficient for scale. During the COVID-19 pandemic, investments in Uganda were stifled. The total number of investments fell to 35 in 2020 compared to 131 in 2019.[64]

Recognizing the low investment attraction traditional financiers have towards the agriculture sector, development actors have created some blended finance facilities to try to bridge the financing gap. Most of the facilities like the FCDO-funded Northern Uganda Transforming the Economy Through Climate Smart Agriculture (NUTEC) facility are structured towards supporting agribusiness growth and less towards agriculture technology start-ups. In July 2021, USAID Uganda launched the Strategic Investment Activity (SIA), a five-year program that strives to improve the livelihoods of under-represented and marginalised people by accelerating private investment in the country's agriculture, health, and energy sectors. The program works to accelerate and grow the investment ecosystem by increasing transparency, lowering transaction costs and risks, and creating partnerships that unlock commercial investments. The activity creates a pipeline of up to 40 investable companies operating in agriculture, health, and productive use of energy and screens them for gender, youth, and social inclusion impacts.[65] SIA should consider incorporating a component that focuses on increasing access to finance for AgTech companies.

Despite the growth of DFS enabled credit offerings, very few solutions address the long-term financing needs of smallholder farmers which include investments in machinery, farming tools and irrigation systems.[66] Increasingly, FinTechs and AgTechs are incorporating non-traditional financial transactions data like airtime purchases and Pay-as-you-go (PAYGo) utility payments into credit scoring algorithms, but to date, the credit amount thresholds are not suitable for long-term investment financing.

In 202O, the BoU, Financial Sector Deepening Uganda (FSDU) and Uganda Bankers Association (UBA) embarked on the development of an e-KYC facility - a centralized Application Programming Interface (API) to enable real-time and remote authentication of customer information in the Uganda Financial Sector. Integration of the e-KYC facility with the National Identification and Registration Authority (NIRA) ID database, MNO, Bank and Microfinance Institution platforms should reduce the access to finance burdens faced by farmers but this level of database integration is yet to be achieved.

4.1.2.2 Incubation Ecosystem

There is an active digital innovation community in Uganda. Most of this community can be found in universities, established innovation hubs and start-up accelerators that are predominantly situated in Kampala.[67] The Uganda Communications Commission identified 12 innovation and incubation centers in Uganda.[68] These institutions predominantly rely on grants to facilitate their operations and generally lack the technical capacity to support growth of start-up companies beyond the ideation stage. Given that many start-ups are operated by young, inexperienced university students or fresh graduates (19-29 yrs), they often lack the necessary skills to grow and manage businesses.[69] [70]

To increase access to innovation hubs, in 2020 the MasterCard Foundation partnered with the Innovation Village to establish centers in Mbarara, Jinja, Arua and Gulu. This initiative is a step in the right direction with regards to increasing access to creative spaces for remote developers; however, the major challenge of sustainability remains. Many hubs survive on short-term grants and

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[64] The start-up scene: Uganda's Small and Medium size enterprises account for sizeable share of Uganda's impact investing market, Investment Guide Africa

[65] Growing Uganda's Investment Ecosystem, Chemonics 2020

[66] Digital Agriculture Maps. 2020 State of the Sector in Low and Middle-Income Countries. GSMA AgriTech Program 2020.

[67] The terms "incubator", "start-up accelerator" and "innovation hubs" can be used interchangeably as most established hubs provide a mix of innovation incubation and acceleration.

[68] See Annex 1

[69] See Annex 8.3 for list of Innovations identified by UCC study.

[70] State of Information Communications Technology (ICT) for Agricultural Innovations in Uganda. UCC, 2019.

often struggle to retain subject experts who would mentor and coach start-ups towards developing sustainable business models. In addition, there is a wide gap between male and female developers, with women making up only 23.4 percent of all the developers in Uganda.[71] This can be explained by the fact that female participation in STEM in tertiary education is low. For example, at Makerere University, the largest university in the country, women enrolment in STEM courses is about 30 percent according to data from the 2016 Report of the Visitation Committee on Makerere University.[72] Second, women are faced with the expectation of securing predictable, full-time employment as soon as they graduate in order to supplement household incomes.

Siloed product development within institutions has led to considerable duplication and resource waste. Rapid prototype development challenges (hackathons) mostly financed by development partners, to address project specific challenges has skewed innovation incentives towards short-term financed projects with underdeveloped businesses cases rather than holistic long-term digital agriculture ecosystem development. As a result, many innovations struggle to survive after projects wind down and result in developers abandoning their innovations. The Innovation Village study found that 42 percent of technology developers were actively looking for another job.[73] One of the major downsides to this in key value chains of interest such as maize and coffee is the increasing farmer fatigue and mistrust in solutions that keep getting replaced with something new just when they are getting accustomed to a recently introduced solution.[74]

Facilitated by the innovation hubs, increasing collaboration between technology start-ups, private sector, and development partners has accelerated digital solutions testing in some agriculture value chains such as coffee. For example, in 2017 MTN Uganda partnered with UNCDF, Yo! Uganda (Fintech) and Kyagalanyi Coffee Ltd to deploy a digital payments solution in the coffee value chain. This collaboration has been beneficial for all stakeholders; MTN gained access to a new consumer base, Yo! Uganda was able to prototype, improve and scale their digital payments solution, Kyagalanyi Coffee Ltd gained from the increased payments transparency and traceability while UNCDF learned key lessons for digitizing agriculture value chains as a channel for increasing financial inclusion. In addition, championed by the Global System for Mobile Communications (GSMA) and the Bill and Melinda Gates Foundation, mobile network operators developed and opened technology company access to Mobile Money Access Programming Interface (API), which is enabling entrepreneurs to develop innovative financial and supply chain management solutions that can be leveraged by multiple sectors including agriculture.

4.1.2.3 Digital Literacy & Skills

Farmers' low levels of alpha-numeric, digital, and financial literacy are a major obstacle faced by developers and providers of digital technologies. For example, smallholder heads of households have limited formal education, rarely surpassing primary school (Figure 15), where one-fifth have no formal education, 64 percent did not continue their education past primary school and only 16 percent advanced through secondary school.[75] There is a sharp gender difference in education levels where female household heads are more likely not to have any formal education(47 percent, vs. 12 percent of men, have never attended school), (Figure 16).[76]

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[71] State Of The Developer Landscape in Uganda. Innovation Village, 2021

[72] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[73] State Of The Developer Landscape in Uganda. Innovation Village, 2021

[74] Extension services agent Interview. Conducted by NIRAS LTS, December 2021.

[75] National Survey and Segmentation of Smallholder Households in Uganda. CGAP, 2016.

[76] National Survey and Segmentation of Smallholder Households in Uganda. CGAP, 2016.
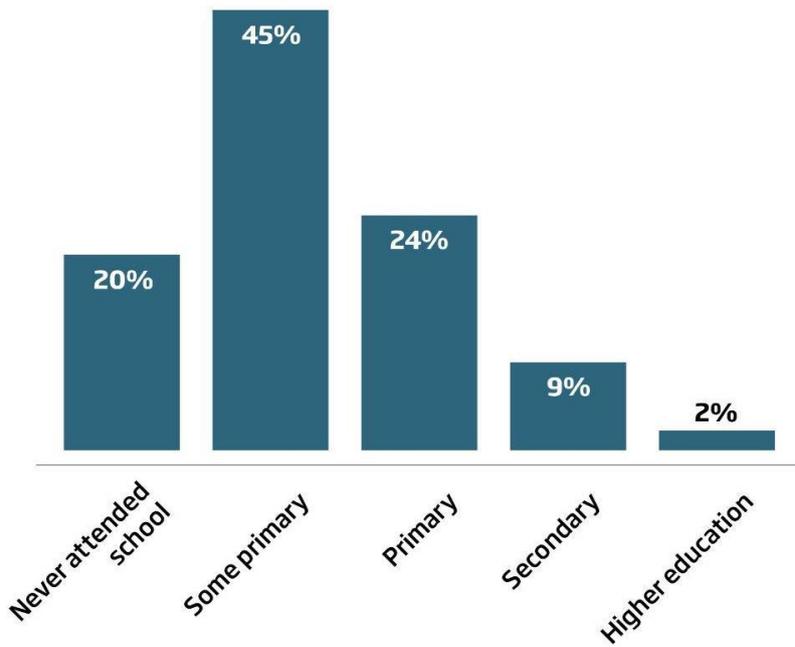
Source: National Survey & Segmentation of Smallholder Households in Uganda. CGAP, 2016.

Figure 15: Highest education attained by head of household.
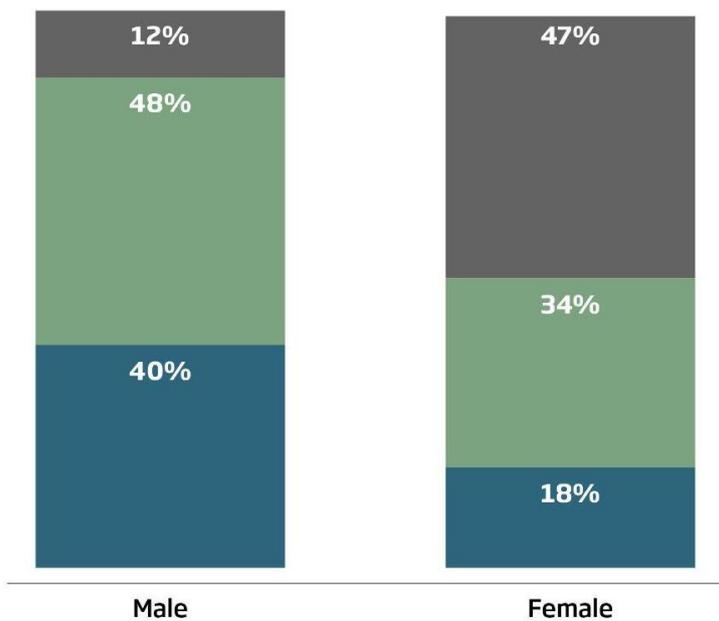
Source: National Survey & Segmentation of Smallholder Households in Uganda. CGAP, 2016.

Figure 16: Highest education attained by gender of household.

Persons with disabilities in Uganda struggle to attain digital skills due to limited access to appropriate learning technologies. One in five people over the age of five has a form of disability with the prevalence of disability increasing with age, from 12 percent among 5-9 years olds to 67 percent among those aged 60 years and above. Overall, there is limited research on digital inclusion of farmers with disabilities. GSMA identifies three types of barriers faced by persons with disabilities to their inclusion in farming activities i.e., systemic, attitudinal, and environmental barriers (includes barriers to digital inclusion). Although there are a limited number of digital solutions designed to increase the inclusion of disabled farmers, initiatives by agribusinesses to include farmers with disabilities are a step in the right direction.

Box 3: Case Study: East African Brewery Limited (EABL) and Oasis Agribusiness.

By working together with Organizations of Persons with Disabilities (OPDs), such as Sightsavers and Light of the World, EABL and Oasis identified different barriers that farmers with disabilities experienced in their value chain and implemented multiple changes, from introducing subsidized prices to increase the affordability of agricultural inputs, to deploying technologies that can improve commercial interactions (i.e. electronic scales with audible feedback, physically-accessible storage facilities). Importantly, by working with OPDs, both EABL and Oasis were able to develop a holistic strategy to ensure that their services are more accessible for farmers with disabilities.

Key lessons for disablity inclusion in the agricultral value chain

Actions	Farmer recruitment	Capacity building	Crop purchasing	Financing
Disability Inclusion in programme design	**Oasis:** Works with Light for the World to understand farmers' specific needs.	**Oasis:** Works with Light for the World to understand farmers' specific needs and how to provide training (e.g. content in accessible formats). Light for the World provides sign language training to staff and training on disability-inclusive employment.		
	EABL: Works with Sightsavers and local OPDs to identify and recruit farmers with disabilities and assess their specific needs.	**EABL:** Works with Sightsavers and local OPDs to identify the areas and specific skills that farmers with disabilities may be missing to develop tailored training.		
	EABL: Sightsavers conducted an accessibility audit of physical infrastrcutre and internal policies, and supported EABL in developing a disabilty inclusion strategy.			
Providing tailored services and support to farmers with disabilites	Oasis: Sells rice seeds and agricultural inputs via village agents at subsidsed prices.	Oasis: Trains farmers to train others. Supports service linkages with workers. Provides information via app and SMS, free call centre, support in local languages and sign language. There are plans to launch an IVR-enabled SMS.	Oasis: Installed audio software on digital scales. Storage is physically accessible.	Oasis: Identification and verification via fingerprint. Village agents (and mobiel money agents) come to farmers.
	EABL: Offered pre-financing and Sightsavers underwrote crop failures during a pilot to prove the business case for disablity inclusion.	EABL: Trains farmers in business skills.		

Source: Driving Inclusion of Farmers With Disabilities Through Digital Agriculture. GSMA, 2021.

Source: Platforms in Agricultural Value Chains: Emergence of New Business Models. ODI, 2020.

By embedding the [GSMA Principles for Driving the Digital Inclusion of Persons with Disabilities](link) into FtF activities, USAID can expand the digital inclusion of SHFs with disabilities.

4.1.2.4 Digital and Data Policies and Regulation

In general, there is an enabling policy environment with proper guiding frameworks to promote the development, adoption and safe use of digital technologies in agriculture. Key policies include the Uganda Communications Act 2013, Telecommunications Policy, National Broadband Strategy, Computer Misuse Act 2011, Electronic Transactions Act 2011, Electronic Signatures Act 2011, NITA-U Act 2009, and the E-Waste Management Policy. To align with technology evolution, policies and respective regulatory frameworks will need to be continually updated.

Uganda has in place a National Broadband Policy which aims to expand broadband access across the country. In addition, the draft Digital Uganda Vision provides an overarching framework that responds to the national Vision 2040 by providing a unified ICT policy direction. It further provides the Government's integrated policy and strategic framework to show how ICT can empower Ugandan citizens and achieve the goals of universal inclusion, sustainable development, economic progress, and poverty eradication through digital innovation.[77]

Increasing access to digital financial services will be facilitated by the recently passed National Payment Systems (NPS) Act and its respective implementation regulations. The new law seeks to enhance financial inclusion especially for poorer and rural people to access financial services by allowing non-telecommunication players to establish more payment services. Through this Act, the Bank of Uganda commenced licensing of Payment System Operators, Payment Service Providers, and Issuers of Payment Instruments. Section 49 (6) of the NPS Act, 2020 and Regulation 14 of the NPS Regulations, 2021, provides for interest to be paid to e-value account holders. Going forward, holders of mobile money accounts will earn interest on their accounts.[78]

To accelerate implementation of digital skills capacity building at the tertiary institution level, and to streamline investments in the formal education sector, the passing of the draft ICT in Education Policy is required. Coupled with this, the government needs to develop a national digital skills framework that guides government policies, programs, curriculum and standards for digital skills, inadequate connectivity and equipment at schools, and strong leadership on digital skills development.[79]

The taxation policy for digital products and services is a hindrance to the adoption of digital technologies and the growth of the digital economy. The 0.5 percent tax levied on mobile money withdrawals has become a deterrent to increasing mobile money usage by poor consumers. Given that mobile money is a gateway product to formal DFS, such a tax hampers DFS product development and makes it challenging for start-ups to extend products and services to the masses to achieve scale and commercial sustainability. Reducing internet access taxes from 30 percent to 10 percent, by some estimates, could lead to a seven percent increase in internet users and 30 percent increase in internet traffic.[80] This tax also creates an uneven playing field between DFS providers and traditional financial services providers as this tax does not apply to withdrawals through the traditional channels.

Uganda passed the Data Protection and Privacy Act, 2019 and the Data Protection and Privacy Regulations, 2021 to ensure individuals and their personal data are protected. The law expands the rights of individuals to control how their personal data is collected and processed, placing a range of obligations on those processing (which includes both public bodies and companies) personal data to be more accountable for data protection and regulates and limits the processing of special categories of personal data, including tribe, religion, and health, amongst others.[81] Unfortunately, with the delay in operationalizing the Data Commission Office, responsible for the implementation of the

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[77] Ministry of ICT and National Guidance. Mar 4, 2022. www.ict.go.ug/initiatives/digital-uganda-vision/

[78] What does separation of mobile money from telcos mean? The independent, 26 May 2021.

[79] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[80] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[81] One year on, what has Uganda's Data Protection Law Changed? Privacy International, 3 March 2020. https://privacyinternational.org/news-analysis/3385/one-year-what-has-ugandas-data-protection-law-changed

regulations, public and private sector actors are taking almost no measures to meet their obligations under the Act and are collecting increasingly sensitive data. MNOs and banks are collecting biometric data for SIM registration and bank account opening respectively. When interviewed, the understanding by MNO management is that this is a government directive. Different levels of adherence to the regulations are applied by FinTechs depending on interpretation of the obligations. Few AgTech companies were able to articulate the real implications of adhering to the regulations on their business processes and operations. They advised that sensitization workshops be conducted for knowledge sharing and guidance on interpretation of the law as few of them could afford private legal counsel services.

To foster digital enterprise growth, cyber security laws and regulations were developed under the Uganda Communications Act. The World Bank recommends strengthening cybersecurity and cybercrime legislation by passing the Critical National Information Infrastructure (CNII) bill, developing a standalone national cybersecurity agency to house the national Cyber Emergency Response Team (CERT) and supporting sectoral CERTs/Security Operations Centers (SOCs).[82] In addition, strengthening threat intelligence, monitoring, prevention and response by upgrading and scaling up the capacities and operations of the national CERT as well as building cybersecurity capacity and digital skills by piloting a cybersecurity skills program in the education system will be necessary steps for increasing consumer confidence in digital technologies.[83]

4.1.3 Digital Agriculture Infrastructure (digital stack)

Digital Agriculture Infrastructure (digital stack) is built on agriculture data (farmer and farm profiles) data analytics and integration software and hardware. The digital stack is a foundational bedrock upon which sound digital platforms can be built leveraging big data analytics.

Agriculture data infrastructure is key to accelerating agriculture technology research and development. Data infrastructure is the system which enables and governs the collection, access and transfer of data (which together are referred to as data governance), as well as storage, and analysis of farm data to produce knowledge and advice (actionable insights) and feedback loops to stakeholders in the agriculture sector, including farmers and policy makers.[84] Unfortunately, the agriculture data infrastructure is weak with fragmented distribution of data sets, duplication of hardware and non-interoperable software developments across MDAs, private sector and development partners. For example, there is no shared or centralized data platform where data collected on smallholder farmers by AgTechs, FinTechs, Banks and government agencies can be accessed. One way of visualizing the infrastructure for agriculture data is set out in Figure 17, below.

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[82] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[83] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.

[84] Digital Opportunities for Better Agricultural Policies. OECD, 2019.
https://www.oecd-ilibrary.org/sites/d2fbead0-en/index.html?itemId=/content/component/d2fbead0-en

Policies affecting technology adoption and service provision
► Regulations affecting the harvesting of data specific to the production system and its ecosystem

Farm Production system

Sensors: Remote and in-situ
► Other (drones, network of sensors in monitored ecosystems)
► On-farm

Analytics and modelling: augmented intelligence
► Agriculture business services (platforms, digital extension services, technical advices)
► IoT specific: augmented behaviour (machine to machine)

► Regulations affecting the supply of services to provide actionable insights

Policy monitoring and implentation

UNDERPINNING CONNECTIVITY INFRASTRUCTURE

Standards:
► Data ownership
► Data flows
► Privacy
► Security

Digitalisation of the farm system & collection of data (datafication)
► Connectivity infrastructure in rural areas (broadband, WiFi, mobile)

Storage and data management
► Data management & storage technologies

Standards:
► Interoperability
► Data ownership
► Privacy
► Security

Association with data from other sources (Big Data)
► Data analytics

► Big Data governance:
► Data ownership and open data
► Pre-competitive space
► Liability

● Digital technologies and services   ● Institutional arrangements   ● Data and information flows

Source: Digital Opportunities for Better Agricultural Policies. OECD. 2019.

Figure 17: Agriculture Data Infrastructure.

4.1.3.1 Agriculture Data

Agriculture generates more field level data across the entire value chain than almost any other sector. Unfortunately, the integration of data generated from farmers, input manufacturers and dealers, off-takers, and technology solution providers remains largely unattained. These large data sets containing agronomic data, market information, soil and weather data and financial data can be analyzed to identify patterns, glean insights, and inform trends that overall contribute to the development of sustainable solutions that are tailored to farmer needs. Agriculture data is necessary for the development and scaling of artificial intelligence (AI) and machine learning technologies. Unfortunately, as in most emerging markets, gaps in agronomic data needed to teach AI systems, particularly given the diversity of farmland and crop varieties, is a barrier to replication and scale.[85] Quality up-to-date data is the fuel for data software used to develop appropriate technologies. Figure 18 shows how different data sets overlap to inform software and hardware developments.

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[85] Artificial Intelligence in Agribusiness is Growing in Emerging Markets. IFC,2020.
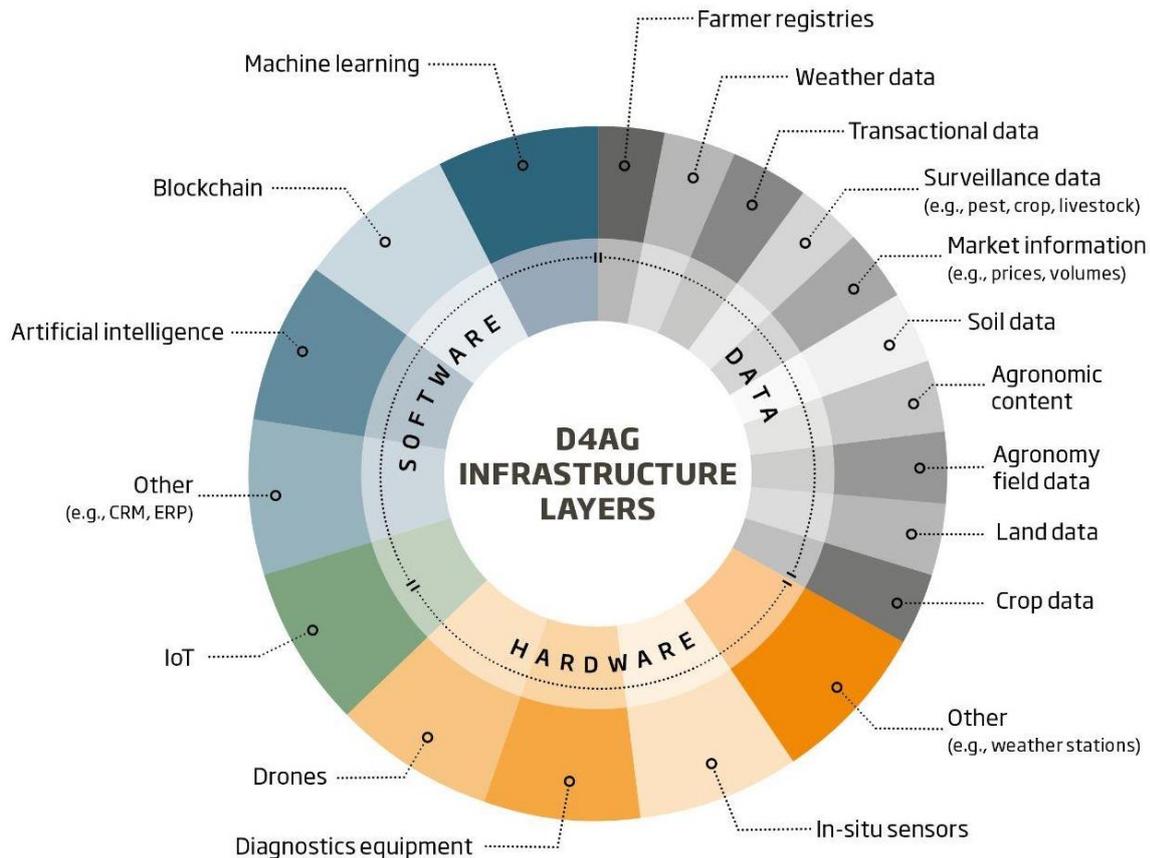
Source: The Digitalization of African Agriculture Report, CTA ,2019.

Figure 18: D4Ag Infrastructure Layers

There is significant duplication of data collection at multiple levels in the agriculture sector. Agriculture sector data sets are not standardized, are irregularly updated and weakly integrated. This makes aggregation of information for innovation purposes a challenge – it is a missed opportunity for accelerating modelling and informing policy formulation. Fragmented data and the absence of a data analytics stack limit the ability for stakeholders to access, model and utilize data to generate business models. For example, USAID, UNDP and GIZ have provided substantial support to the Uganda National Emergency Coordination Operations Center (NECOC) to enhance provision of early-warning information on disasters, climate modelling and forecasting. NECOC currently sits on a wealth of weather, pasture and soil data that could be leveraged by banks, insurance providers and AgTechs to design suitable products and services. Unfortunately, NECOC lacks the appropriate infrastructure to share this information in a timely manner to a multitude of stakeholders.

Reliable data is also a foundational pillar of product development for suitable digital financial services. A robust data infrastructure would enable financial service providers to collate a cross section of data points across data sets to construct comprehensive financial profiles of farmers leading to development of suitable products and services. The ability to include alternative financial data like mobile money transactions data, remittances data and utility payments data in credit scoring algorithms increases the probability of farmers meeting financial service provider eligibility criteria and thus increases access to timely finance through production and marketing cycles. In addition, data informed curriculum design for digital and financial literacy would enhance the impact of education activities.

Through several partnerships, USAID has invested in agriculture data development related programs such as: Enabling Crop Analytics at Scale; Regional Food Balance Sheet; and NASA Harvest. Agriculture stakeholders such as national and international research institutions, international institutions like FAO, IFAD, IFPRI, MNOs, data firms and technology companies have a wealth of data stored and utilized in silos. What appears to be the missing link is a deliberate approach to harmonize, build upon, and centralize the access to and utility of these data sets.

4.1.3.2 Digital for Agriculture (D4Ag) Software and Analytics

The absence of an integrated framework to drive agriculture ICT integration has contributed to the duplication of efforts in the sector. Both public and private sector actors develop standalone products with niche or non-interoperable software platforms creating a plethora of similar single user and single function solutions. In an effort to address this challenge, MAAIF is in the process of developing an ICT strategy to streamline stakeholder efforts. With support from the World Bank, MAAIF, National Agriculture Research Organization (NARO) Secretariat and some Zonal Agricultural Research and Development Institute (ZARDIs), capacity building activities for ICT officers in the area of e-platforms development have been conducted.[86] MAAIF is working on developing e-M&E, e-Extension and e-Markets platforms to meet the objectives of performance improvement in terms of (a) flow of information between farmers and other actors, (b) enhancing sector e-M&E function and public accountability; (c) facilitation of market links through e-marketing and e-certification; (d) production support through e-vouchers; and (e) publicly accessible platform for agricultural information and statistics (e-agric statistics).[87]

There are few companies offering agriculture data analytics services with development partners being their predominant clients. Not fully appreciating the value of big data analytics in product development and decision making, the local agribusiness private sector is reluctant to pay for data analysis services. Key informant interviews revealed that MNOs have been exploring ways to monetize their big data particularly for the agriculture sector but have struggled to arrive at sound revenue models. Another shortcoming is the limited integration of data from other facets of farmer lives and agribusiness life cycles. Public and private sector entities such as utility companies, banks and credit reference bureaus do not openly share useful data that would inform development of suitable value adding/bundling products and services. Interviews also revealed that AgTechs would like more capacity building around the development and application of machine learning and artificial intelligence technologies. Although few, Table 2 shows that, increasingly, firms are recognizing the commercial value of agriculture data and are providing data as a service.

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[86] State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.
[87] State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.

Table 2: Sample of companies offering data solutions

	Company/ Brand Name	Products	Development Partners/Investors
1.	Axion Zorn	Provides Big Data analytics for the agriculture sector. Collects drone & satellite enabled weather data, fertilizer optimization data and tools. Extension and advisory services as well as farmer and agent certification.	Heifer International
2.	Data Care	Provides mobile survey data collection tools and customized information systems development to enhance data driven decision making. Data Care has also designed the system architecture for an integrated National Food and Agricultural Statistics system for MAAIF. The system will be integrated with all key stakeholders information systems that collect agricultural statistics data such as Bank of Uganda, Uganda Bureau of Statistics and Uganda Revenue Authority.	USAID, ASARECA, Kilimo Trust, MAAIF

4.1.3.3 Digital for Agriculture (D4Ag) Hardware

There is limited adoption of D4Ag hardware like drones, IoT sensors, robots, and Radio Frequency Identification (RFID) technologies as they are expensive to deploy. The dearth of basic ICT and digital technology tools like computers, robotics hardware and software in higher education institutions has constrained digital skills development around smart farming technologies. The State of Higher Education Report 2017/18 notes that the computer to student ratio at higher education institutions is still low at 1:16 with the majority of the computers being old with a limited life span and unable to support modern software programmes.[88]

Many smart technologies from more advanced economies are designed for large scale commercial agriculture business models and do not meet the reality of small farm holdings predominant in Uganda. A robust open data infrastructure would support the development of technologies that are suitable for smallholder farms and save resources spent on trying to fit first world technologies into smallholder farm contexts with unsustainable business models.

Globally there is a slow but steady growth in the uptake of digitally shared agriculture assets enabled by Pay-as-you-go (PAYGo) models through DFS platforms, however, there has been low success of this business model in Uganda. These shared assets services include a range of mechanized farm equipment and drones for crop monitoring and spraying.[89] Globally, examples of companies offering drone services are Poladrone in Indonesia, Thailand, Vietnam and Malaysia, AcquahMeyer in Ghana and BeatDrone in Nigeria. Agritech companies like SunCulture in Kenya are offering farmers access to PAYGo solar-powered irrigation systems, making them more affordable.[90]

4.1.4 Digital Agriculture Solutions Use Cases

Digital Agriculture Solutions Use Cases are the primary incentives that drive farmer and agribusiness adoption of digital technologies. The more fit-for-purpose a solution is in addressing a challenge, the higher its adoption and repeat use which drives scalability and profitability for the

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[88] Uganda Digital Economy for Africa (DE4A) Report, Country Diagnostic, 2020.
[89] Digital Agriculture Maps. 2020 State of the Sector in Low and Middle-Income Countries. GSMA AgriTech Program 2020.
[90] Digital Agriculture Maps. 2020 State of the Sector in Low and Middle-Income Countries. GSMA AgriTech Program 2020.

service provider. GSMA has categorized the breakdown of digital technology in agriculture use cases (see Annex 8.2).

Most D4Ag solutions in Uganda are at the critical inflection stage (Figure 19) and need technical capacity building and financial resources to mature into scalable business models. According to the Uganda Communications Commission, 183 innovations at various stages of development were identified as of 2019 with the majority (109) of them at idealization stage and largely focusing on smallholder farmers' information management needs as a means of complementing extension services.[91]

DIGITAL AGRICULTURE PERFORMANCE AND POTENTIAL

	Basic investment stage	Digital inflection point	Moderate digital capacity	Robust scaling capacity
STAGE	Regions at this stage require significant basic investments in agriculture systems to prepare the way for digital agriculture to have a meaningful impact	Regions at this stage some limited digital infrastructure, but are at an inflection point for digital agriculture, driven by the public or private sector	Regions at this stage have moderate digital infrastructure and innovation capacity with public or private sector led pathways for scaling and impact	Regions at this stage have more robust digital infrastructure and innovation capacity to scale comprehensive digital agriculture solutions (led by the public sector, the private sector or both)
EXAMPLES	Burkina Faso, Malawi, Mali and Mozambique	Ethiopia, Tanzania, Uganda, some Indian states (e.g. Bihar)	Nigeria and some Indian states (e.g. Uttar Pradesh and Odisha)	Ghana, Indonesia, Kenya, Rwanda and some Indian states (e.g. Andhra Pradesh)

Source: The Digital Agricultural Revolution Will Take more than Innovation.

Source: The Digital Agricultural Revolution Will Take more than Innovation.[92]

Figure 19: Stages of Digital Agriculture Maturity.

AgTech solutions promise to enable smallholder farmers to be shock responsive and manage scarce resources like fertilizers and water efficiently as well as enhance access to markets, transport logistics, extension services and credit. Many of the innovations are centred around mobile phone-based applications. Solutions offered are largely developed using mobile and web technologies especially Android platform for mobile, Java, PHP, and MySQL for web applications.[93] Local tech hub Innovation Village estimates that four in five tech start-ups in Uganda use one or more mobile platforms in their solutions to create and distribute locally relevant content and services across the country.[94] There is limited development in the space of artificial intelligence, machine learning and robotics.

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[91] State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.

[92] Baskaran Shruti et al. "The Digital Agricultural Revolution Will Take more than Innovation." Boston Consulting Group, JULY 22, 2021, https://www.bcg.com/publications/2021/digital-agriculture-and-development.

[93] State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.

[94] C. K Japheth, interviewed by NIRAS LTS, Dec 2021.

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Although there has been growth in the number of technology companies in Uganda such as Metajua, Akorion and MobiPay engaging in the sector, the majority have failed to develop sustainable business models to scale. Figure 20 shows that only about 9.3 percent of innovations have grown to commercialization stage, with the majority, 54.3 percent, at the ideation stage. Few firms provide a suite of digital solutions to address bottlenecks along the entire value chain creating the need for end users to purchase multiple digital solutions to address different needs along the value chain. The cost implications of adopting multiple fragmented digital solutions is a disincentive for adoption of digital tools by farmers and agribusiness. Products that offer end-to-end solutions with clear revenue models have a stronger value proposition for users and providers.
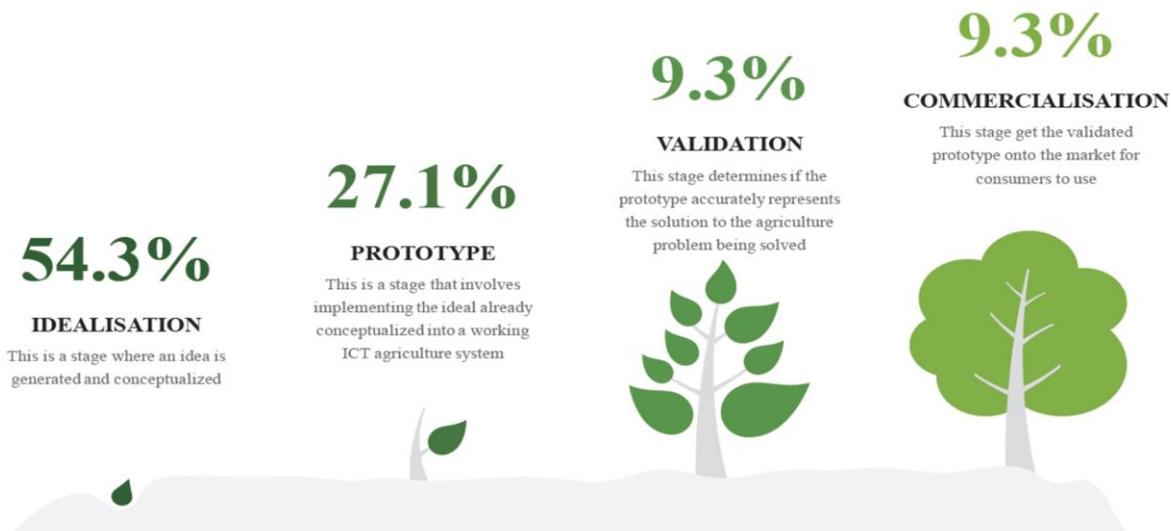
54.3%
IDEALISATION
This is a stage where an idea is generated and conceptualized

27.1%
PROTOTYPE
This is a stage that involves implementing the ideal already conceptualized into a working ICT agriculture system

9.3%
VALIDATION
This stage determines if the prototype accurately represents the solution to the agriculture problem being solved

9.3%
COMMERCIALISATION
This stage get the validated prototype onto the market for consumers to use

Source: State of Information Communications Technology (ICT) for Agricultural Innovations in Uganda. UCC, 2019.

Figure 20: Profile of Key ICT4Ag Innovations.

There is an over-concentration and duplication of similar solutions tackling the same problems driven by innovator intuition and passion rather than informed research.[95] Many of the available solutions address farmer profiling, input sourcing, generic agriculture information services, basic market price information and identification of produce and input suppliers. For example, AgTechs like Famunera, MobiPay, Akorion, Farm Kiosk all offer similar solutions. There are few solutions tackling transport logistics, crop and livestock insurance and climate smart agriculture training.

4.1.4.1 Agriculture Information and Advisory Services

Timely and quality extension services are now more crucial than ever with the reality of climate change and the need for farmers to continuously upgrade their skills to keep up with developments in agricultural best practices, as well as to adopt climate smart farming techniques. Given the low literacy levels of SHFs, extension workers provide important face to face knowledge for communities where learning by doing and visual learning is most effective. The cost of upgrading extension worker technical capacity continues to be prohibitive for the government which has resulted in farmers receiving outdated farming technologies training with negative impacts on productivity.

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[95] State of Information Communications Technology (ICT) for Agricultural Innovations in Uganda. Uganda Communications Commission, 2019.

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The Directorate of Agricultural Extension Services (DAES) struggles to deliver adequate and consistent agricultural extension services.[96] According to the Budget Monitoring and Accountability Units' Policy Brief (2019), Uganda's agriculture extension system faces the following key issues:

1. Lack of coordination and collaboration that leads to duplication of services.
2. Low coverage of extension beneficiaries and inadequate provision of services. This is largely due to limited transportation means for agricultural extension workers.
3. Poor adoption of agricultural technologies and best practices.
4. Ineffective extension approaches delivered through unskilled extension workers.
5. Late release of funds that delays implementation.

In Uganda, mobile connectivity is well developed and has contributed to the growth of the agricultural information dissemination via mobile (e-Extension) use-case. Our research identified more than 20 organizations and companies providing e-extension services including Sasakawa, EzyAgric, eDiary, WeFarm and MAAIF. Table 3 shows a sample of local companies, some of which have been supported with technical and financial assistance from USAID (Akorion, MobiPay).

Table 3: Sample of companies offering digital advisory and extension services

	Company/ Brand Name	Products & Services	Users	Development Partners/Investors
1	M-Omulimisa	- Extension services (farm mapping, soil testing, weather, advisory) - Inputs distribution - Produce e-marketing - Agriculture finance and insurance.	- Farmers - Extension Agents	Indigo Trust, MAAIF, Yunus Social Business
2	Akorion (EzyAgric)	- Extension services (farm mapping, soil testing) - Inputs distribution	- Farmers - Extension Agents	USAID, Airtel Uganda, Nguvu Africa
3	MobiPay	- Extension services (advisory, farm mapping, soil testing, crop monitoring,) - Inputs distribution - M I S development management and enterprise solutions - D F S (Bulk Collections and Bulk Payments), Micro credit and loan recovery, digital VSLA and SACCO platforms. - Digital literacy training	- Farmers - Extension Agents	UNCDF, USAID

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[96] Performance of Agricultural Extension Services: What are the emerging challenges? MoFPED. Budget Monitoring and Accountability Unit Briefing Paper 25/19. May 2019.

Most agriculture technology companies are participating in the agriculture information and advisory space. Unfortunately, almost all these solutions have failed to scale due to their being founded on non-sustainable business models driven by development partner funding incentives rather than private sector investment (see Box 2). Our research shows that digital technology development for the agriculture sector is marred by:

A. Solution and content development occurring in silos, leading to duplication of effort.
B. Duplication of data collection exercises. Lack of standard data parameters limits functionality and interoperability of data platforms.
C. Free-to-user solutions that wither away when donor funding ceases.
D. Repeat targeting of similar beneficiaries driven by grant provider geographies/crop value chains of choice.
E. Non-customer centric products designed to solve development partner challenges rather than farmer challenges. Most of the content is in English which limits the self-navigation potential of farmers, many of whom are essentially illiterate.
F. Most solutions are targeted towards primary production activities and not off-farm value chain activities where youth are more likely to have interest.
G. Single service value proposition products which overwhelm farmers and agribusinesses as they must access multiple platforms for different types of information which increases cost of access.
H. Limited or no verification and certification of advisory information being disseminated over these platforms, especially the peer-to-peer advisory platforms.
I. Standards for e-Extension are non-existent with poor oversight and verification of learning content. Farmers have stated that they are often in receipt of contradictory information from technology companies, government agencies, NGOs and donor agencies which reduces their trust in digital tools that ought to provide reference and guidance.[97]

Box 4: USAID Observations on Inclusive Agricultural Markets Activity Expressions of Interest Reponses

An evaluation of Expressions of Interest and Requests for Applications of the IAM activity (Quarterly Progress Report, Q3 FY 2020) identified two key bottlenecks for digital technology development in the extension services space:

Proposals did not have sustainable business models for fit-for-context solutions - "A key problem among all the proposals was a clear statement of the business model being pursued by the proposer, nor did many of the proposers delve into how their proposed approaches intended to bring underserved target groups into the market systems. Across almost all the proposals, there was a prominent lack of innovation as many of the proposers simply presented ideas that have been tried and funded in the past with limited success and sustainability."
Low private sector engagement due to fear of information confidentiality and misalignment of RFA processes and private sector internal results and performance system.

4.1.4.2 Market Linkages

Timely and predictable access to markets is essential for securing and growing smallholder incomes. Digital marketplaces have the benefit of connecting farmers to wider markets, especially non-traditional customers. Given the weak storage infrastructure, digital platforms offer speed to market which reduces the loss of produce. Agriculture e-commerce has emerged as a critical channel for market access during the pandemic, fuelled by social distancing measures and the shift to cashless transactions and mobile money.[98]

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[97] Farmer Focus Group Discussions. Conducted by NIRAS LTS, December 2021.
[98] Bridging The Digital Gender Divide: Include, Upskill, Innovate. OECD 2018.

Farmers on agricultural technology platforms have greater access to productivity-enhancing services, such as training and financial services.[99] Farmers who use agriculture platforms report that their main reasons for registering relate to the sale of produce over 20 percent of users ranked 'finding buyers' as the most important reason for registering (Figure 21), followed by access to advisory/extension services (15.7 percent), information on prices and weather (15.7 percent), obtaining working capital or loans (14.3 percent), and gaining access to better inputs (14 percent).[100]

Percentage of users %
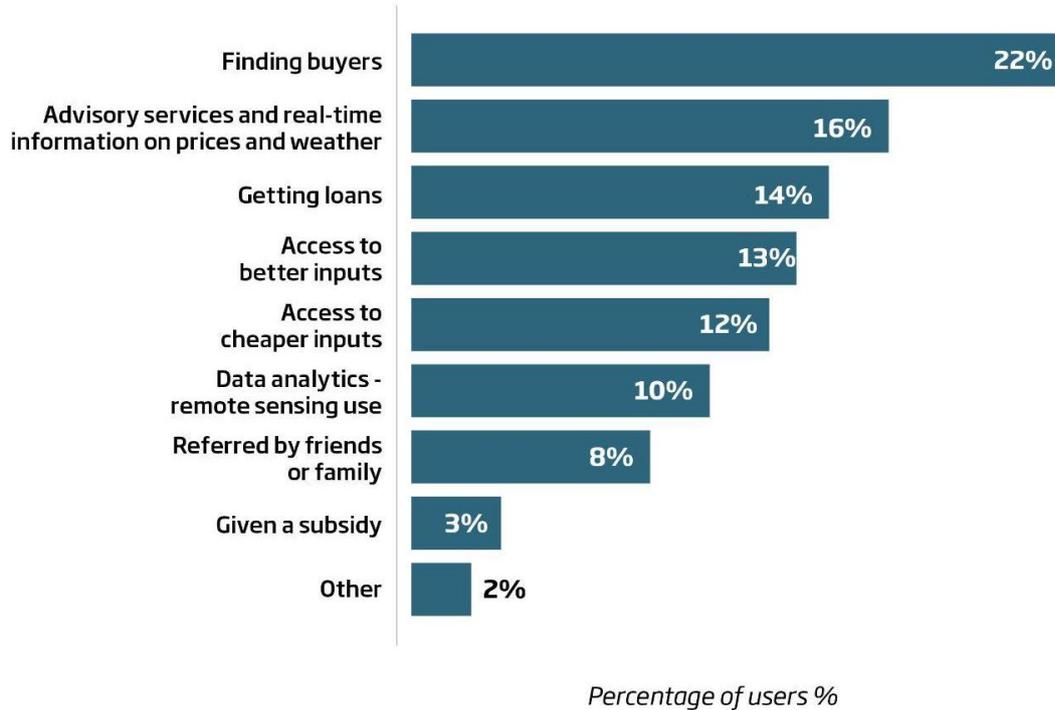
Source: Ag-Platforms as disruptors in value chains: evidence from Uganda. ODI Agritech Report Series, 2020.

Figure 21: Top reasons farmers register on ag-platforms.

Agriculture technology platforms have increased access to formal work, particularly for women and youth, but the share of women and young farmers who receive off-taker contracts remains critically low.[101] Globally, for women farmers who are on these platforms, 21 percent are given a contract for their produce and 49.5 percent have access to working capital loans, compared to 9.32 percent and 29 percent respectively for women farmers who are not on agriculture technology platforms. Similarly, 17 percent of young platform users receive a contract for the produce, compared to 14.5 percent of young non-platform farmers in the sample.[102]

Many digital market platforms on the market do not provide an end-to-end service and typically stop at price and location identification. Processes of quality certification, verification, payment, and transport logistics are coordinated and conducted over mobile phones making the digital market platform an inefficient resource. These limitations disincentivizes farmers from investing in digital tools and respective services like internet connectivity to access digital markets. A few private commodity trading companies, off-takers and technology companies have invested in digital solutions to increase

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[99] Digital Solutions Used by Agriculture Market System Actors in Response to COVID-19, Judy Payne, Marcella Willis, 26 April 2021.

[100] Ag-Platforms as disruptors in value chains: evidence from Uganda. ODI Agritech Report Series, 2020.

[101] Baskaran Shruti et al. "The Digital Agricultural Revolution Will Take more than Innovation." Boston Consulting Group, JULY 22, 2021, https://www.bcg.com/publications/2021/digital-agriculture-and-development.

[102] Baskaran Shruti et al. "The Digital Agricultural Revolution Will Take more than Innovation." Boston Consulting Group, JULY 22, 2021, https://www.bcg.com/publications/2021/digital-agriculture-and-development.

efficiencies in access to markets, price transparency, transportation logistics and payments modalities (Table 4) but their reach is limited.

Table 4: Sample of companies offering digital solutions addressing access to market.

	Company	Products & Services	Users	Development Partners/Investors
1	TruTrade	● Digital trading platform ● Digital Payment Platform	● Smallholder farmers ● Farmer Cooperatives ● Farm Produce Aggregators (traders) ● Processors ● Development partner programs	MercyCorps
2	SAP	● Digital traceability (farm to market) ● Digital payments	● Uganda Coffee Farmers Alliance	GiZ
3	Farm Kiosk	● E-marketplace ● Extension services (equipment hire)	● Farmers ● Veterinarians ● Input Dealer	African Development Bank (African Youth Agripreneuers Forum), USAID

Platforms such as Twiga Foods in Kenya and Dehaat in India have proven that digital market platforms targeting smallholder farmers can be profitable and sustainable given the right composition of product features, interoperability of platforms, data infrastructure, tele-connectivity, financing, and farmer capability to interact with the platforms. For example, during the Covid-19 lockdown, UNCDF partnered with the Kampala Capital City Authority (KCCA) and SafeBoda (a ride hailing service) to connect 800 market vendors to their platform to enable vendors to connect to customers and have produce delivered in a timely manner. Mobile money enabled cashless transactions and provided vendors a safe place to store their income. This was an enterprise saving initiative because failure to reach customers meant many vendors were throwing away perishable produce. Unfortunately, for rural SHFs the absence of digital solutions during the lockdown meant that they either threw away produce or sold it at giveaway prices. The FSDU study concluded that digitising agri-systems (e-extension, e-commerce, digital payments, and mobile-enabled market information) would reduce hoarding behavior, price volatility, and producer uncertainty during the covid pandemic.[103]

Box 5: Market Vendor Experiences from E-marketplace.

> **Ms. Ruth Tindyebwa is one of the market vendors enrolled on the SafeBoda App. By participating on the platform, her daily revenue far exceeded her normal sales and for the first time since she started her business, her daily sales hit the UGX500,000 mark. "The most amazing part is that I can save for my children's school fees on my e-wallet as I wait for the schools to reopen after this lockdown".[104]**

Source: UNCDF, 2020

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[103] Agricultural MSME financing in Uganda: A response to COVID-19, 2020, Alliance for financial inclusion, 2021.

[104] UNCDF and SafeBoda with support from SIDA, re-launch e-commerce platform for home delivery amid covid-19, UNCDF, 29, April 2020.
https://www.uncdf.org/article/5577/uncdf-and-safeboda-with-support-from-sida-launch-an-e-commerce-platform-for-home-delivery-amid-covid-19 (Accessed Jan 2022)

4.1.4.3 Supply Chain Management

Digital supply chain management solutions include traceability and certification solutions that help agribusinesses document farm compliance with global standards and trace produce along value chains at lower costs. Agribusinesses in structured value chains have a keen interest in making both production and procurement activities more visible and reducing the cost of operating in cash by digitizing payments to farmers.[105] Formal value chains also have strong connections to international markets where demand is growing for "farm-to-fork" traceability in food chains and, in turn, drives the need to digitise value chains.[106] Traceable and certified produce attract better prices on international markets. In Uganda, there is less effort in digital innovation for less structured value chains such as rabbits, vegetables and beans where women predominantly have agency over incomes. This trend contributes to women in agriculture being left behind in the digital economy space.

Ugandan farmers continue to suffer losses resulting from being sold counterfeit products and banned substances that are harmful to both crops and human health. Counterfeiters have become increasingly innovative in their techniques, making it difficult to identify their products without laboratory tests, while farmers and agro-dealers have little means of verifying whether a product is genuine, unexpired, priced fairly, or accurately labelled by brand, type, or concentration.[107]

The FtF Uganda Agricultural Inputs Activity (2013-2018) focused on increasing maize, beans, and coffee production by decreasing the prevalence of counterfeit agricultural inputs and increasing the appropriate use of high-quality agricultural inputs like improved seeds and fertilizers. The activity worked in eight key areas: anti-counterfeit, e-verification, seed quality, finance, distribution, professionalisation of spray services, compliance, and climate smart farming. FtF supported the Uganda National Bureau of Standards (UNBS) to implement an e-verification scheme under the name 'E-tag', also known as 'Kakasa'. Later, a private sector seed quality verification consortium (Heartland Global, Chemiphar and UgoCert) also implemented a slightly different tag under the E-tag scheme, called Ag-verify.[108] E-tag involved labelling agricultural inputs with a scratch-off label that provides an authentication code that can be used to confirm that the labelled product is what is claimed on the packaging (for example, brand and bottle size). The consumer sends the code that they have scratched off the product to a short code and receives back an SMS message confirming the identity of the product.[109] The program also used a digital performance tracking system, ePort, to monitor progress. In addition, the FtF Market Systems Global Learning and Evidence Exchange (GLEE) brought together actors including government, industry associations and farmers associations to enhance the demand for quality inputs, provide farmers with a way to identify quality inputs, creating incentives for actors to use high quality agricultural inputs including seeds and fertilizer while decreasing the prevalence of counterfeits on the market by increasing the regulatory pressure on counterfeiters.

In 2017, when e-verification was largely scaled up in the study area, the program caused large increases in take-up of agricultural inputs, including a 5.4 percent increase in use of hybrid maize seed; a 7.7 percent increase in use of glyphosate herbicide; and a 5.3 percent increase in use of both inorganic fertilizer and any fertilizer.[110] Stakeholders expressed disappointment that the project had come to a close, stating that "the Agriculture Inputs activity really helped us to tackle the problem of fake inputs on the market, it's disappointing that the program stopped".[111]

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[105] Digital Agriculture Maps. 2020 State of the Sector in Low and Middle-Income Countries. GSMA AgriTech Program 2020.

[106] Digital Agriculture Maps. 2020 State of the Sector in Low and Middle-Income Countries. GSMA AgriTech Program 2020.

[107] Evaluation of the Impact of E-Verification on Counterfeit Agricultural Inputs and Technology Adoption in Uganda, Endline Report. USAID, 2019.

[108] Evaluation of the Impact of E-Verification on Counterfeit Agricultural Inputs and Technology Adoption in Uganda, Endline Report. USAID, 2019.

[109] Evaluation of the Impact of E-Verification on Counterfeit Agricultural Inputs and Technology Adoption in Uganda, Endline Report. USAID, 2019.

[110] Evaluation of the Impact of E-Verification on Counterfeit Agricultural Inputs and Technology Adoption in Uganda, Endline Report. USAID, 2019.

[111] Katende Brian (Chairperson Uganda Agribusiness Alliance) Interview. Conducted by NIRAS LTS, December 2021.

There are several technology start-ups that are providing solutions to enhance genuine input access and distribution (Table 5). Their reach remains limited as many report access to finance challenges for scaling their operations.

Table 5: Sample of companies offering digital supply chain management solutions

	Company/ Brand Name	Products & Services	Users	Development Partners/Investors
1	Famunera	- Online input e-store for agriculture inputs and machinery - Extension services (soil testing, tractor hire, farming training. - Crop Insurance	- Farmers - Agribusinesses	Uganda National Young Farmers Association
2	Metajua		- Agribusinesses - Development Partner projects	USAID, Airtel Uganda, Nguvu Africa

4.1.4.4 Financial Access

SHF predominantly live in locations that are hard to reach by formal financial institutions and, as such, rely predominantly on informal financial services. Usage of informal services is significantly skewed towards adults residing in rural areas – 57 percent (8.1 million) of rural adults vs. 51 percent (2.3 million) of urban adults are informally served.[112] Women (48 percent) and men (47 percent) feel most confident borrowing from family and or friends, followed by savings groups.[113]

The informal nature of smallholder operations makes them ineligible for formal financial services. Poor business processes such as record keeping, and financial management practices make credit worthiness assessments challenging and represent a major obstacle for agribusiness access to finance from formal financial institutions. In addition, smallholders do not possess, or have low value, traditional collateral assets to secure formal financing facilities for timely investments into their enterprises to enable them to grow.

For SHF who access formal financial services, Savings and Credit Cooperative Organizations (SACCOs) and Village Savings and Loan Associations (VSLAs) are the primary formal financial service providers. 50 percent of savers (5 million adults) save informally – i.e. with savings group/VLSAs, ROSCAs.[114] Unfortunately, these organizations are the least digitized in the financial services industry which curtails consumer graduation from early start-up phase financing to more suitable financial products and services suitable to agribusiness growth stages. The limited digitalization of these institutions means that little or no credible financial history profiles of farmers can be leveraged to access larger and better suited financial products and services. Females (57 percent; 5.7 million) are more likely than males (54 percent; 4.6 million) to use informal services[115] to access credit for emergency expenses and consumption smoothing. Lack of formal IDs, low financial literacy and limited geographic access to formal financial institutions are barriers to women owning formal financial accounts.

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[112] Finscope 2018- Topline Findings Report. FSDU,2018.

[113] FinScope Gender and Youth Analysis in Uganda. FSDU, 2018.

[114] Finscope 2018- Topline Findings Report. FSDU,2018.

[115] Finscope 2018- Topline Findings Report. FSDU,2018
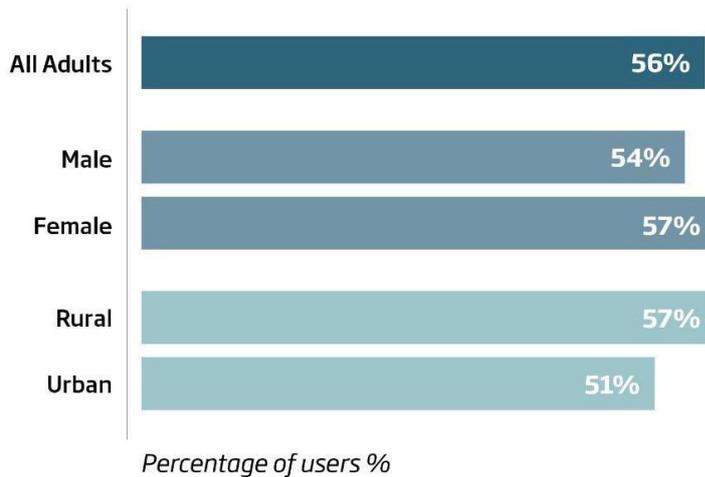
Source:Finscope 2018- Topline Findings Report. FSDU,2018.

Figure 22: Uptake of informal services by gender

Although last mile distribution bottlenecks limit SHF access to finance, a significant growth in mobile money, agency banking and mobile phone enabled IoT is enabling financial service providers to offer digital financial services (DFS) to the un/underserved. Farmer focus group discussions revealed that for some, this access to digital payment channels has created the opportunity to sell their produce at better prices in distant markets. For example, mobile money enabled households in Uganda to sell more coffee produce as shelled beans, receive better prices for these, and earn higher off-farm incomes because better prices boost investment in off-farm employment.[116]

Table 6: Sample of companies offering Digital Financial Services in the agriculture sector.

	Company/ Brand Name	Products & Services	Users	Development Partners/Investors
1	Numida	• Digital credit (working capital loans $100-$5000) via mobile money platform. • Inventory and cash flow management solutions	• Agribusinesses	MFS Africa, Draper Richards Kaplan Foundation, Engineers Without Borders Canada
2	Emata	• Micro-credit disbursed and repaid via mobile money • Digital inventory and cash flow management solutions	• Dairy farmers • Dairy Cooperatives	Rabobank Foundation, NORAD, FSDU, UNCDF, LHoFT Foundation, Dairy Development Authority

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[116] Closing the Potential- Performance Divide in Ugandan Agriculture. World Bank, 2018.

5. USAID programming: an overview of lessons learned from interventions in digital agriculture

This section highlights some of the interventions and lessons learned by USAID Uganda through interventions aimed at accelerating digital technology development and adoption in the agriculture sector. These interventions include efforts to support the expansion of physical ICT infrastructure, digital applications development and piloting, agriculture technology start-up development support, increasing knowledge and application of smart agriculture technologies and digital literacy expansion.

5.1 Digital Development for Feed the Future (D2FTF) (2015-2018)

The intervention

A collaboration between US Global Development Lab and the USAID Bureau of Food Security (now Bureau for Resilience and Food Security) established a three year partnership aimed at integrating digital tools and approaches into the Feed the Future portfolio. In Uganda efforts were directed at increasing uptake of digital financial services. This activity generated helpful guidelines[117] and a resourceful "Digital Financial Services for Agriculture Guide" was also developed to guide future implementation design teams.

Lessons Learned

- DFS products need to respond to seasonal incomes and outflows.
- To incentivize adoption, DFS tools should empower field staff and not threaten to replace them.
- DFS serves different functions (consumption smoothing, commitment savings, remittances, input credit, asset financing, crop insurance, value chain payments) for different farmer segments (non-commercial smallholders, commercial smallholders in loose value chains and commercial smallholders in tight value chains).
- Donor capital needs to be leveraged for innovation but ultimately, any intervention should help smallholder farmers access sustainable financial services that support their livelihood goals and must be offered by the local private sector and continue to serve the needs of rural communities long after the donor-funded project has ended.

5.2 Commodity Production and Marketing (CPM) Activity (2013-2018).

The intervention

The activity designed interventions to introduce and scale mobile money payments, bundled crop insurance and production loans over mobile technology within the coffee, maize and beans value chains.
- CPM collaborated with ZAABTA, a Luweero based farmers association, to develop a mobile solution for logistics and payments called the Nokia Farming Model where farm preparation services, input purchase and distribution for a network of farmers was conducted over the mobile phone (predominantly of the Nokia brand at the time) and payments for services were conducted via mobile money.

Lessons Learned

- Farmers will change behaviors if the new technology is appropriate, affordable, manageable and makes a positive difference.
- Mobile money provides youth a safe and convenient money management tool. During Key Informant Interviews, youth agents reported that they liked the safety of mobile money and the fact that it reduced "money pressure" (slang for impulse spending). Receiving payments

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[117] What Works for Digital Financial Services in Agricultural Development? USAID, 2019.

on mobile money wallets enabled youth to stick to their savings goals by planning their expenses before withdrawing cash.

5.3 Youth Leadership in Agriculture (YLA) Activity (2015-2020).

The intervention

In partnership with multiple stakeholders, the activity integrated a number of digitization solutions along different stages of the agriculture value chain.

- In partnership with AgriNet Uganda Limited, a microfinance provider and Bionic, a payments platform, the activity was able to advance $2090 in start-up capital to young farmers via mobile money. Unfortunately, when a one percent excise duty tax was imposed on mobile money transactions, many village agents and farmers opted to revert to cash to avoid the tax. While these transactions were intended originally to be driven through digital financial solutions that would have enabled farmers and the business to reduce costs and risks associated with financial transactions, more than 1.1 billion UGX ($310,075) in transactions were made in cash instead.[118]
- During the activity, less than one percent of 13,789 MSMEs were supported with a mobile money service as part of the business development services provision.[119]
- YLA partnered with Africa Cereals and Grains Corporation to increase access to finance for 2,944 youth farmers in the soybean and sorghum value chains through procurement and installation of a digital record management and traceability system.
- YLA procured an integrated and customizable digital platform that strengthened Aponye Uganda Limited's seed oil off taker, value chain management by boosting access to quality inputs, improved storage, and improved dissemination of advisory and market information among its farmers especially the female youth.
- YLA partnered with Ensibuuko Technologies to design, develop, and deploy a non-cash asset management module to the Mobis application software (cloud based microfinance management solution), to aid three Savings and Credit Cooperative Organizations (SACCOs) in tracking commodity sales digitally.
- YLA's partnership with Equator Seeds Limited (ESL) digitized ESL's supply chain management system to track the seed multiplication process through application of digital financing and record keeping technology. As a result, youth accessed inputs worth $111,147 and made sales worth $3,907,872.[120]

Lessons Learned

- Taxation of digital financial services increases the cost of using digital channels which hinders adoption of DFS.

5.4 Agricultural Inputs Activity (2012-2017).

The intervention

This activity sought to address the unavailability of high-quality inputs and prevalence of counterfeit inputs and promote the responsible use of agricultural inputs. The activity worked with 3,280 businesses in the agricultural inputs supply chain. The digital e-Tag (Kakasa) input verification solution noted earlier in the report, was piloted under this activity.

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[118] Feed The Future Uganda Youth Leadership for Agriculture Activity Final Report. USAID, 2020.
[119] Feed The Future Uganda Youth Leadership for Agriculture Activity Final Report. USAID, 2020.
[120] Feed The Future Uganda Youth Leadership for Agriculture Activity Final Report. USAID, 2020.

Lessons Learned

- e-Verification discourages re-packing and decanting from open containers because the product cannot be verified more than once. Thus, it will be important for manufacturers and suppliers to introduce small packages for effectiveness of e-verification. This should help to protect farmers but raises costs of packing in smaller packages.[121]

5.5 USAID-NetHope Global Broadband and Innovations Alliance (GBI) (2017).

The intervention

- The activity coordinated and aggregated NGO partners' purchase of broadband connectivity to increase the quality of connectivity and internet services that support development programs particularly in refugee settlements, lowers the price and cost of those services, and improves the availability of connectivity services generally in communities where USAID Uganda programs operate.

Lessons Learned

- Partners and NGOs working together as a community to gather and present information on their collective current purchases, immediate needs, and long-term plans can have a significant impact on a telecommunications service provider's decision to make an up-front investment in new network capacity.[122]

5.6 Partnerships for Enhanced Engagement in Research (PEER) (2017)

The intervention

Via a collaboration between researchers at Kansas State University and Makerere University under the project *"Scaled deployment of smart-phone agro-applications for field based diagnosis and real-time surveillance data collection"* a plant (cassava) disease diagnosis data collection platform (Adsurv App) was piloted. The objective was to support the use of quality data for government stakeholders to make informed intervention decisions and for farmers to apply timely local interventions. The activity would also inform how to build better models to predict disease from images as well as conduct disease spatial analysis. Through a network of 200 farmers equipped with smartphones to report surveillance data to the National Crops Resources Research Institute (NaCRRI), the project provided an unprecedented quantity of geo-tagged images of cassava in different levels of health.

Lessons Learned

- The project struggled with technical challenges related to telecommunications failure and incentivizing farmers to continue using the application.[123]

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[121] Feed The Future Agricultural Inputs Activity, Annual Report October 2015- September 2016.

[122] Better Connectivity, Better Programs: How to Implement a Broadband Demand Aggregation Program. USAID 2018.

[123] Scaled deployment of smart-phone agro-applications for field based diagnosis and real-time surveillance data collection. Presentation for USAID, Ernest Mwebaze. Makerere University. www. sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_188650.pdf. (Accessed March 2022)

6. Recommendations

Although there are several high priority agriculture digitalization bottlenecks that USAID programs could address, presented below are recommendations which meet the following criteria:

A. Immediate intervention could accelerate coordinated and efficient digital agriculture ecosystem development.
B. Significant technical and financial resources have been expended by other stakeholders and the additional effort from USAID would potentially accelerate the impact of digital technology adoption and utilization to materialize productivity gains.
C. Interventions would build on the successes driven by the various Feed the Future program activities.
D. Digitization should improve youth, women, people with disabilities and refugee participation and productivity.
E. Digitalization developments that would improve mechanisms for unlocking access to finance, particularly value chain financing.

Given the level of fragmentation and duplication of agriculture digitization efforts, it is our recommendation that USAID designs and funds programs that execute the proposed recommendations to catalyze ecosystem development rather than funding one-off activities across multiple projects. The recommendations below are organized in order of those that are actionable in the short and medium-term and those that should be considered in the long-term.

Recommendations for the short and medium-term.

Recommendation 1: Establish a Digital Innovation in Agriculture InterAgency Working Group

The donor and stakeholder mapping exercises (see Annex 8.6 and 8.7) revealed that there is a significant level of effort duplication. The range of activities (technology research and development, piloting, hackathons) supported through technical and financial assistance reveals the lack of an ecosystem development approach. There is a need to increase the level of coordination and visibility of activities in the digital agriculture development space. By establishing an interagency technical working group (TWG), USAID can drive an ecosystem development approach to foster sustainability in this space. The TWG can be an efficient platform for knowledge transfer across programs and a learning platform for smaller NGOs and private sector interested in promoting D4Ag. Transparency of developments across programs can inform decision making with regards to programming continuity and mitigate against disruptions when projects close.

Proposed Activities

- Convene stakeholders to generate buy-in for the TWG and develop terms of reference for the group.
- Develop TWG work plan.
- Lead and coordinate TWG activities which could include:
  - identification of areas where cross collaboration and leveraging of resources across different programs can be achieved.
  - identification of regulatory and policy areas where advocacy by the newly formed working group would influence desired developments.
  - provide technical and financial support towards MAAIF's efforts in developing e-M&E, e-Extension and e-Markets platforms.
  - development of a cloud based dashboard that tracks interventions, results and challenges across programs.

Expected Results

- A representative and effective TWG is established to drive digital technologies in agriculture ecosystem development.

- Better coordination and reduced duplication of effort in the design of interventions.
- Improved enabling policy and regulatory environment for the sustainable introduction and adoption of digital technologies in the agriculture sector.

Potential Partners

- Development partners: FCDO, GiZ, JICA, SIDA, EU.
- GoU (MAAIF, MoICT & NG, NITA-U).
- Research Institutions (Makerere University, IFPRI etc).
- Agtech and Fintech Associations (FITSPA).
- Telecommunications Service Stakeholders (UCC, MNOs, NetHope, GSMA).
- Innovation / Startup Accelerator Hubs (Hive Colab, Design Hub, Innovation Village).

Link to USAID Feed the Future Program Objectives

- This activity is in line with FtFs approach of bringing together partners from across various sectors and the U.S. Government to use each unique skill and insight in a targeted, coordinated way to help countries that are ripe for transformation change the way their food systems work.[124]
- The TWG would increase the institutional (leadership, management, technical, adaptive) capacity of Government of Uganda (GoU) institutions and agencies such as MAAIF, NECOC and UBOS, private sector and civil society organizations to coordinate development of an efficient D4Ag ecosystem.

Recommendation 2: Support Development of Sustainable e-Extension Platforms

Recognizing the challenges faced by the Directorate of Agricultural Extension Services (DAES) in providing reliable and quality extension services, and the opportunities digital extension services offer with regards to expanding access to quality agronomy information and youth participation (as agents) in agriculture, the development of sustainable e-extension platforms should be supported. The existing solutions are yet to reach scale with sustainable revenue models. USAID Uganda should lend technical and financial assistance to stakeholders working in the e-Extension space to facilitate the iteration, testing and learning necessary for the development of sustainable e-Extension platforms.

Proposed Activities

- Evaluation of existing E-extension solutions business model shortfalls.
- Review of lessons learned of promising digital extension service programs in Low Income Countries (LICs).
- Through the existing innovation hubs provide technical and financial assistance to start-ups and established companies to iterate, refine and scale business models of viable technology solutions already on the market.

Expected Results

- 2-3 private sector driven e-Extension platforms with sound business models are scaled. An increased offering of embedded services (i.e., extension, payment, financing, information, logistics, and business support) solutions to improve the value proposition for adopting digital technologies.

Potential Partners

- Existing Agriculture Technology Partners across different FtF activities (MobiPay, Ag Ploutous, Outbox, Asigma Advisory, Akorion, Ensibuuko).
- Development Partners with a shared objective of developing agriculture data infrastructure (World Bank, FAO, FSDU, JICA).
- Government MDAs (Uganda National Meteorological Association (UNMA), MAAIF), Makerere University, Resilient Africa Network (RAN), DAES).

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[124] https://www.feedthefuture.gov/about/

Link to USAID Feed the Future Program Objectives

- The proposed activity would support the IAM objective of extending new models that deliver extension, weather, or price information, and financial services to SHF and other agricultural actors.
- The development of sustainable e-Extension platforms would support FtF's ongoing investment in activities that guarantee sustainable access to good quality seeds and other inputs to farmers.

Recommendation 3: Support Development of Commercially Viable Digital Aggregation and Marketing Platforms

Efficiencies in post-harvest handling, transportation logistics and marketing activities would significantly reduce farmer income susceptibility to the respective bottlenecks. By tapping into their affinity towards digital technologies, youth that do not find primary production activities attractive could be incentivized to participate in the aggregation and marketing stages of value chains. Digital technologies can also help address women's challenges around access to markets and price negotiation challenges. By supporting the development of commercially viable digital marketplaces, USAID can significantly accelerate national agriculture market systems development that would secure and increase farmer and agribusiness incomes and increase youth and women's gainful participation in the agriculture sector.

Proposed Activities

- Map the existing digital aggregation and marketing platforms to identify key barriers to scale and opportunities for developing commercially viable business models.
- Through technical assistance and financing support, USAID implementing partners can work with local partners to build the capacity of existing innovation hubs to enable existing digital marketplaces. Technical assistance to start-up companies would include business development services training to gain capacity in building, managing and growing e-commerce platforms, knowledge sharing webinars and field visits with successful e-commerce businesses. Start-ups would also benefit from technical expertise in testing digital technology-enabled produce aggregation and transport logistic models. USAID should also consider building on its existing programs to support innovation hubs to deliver business development services to increase the capacity of technology start-ups to qualify for suitable financing vehicles.

Expected Results

- 2-3 commercially viable digital aggregation and marketing platforms sustainably scaled over a five year period.

Potential Partners

- Existing agriculture technology partners across different FtF activities (MobiPay, M-Omulimisa, Kudu, Jaguza, Akorion, Ensibuuko, Emata).
- Development Partners with a shared objective of enhancing digital aggregation and marketing platforms (IFC, Netherlands Development Organization, World Bank, FAO, FSDU, JICA).
- Government MDAs (Uganda National Meteorological Association (UNMA), MAAIF), Makerere University ResilientAfrica Network (RAN), DAES).

Link to USAID Feed the Future Program Objectives

- Activities that diversify, improve, and increase marketing channels for smallholder produce.
- Investments in technology and activities that increase access of farmers and POs to storage and post-harvest services that enhance quality of agricultural products (such as reduction of aflatoxin in agricultural products).
- Warehousing, aggregation, and distribution services that increase supply of agricultural products to new geographies.

Recommendations for the long-term

Recommendation 4: Accelerate Development of Agriculture Data Infrastructure

Although a major undertaking, the development of agriculture data infrastructure would promote innovation and adoption of a range of suitable digital technologies. The organization and standardization of data collection, storage, processing, sharing and centralization of data would accelerate research and innovation, dissemination of information and generation of informed policies and regulations.[125] This initiative would present an opportunity to drive the principles for digital development co-developed by USAID as well as embed best practices for responsible data use guided by the framework for responsible data usage developed by USAID to ensure that the digital ecosystem meets global standards and regulations from the onset. Given USAID's convening power, USAID is well placed to coordinate international development partners and local stakeholders who are custodians of rich agriculture data sets, technical experts and financiers of digital agriculture programs to develop the agriculture data infrastructure. As a starting point, USAID in collaboration with local partners could embark on developing and improving an open data infrastructure with robust privacy and security safeguards for use by FtF programs as well as other USAID funded projects in agriculture. See Case Studies 1 and 2 in Annex 8.1 for examples of beneficial agriculture data infrastructure developments in the United States and the Netherlands.

Proposed Activities

The following is a preliminary set of activities that would inform the design and development of the agriculture data infrastructure.

- Assessment of the state of agriculture data infrastructure layers including but not limited to data protection and transfer protocols, storage, and data gaps.
- Assessment on the nature and quality of FtF agriculture data across respective activities, its utility, and limitations.
- Policy and regulation assessment to identify gaps that would hinder the effective development and utility of the infrastructure.
- Stakeholder consultations and awareness creation on data protection rights and access.
- Through the proposed technical working group or independently, USAID Uganda should provide technical and financial assistance to MAAIF towards the creation of a centralized database for all data stored across its departments. This database would have relevant and live dashboards and interfaces for third parties to analyze this data.

Expected Results

- An efficient agriculture data infrastructure is developed.
- Standards and best practices around agriculture data collection with adherence to consumer protection principles are adopted.
- Accelerated innovation and design of suitable bundled solutions for SHFs informed by data analytics.
- Design of suitable and innovative DFS products such as crowdfunding, digital factoring and crop receipts.
- National Early Warning Systems Data from respective MDA's is easily accessed by the public and private sector to inform timely decision making.

Potential Partners

- Existing partners developing agriculture data infrastructure (e.g. NASA HARVEST, Enabling Crop Analytics at scale program, Grameen Foundation Digital Farmer Profile Project).
- Agriculture research institutions. (e.g., Rural & Agricultural Finance Learning Lab).
- Data analytics firms (Dalberg Data Insights, Axion Zorn, Metajua).
- Agriculture research Institutions. e.g., Rural & Agricultural Finance Learning Lab.
- Data analytics firms (Dalberg Data Insights, Axion Zorn, Metajua).

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[125] See Annex for case studies.

- Existing Agriculture Technology Partners across different FtF activities (MobiPay, Ag Ploutous, Outbox, Asigma Advisory, Akorion, Ensibuuko, Tulaa).
- Development Partners with a shared objective of developing agriculture data infrastructure (IFC, FCDO, KfW, FAO, JICA, KOICA EU).
- Government MDAs (Uganda National Meteorological Association (UNMA); MAAIF- National Food and Agricultural Statistics System (NFASS); Makerere University Resilient Africa Network (RAN).

Link to USAID Feed the Future Program Objectives

The agriculture data infrastructure would contribute to FtF objectives of developing agriculture market systems, harnessing private sector finance for scale and sustainability and improving farmstead productivity. For example, the proposed infrastructure would support the ongoing activities below to meet their objectives.

IAM (Inclusive Agriculture Markets):
- Access to reliable data would increase the institutional (leadership, management, technical, adaptive) capacity of Government of Uganda (GoU) institutions and agencies, to make timely policy and regulation improvements to enable the digital agriculture ecosystem.
- Access to reliable data should create incentives for agro-industry and agribusiness firms both to respond to changes and to drive innovation in the market system and invest in it.

Recommendation 5: Support Development of Digital Certified Input Distribution Ecosystem

By leveraging digital tools, greater consistency and efficiency in input quality monitoring and access to genuine products can be accomplished. Building on previous FtF activities and lessons learned from other country programs, USAID in partnership with the private sector, MAAIF and donor partners should drive efforts toward building a comprehensive digital certified input distribution system.

Proposed Activities
- Within the proposed interagency working group (Recommendation 1), establish a sub working group tasked with steering the development of a digital certified input distribution ecosystem. The sub working group could:
  - Facilitate a mapping exercise to identify programs working on digital solutions to combat counterfeit products.
  - Through workshops and seminars, convene stakeholders to promote knowledge sharing and identify areas of advocacy necessary for promoting the development of a digital certified input distribution ecosystem.
- USAID should assess the challenges for the scalability of the e-verification (Kakasa) and Ag-verify platforms and identify areas of support to MAAIF and the seed quality verification consortium to address identified challenges.
- Through innovation hubs, provide technical and financial assistance to support the private sector to refine and scale digital solutions that increase transparency and distribution of certified agriculture inputs, and incentivize agro dealers and consumers to invest in genuine products.

Expected Results
- Reduced farmer use of counterfeit inputs, contributing to higher farmer productivity.
- Improved efficiency in agricultural inputs distribution.
- Increased offering of bundled solutions (inputs, finance, insurance).

Potential Partners
- Agriculture technology firms.
- Agro-dealers (Uganda National Agro Dealers Association (UNADA)), Uganda Seed Trade Association (USTA).

- Insurance providers (micro-insurance).
- E-extension service providers.
- Development partners addressing the challenge of counterfeit agricultural inputs.

Link to USAID Feed the Future Program Objectives

- This recommendation is aligned with USAID IAM Activity Vision: A competitive agricultural input market in which agro input suppliers (input companies, agribusiness service providers, cooperatives, agents) target underserved customers with high quality non-counterfeit products, increasing investment in agro input distribution models and other agricultural services.
- USAID through the Feed the Future (FtF) initiative has supported a government program for input authentication called Kakasa e-verification (EV). Through the proposed activities, the EV can be further improved to achieve scale.

Recommendation 6: Establish a Digital Technologies for Agriculture Innovation Hub

Although USAID supports technology development and testing opportunities through implementing partners, there is a need for a better structured innovation development support mechanism. A dedicated D4Ag innovation hub would create a center of excellence and thought leadership that will drive the development of a D4Ag ecosystem. The proposed hub would have up-to-date visibility on trends and developments in the sector which would limit the amount of wasteful innovation duplication and leverage resources to accelerate start-up innovation and sustainable business model development for digital products and services. As part of the Partnering to Accelerate Entrepreneurship (PACE) Initiative[126] or as a separate initiative, there may be considerable value in USAID establishing an agriculture technology innovation hub that would:

- Leverage the proposed digital data infrastructure developments (Recommendation 2).
- Purposefully identify and grow innovative agriculture technology start-ups.
- Provide business development services and financing to unlock alternative finance for start-ups.
- Leverage knowledge from USAID digital for agriculture developments in other countries to accelerate digital agriculture ecosystem development.

Where direct implementation/ownership may be a challenge, USAID could also conduct an assessment on the readiness of existing innovation hubs to develop a specialized program for digital agriculture technologies development.

Proposed Activities

- As an extension of the PACE Initiative or as a separate activity, a digital agriculture innovation hub should be established as a one stop center for digital agriculture innovation incubation, acceleration and scale. Ideally, the hub should be established in partnership with key members of the interagency TWG (Recommendation 1) to ensure buy-in and sustainability of the hub.
- The innovation hub should have a financing facility to support the growth stage of successful start-ups.
- As a component of the hub, establish a Technology Challenge Fund to catalyze innovation in the sector.

Expected Results

- At least five digital technology start-ups facilitated from initiation to scale stages over a five-year period.

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[126] PACE is a USAID initiative with the goal of spurring innovations that accelerate the creation of promising, high growth, and sustainable entrepreneurial ventures across the developing world. PACE financial resources are leveraged to identify, test, and implement financially sustainable models that accelerate the growth of small and growing businesses that promote broad-based economic prosperity or address development challenges in areas such as food security, health, and energy access

- More innovative digital technologies beyond mobile phone based applications are introduced to the market and scaled (Artificial intelligence, remote sensing, machine learning).
- Development of on-farm technologies that maximise small scale farming productivity.
- Greater adoption of digital technologies by SHFs.
- Better coordinated community of digital agriculture innovation practitioners.

Potential Partners

- Institutions working on digital development (Makerere University Ran Network), (Hive Colab), (Design Hub).
- Existing Agriculture Technology Partners across different FtF activities (MobiPay, Ag Ploutous, Outbox, Asigma Advisory, Akkorion, Ensibuuko).
- Development Partners with a shared objective of developing agriculture data infrastructure (the World Bank, FCDO, KfW, FAO, JICA).
- Yunus Social Business (YSB).

Link to USAID Feed the Future Program Objectives

- The Feed the Future Innovation Labs draw on the expertise of top U.S. universities and developing country (Bangladesh, Ethiopia, Ghana, Guatemala, Honduras, Kenya, Mali, Nepal, Niger, Nigeria, Senegal, Uganda) research institutions to tackle some of the world's challenges in agriculture and food security. The labs have developed and deployed more than 1000 innovations that have impacted more than 23 million people and generated more than USD 15 Billion in agricultural sales. The Uganda based hub would benefit from tapping into global expertise.
- Private sector partnerships established by the labs help to build healthy business environments, strong, well-functioning and connected market systems while fostering economic growth.
- Lessons and expertise can also be extracted from the PACE initiative. This would support leapfrogging some product development processes and adoption of industry best practices from the onset of product and service development.

6.1 Other Recommendations

6.1.1 Dedicated Digital Development Experts

Recognizing that Mission and Bureau staff have many demands on their time across different sector programs, the team recommends that a dedicated human resource should be recruited to ensure deliberate and sustainable embedding of digital development across USAID programs, especially those in the agriculture sector. The resource would for example:

A. develop basic digital skills within sector teams to build internal expertise on digital ecosystems;
B. enable and promote data-informed decision-making by Mission projects;
C. develop and implement digital technology adoption strategies and programs for respective sectors;
D. keep Mission teams updated on relevant developments in a rapidly changing digital landscape;
E. develop a digital learning agenda that will inform future program design for continuity and sustainability;
F. act as the focal point between the Mission, development partners, government and private sector on digital development related initiatives.

7. Conclusion

Poor agricultural practices, low technological adoption, insecurity over land ownership, low quality and fragmented extension services, low quality inputs, weak aggregation and marketing systems and low access to suitable financial products and services are among the leading challenges that continue to plague agriculture productivity in Uganda. Digital technologies can be leveraged to address these challenges.

Facilitating an enabling environment is essential for the development of a sustainable digital agriculture ecosystem that benefits farmers, agribusinesses, includes more women and youth and incentivizes private sector investment. By supporting the development of key digital agriculture ecosystem pillars, USAID can contribute to accelerated adoption of digital technologies in the agriculture sector.

Digital technologies and platforms have the potential to increase vertical integration of farmers into higher value supply chains and thereby increase household incomes. Upstream and downstream efficiencies along both structured and unstructured value chains can be gained by reducing technology and information asymmetries across the range of stakeholders (farmers, input dealers, marketers and processors).

The team identified six areas where USAID Uganda can significantly shift the adoption of digital technologies in the agriculture sector i.e., establish a digital innovation in agriculture interagency working group; support the development of agriculture data infrastructure; support the development of sustainable e-Extension platforms; support the development of sustainable digital aggregation and marketing platforms; support development of a digital certified inputs distribution ecosystem and establish a digital technology in agriculture innovation hub.

Key to note is that digital literacy programs should be embedded in all program design to ensure adoption, repeat usage and scaling of digital products and services. Program design should be cognizant of the digital customer adoption journey with regards to project time horizons.

8. Annexes

8.1 Agriculture Data Infrastructure Case Studies

Case Study 1

Connecting the dots to create a data infrastructure: The US National Soil Moisture Network (NSMN).

Two types of technologies are used for the monitoring of soil water content in the United States: direct in situ instruments and remote sensing. Each approach has strengths and weaknesses. Remote sensing has the advantage of allowing contiguous data coverage across the United States and progress in its precision has resulted in increasing use for agriculture services and policy implementation. However, data provided is still at a relatively coarse level of resolution. In-situ measurements group diverse types of networks. Some, such as wireless sensors networks (WSN), provide data at the farm level and can be integrated into decision systems for precision agriculture or water management. However, these are often private and systems are proprietary and focus on the farm level. In addition, the data belongs to either the farmers or the company providing the service and is therefore not easily accessible by other stakeholders, including researchers and the government.

Most data used by researchers is still mostly at the 30km scale. These mesoscale networks, also called mesonet, have principally resulted from initiatives at the State level. As a consequence, they are distributed unevenly across the United States, with some geographic areas more densely covered than others. In addition, they are not always publicly accessible and some are protected by paywalls. While the mesonet is very useful for some applications, understanding a range of natural phenomena requires broader coverage. In addition, understanding the dynamics of soil moisture in ways that can be useful for policy management and decision making requires more information than soil moisture data point estimates. Needed information—such as soil characteristics, composition across multiple soil depths, weather patterns, and land use information—is available but in disparate data networks and from different sources.

While a large amount of data exists and could support researchers and policy makers, it is not used to its full potential. This is due to a lack of technical capacity (data processing and management) but also to the independent and non-coordinated development of networks across the United States. The production of an accurate representation of soil moisture at an informative scale has therefore remained a challenge, and soil moisture observations have been poorly integrated into assessments of vulnerability, such as early warning systems for droughts and floods.

In 2013, the realisation by the policy and research community of the need to improve metadata and calibration and validation of soil moisture data as well as data integration resulted in the development of a Coordinated National Soil Moisture Network (NSMN) The objective is to develop a high-resolution gridded soil moisture resource, accessible to the public through a web portal. The project brought together in situ measurements of soil moisture from the federal networks, in combination with a range of other databases, including the NRCS SSURGO, which provide a unique gridded database of soil properties and satellite (PRISM) data. Challenges highlighted in the feasibility study included data transfer protocols, storage, and data gaps from intermittent connectivity to stations.

Source: Digital Opportunities for Better Agricultural Policies. OECD, 2019.

Example of the Akkerweb in the Netherlands.

This case study provides a practical example of how an open data infrastructure can facilitate the creation and uptake of value adding services by the private sector, supporting productivity and sustainability in agriculture, using the example of the Akkerweb digital platform and data repository. Akkerweb is a foundation, founded by both Wageningen University and Research (WUR) and a farmer association, Agrifirm. Scientific knowledge and a practical approach to farmers' problems are combined to develop successful applications. Some data and applications are made available by the WUR research team, others are added by the private sector.

In the Netherlands, a plethora of unrelated systems have been accumulating data about on-farm activities, farm performance (e.g., yield variation) and the characteristics of production assets, resulting in a fragmentation of data. In addition, while a large amount of data is being used and acquired, most is not actionable, meaning that it cannot be directly used (or re-used) for further production of information feeding into decision processes (analytics). Akkerweb is a digital repository and work bench upon which applications, ranging from data visualisation to analytics and decision support, can be built by both the public and the private sector.

Farmers can access a free account and add information that is securely managed on the platform. The platform provides a variety of agriculture related applications readily usable by farmers, using their data, and providing support to decision making to optimise production objectives. In Akkerweb, the farmer can combine his or her farm specific data with data from public sources (satellites, soil maps, weather data, parcel maps from the Netherlands Enterprise Agency (RVO) etc.) with proprietary data sources such as sampling bodies, parties in the chain, farm management systems, own sensors etc. In particular, WUR currently provides free satellite data already translated, using complex computation, into vegetation indices (indication of the amount of vegetation, distinguishing between soil and vegetation etc.). This data is then combined with other commercial data (for example drone data) for a range of advisory services.

Farmers can also access government data. For instance, active links are available with the data store of the national Paying Agency (RVO) and with other farm management systems, to prevent double entry of data. Only the farmer has access to their own data but they can grant access to others at their discretion, making it a type of "controlled access" data governance. In this way, they can give access to their advisors to help them monitor the crops or interpret a soil analysis. Farmers are therefore free to share enriched data with advisers and other users on the platform, to obtain practical recommendations to optimise crop production. The system itself provides interoperability of data. Any data provider can link their data (e.g., soil laboratories) and make them available to farmers.

Source: Digital Opportunities for Better Agricultural Policies. OECD, 2019.

8.2 Digital Agriculture Solution Use Cases

Characteristics	Sub-category	Characteristics
1. Digital advisory		
Information-based services providing smallholder farmers with agronomic and livestock advice and best practices, information on market prices, weather and climate information as well as financial and digital literacy training.	**1. Agricultural value-added services (Agri VAS)**	One-to-many advisories covering agricultural and livestock information, weather and climate information and information on market prices. Agri VAS are delivered via voice channels (IVR, helplines), text channels (SMS and USSD) and via apps.
	2. Smart advisory	Data driven advisory based on tailored, farm-level agro-climatic and crop-specific information to support decision making, maximize productivity and reduce costs. Technologies such as sensors, satellites and drones, as well as big data analytics and AI, underpin many of these services.
	3. Weather information	Specialist services that provide regional and localized weather forecasts. This sub-category may include weather-adaptive and climate-smart advice.
	4. Pest and disease management	Digital tools that help farmers diagnose plant disease and develop strategies to treat diseased plants as well as mitigate future outbreaks. Most of the services are accessible via mobile applications and require a farmer to upload a picture of the infected plant for diagnosis. Some service are also accessible via USSD. Also includes national and regional-level pest and disease early warning systems.
	5. Product verification	Digital tools designed to enable farmers to validate the authenticity of agriculture inputs such as seeds, fertilisers, agro chemicals and other agro inputs and prevent the proliferation of counterfeit products. Most services require farmers to send a scratch-off code from the product to a specified number via SMS.
	6. Record keeping	Digital tools that enable farmers to keep detailed records of livestock, including heather and feeding data, to help mitigate diseases and avoid missed conceptions. Record keeping tools are also used to keep details of input usage, procurement, cost and revenue and sales records.

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Characteristics	Sub-category	Characteristics
2. Agri digital financial services		
Digitally-enabled financial services for smallholders to facilitate their inclusion in the formal financial economy and allow investment in farming activities. These services are customized to meet farmers' needs and tailored to suit their cropping cycles. This category also includes financial products that enable financial service providers to lower the risk of lending to smallholders.	**7. Credit and loans**	Lending products that target smallholders and address specific agricultural needs. Most of these products enable the provision of short-term financing for agricultural inputs.
	8. Credit scoring	Digital solutions that assess the creditworthiness of smallholder farmers using aggregated data from multiple sources including bio data, procurement records and mobile money transactions. These tools enable financial service providers to serve smallholder farmers and lower their risks.
	9. Crowdfunding	Online platforms that enable investment in smallholders by sourcing funds from individuals (investors or sponsors). Most platforms also allow investors to "follow" the farmers they have invested in by providing updates via text, pictures and videos from their dashboard through a website or an app.
	10. Input financing	Digital tools that enable financing for the purchase of inputs like seeds, fertiliser, pesticides/herbicides from various sources including governments through subsidies.
	11. Savings	Targeted digital savings products for farmers designed to match their spending and savings habits, enabling them to put money aside for agricultural activities.
	12. Digital agri wallets	Digital wallets enable farmers to transact with various actors with the agriculture ecosystem, for instance, making and receiving payments, including electronic vouchers with which to redeem agricultural inputs. Digital wallets also allow farmers to save money and develop a transactional history, which can be used alongside other types of data to access additional financial services.
	13. Insurance	Digitally-enabled agricultural insurance services that help smallholder farmers mitigate the risk associated with external shocks such as weather events and pest and disease outbreaks. Agricultural insurance includes weather index, area yield index, multi-peril, livestock and livestock index insurance products.
	14. Accountability tool	Digital tools designed to help farmers view farming as a business by allowing them to track farming expenses and revenues and prove their creditworthiness.

Characteristics	Sub-category	Characteristics
3. Digital procurement		
Digital solutions in the agricultural last mile that enable a range of digital systems and processes to transition from paper to digital. These solutions help agribusinesses increase transparency in their transactions with smallholders and improve efficiency and operational profitability. At the same time, farmers benefit from more transparent transactions, improved market access and from being able to access a digital footprint, which can be used to access financial services.	**15. Digital records**	Digital solutions that replace paper-based systems and digitise transactions between farmers and agribusinesses.
	16. Digital records with payments	Digital solutions that replace paper-based systems, digitise transactions between farmers and agribusinesses and enable the integration of digital payments for the procurement of crops.
	17. Digital records with traceability	Digital solutions that replace paper-based systems, digitise transactions between farmers and agribusinesses and support the traceability of produce from "farm to fork".
	18. Digital records with payments and traceability	Digital solutions that replace paper-based systems, digitise transactions between farmers and agribusinesses, enable the integration of digital payments for the procurement of crops and support the traceability of produce from "farm to fork".
4. Agri e-commerce		
Digital platforms that enable the buying and selling of agricultural produce and inputs online. Although most agri e-commerce businesses sell domestically to urban customers, agri e-commerce also enables farmers to reach international buyers.	**19. Inputs**	Agri input platforms enable the sale of inputs such as seeds, fertilizers, pesticides/herbicides from input suppliers to farmers. Such platforms may also enable groups of farmers to aggregate demand and place bulk orders.
	20. Outputs	Platforms that enable farmers to sell to consumers (B2C model) and to enterprise customers (B2B model) such as companies in the catering industry (e.g. hotels, restaurants) and market retailers, or a hybrid of the two.
	21. Inputs and outputs	Platforms that enable the sale of agricultural inputs to farmers from input suppliers, as well as the sale of agricultural produce from farmers to consumers and businesses.

Characteristics	Sub-category	Characteristics
5. Smart farming		
Smart farming refers to the use of sensors, drones satellites and other farm assets to generate and transmit date about a specific crop, animal or practice to support agricultural activities. Smart farming solutions rely on connectivity between IoT-enabled devices to optimize production process and growth conditions while minimizing cost and saving resources.	**22. Equipment monitoring**	The smart monitoring of equipment such as irrigation systems that enable farmers to remotely control, track and look after their equipment and farming operations, leading to a reduction in water consumption and wastage.
	23. Livestock and aquaculture management	Digital tools that allow farmers to monitor herds remotely in order to determine their exact location at anytime, track the health and habits of livestock including when they are in oestrus or about to calve. Similarly, aquaculture management systems enable farmers to monitor feeding patterns of fish and other aquaculture, detect diseases in advance, control water quality, and in some cases automate feeding altogether.
	24. Smart shared assets	Digital tools that enable the sharing economy for assets such as tractors, drones and other mechanised farming equipment. They provide smallholder farmers an opportunity to mechanise processes such as crop spraying, crop monitoring and land preparation.

8.3 List of Innovation and Incubation Centers[127]

#	Innovation and Incubation Centers
1	The Innovation Village (Kampala)
2	Center for Innovation and Business Incubation (Kampala)
3	Center for Innovation and Professional Skills Development, CiPSD, Makerere University (Kampala)
4	RAN, Makerere (Kampala)
5	Outbox (Kampala)
6	TechBuzz Hub. (Kampala)
7	The Design Hub. (Kampala)
8	HiveColab (Kampala)
9	Women in Technology Uganda (WITU) (Kampala)
10	ComTech, Makerere University of Science and Technology (Mbarara)
11	Consortium for Enhancing University Responsiveness to Agribusiness Development (CURAD) Incubator (Kabanyoro)
12	Gulu University, Department of Computer Science (Gulu)

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[127] Source: State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.

8.4 List of ICT4 Ag Innovations[128]

#	Innovation
1	Agriculture e-Market Place
2	Agriculture Connect
3	AgricRenaissance Project
4	AgriCombo Call System
5	Agri-Gap
6	Agro-Based Management System
7	AgroDuuka
8	Agrosure
9	AgroTracker
10	Automatic Irrigating Robot
11	Best Beef Farming Practices
12	BrathaFama
13	Buuza Agri Poll
14	Climate Smart Farmers Platform
15	Constituency Farmers App
16	Digital Farms Application
17	Driplex Cloud Based Irrigation Controller
18	Embedded Irrigation System
19	eBits
20	eLunda
21	EzyAgric
22	Farm Animal Management System
23	Farmers Assistant Application
24	Farm Box UG
25	Farmers Diary

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[128] Source: State of Information Communications Technology (ICT) For Agricultural Innovations in Uganda. UCC,2019.

26	Farmer Lottery Receipt
27	Farmershub.net
28	FAM-Sol
29	Farm Solutions 365
30	Kit Farm Trader
31	FootMo
32	iLivestock Management
33	Jaguza Livestock
34	LIMA App
35	Lima Kasooli Mobile APP
36	livestockfy
37	LivestockFarm-Lite
38	Kulimak
39	Lunda
40	MyFarm
41	M-Omulimisa
42	M-Voucher
43	NteLife
44	Oasis Collects
45	Omulunzi Information Management System
46	Online Agro Markets Advisory Portal
47	Online Catalogue for Ugandan local Products
48	Operation Wealth Creation Monitor
49	PataSente
50	PakaSokoni
51	Pesticide Residue Tester
52	Poultry Keeping Solution Application
53	Smart Livestock Tracking and Management System
54	Suasell

55	WeatherBot
56	Weacast Software
57	GreenetPages E-Directory
58	Weather Data Management System
59	Weather and Climate Information Dissemination System
60	Weather Indicator
61	Xsente
62	YoSmart Farm
63	ZiiMart

8.5 Summary of Donor Activity

Donor Activity

Overview

- Bilateral grants have remained the largest source of aid flows to Uganda, but they have fluctuated between 2018 and 2020, with an 8% increase between 2018 and 2019 followed by a similar (8%) decline between 2019 and 2020.
- The agriculture and food security sector received USD $128 million worth of bilateral grants in 2020 - a 34% increase in allocations since 2019.
- The governance and security sectors were the primary beneficiary of loans from International Financial Institution to Uganda in 2020. The agricultural and food security sector was the second most capitalised sector – receiving USD$129 million in 2020 from the same (a 173% increase from 2019).[129]
- The multi-million dollar Partnership for Inclusive Agricultural Transformation in Africa (PIATA) was launched at the September 2017 African Green Revolution Forum (AGRF). It is a transformative partnership and financing vehicle to drive inclusive agriculture transformation across the African continent. Rockefeller Foundation, Bill and Melinda Gates Foundation, USAID and AGRA are the donor partners involved in the project to transform agriculture in African countries. Uganda is among the 11 African countries to benefit from the USD$280m multi-donor agriculture fund. More than 95% of the investments in agriculture go to increasing yields and production.[130]
- USAID set up extension services, supported research and sponsored student travel to American universities to study modern methods of farming. During these years, U.S. Government support helped to significantly improve the agricultural sector and the living standards of more than 650,000 farm families. USAID development assistance supported all aspects of improving agriculture—from marketing, supply and credit information to the basic need for diversified production.[131]
- In 2008, the Bill & Melinda Gates Foundation announced a $306 million package of agricultural development grants designed to boost the yields and incomes of millions of small farmers in Africa and other parts of the developing world so they can lift themselves and their families out of hunger and poverty. To that end, the foundation plans to invest a an additional $900 million through to 2018.[132]
- In 2012, Irish Aid suspended €16 million of development assistance which was due to be channelled through Government of Ugandan systems, following the discovery of fraud in the Office of the Prime Minister. The Government of Uganda has since refunded in full the €4 million of Irish Aid funding which was misappropriated. Ireland continues to press the Government of Uganda for concerted actions following the fraud.[133] It is unclear whether Uganda- Irish Aid have been restored.
- The proliferation and diversity of development partners in Uganda make cross-donor co-ordination and coherence a challenge. The number of bilateral and multilateral development partners active in Uganda grew from 37 to 58 during 2010-19. Development co-operation practices in Uganda reflect a weakening of mutual trust between the government and international partners. Interviewed officials in the government and in the development community both point to cross-donor co-ordination as a major challenge. That said, both the World Bank and the United Nations are leading cross-donor efforts to improve co-ordination and coherence in policy advice.[134]

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[129] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021

[130] Uganda to benefit from the $280m multi-donor agriculture fund, Prossy Nandudu, New Vision, 8 September 2017

[131] US Development Assistance to Uganda, United States Agency for International Development, July 2021

[132] $306 Million Commitment to Agricultural Development, Bill & Melinda Gates Foundation, 2008

[133] Tackling Corruption in Uganda, Irish Aid, 3 December 2018

[134] Aligning development co-operation to the sdgs in least developed countries: a case study of Uganda, Alejandro Guerrero-Ruiz, Kadambote Sachin and Julia Schnatz, OECD DEVELOPMENT CO-OPERATION WORKING PAPER 102, October 2021

	Total ODF (million USD, commitments)		
	2010-14	**2015-19**	**% ODA**
World Bank	1840.7	3482.4	56%
United States	2174	3285.6	99%
UN agencies	684.9	1574.1	70%
United Kingdom	549.6	1550.5	100%
African Development Bank	584.8	912	59%
EU institutions	427	727.2	100%
Global funds and initiatives	263	612.54	97%
Islamic Development Bank	550.4	608.3	11%
Japan	521	576.3	100%
France	108.4	561.4	84%
Germany	400.5	492.1	89%
Sweden	171.9	300.8	100%
Denmark	400.2	210.5	100%
Norway	429.2	196.8	98%
Netherlands	173.1	156.1	100%
Ireland	214.8	134.7	100%
Korea	77	114.2	100%
Belgium	123.6	102.4	97%
Other MDBs	25	91.4	78%
Canada	48.7	85	100%
Iceland	13.8	28	100%
Other bilateral partners (21)	200.7	180.1	100%

Figure 1: The infographic above shows development partners ranked (descending) according to Official Development Finance (ODF) amounts. The People's Republic of China, India and other bilateral partners do not report detailed aid statistics to the

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OECD but add another quarter of official development assistance to Uganda. These funds are a mix of subsidised loans, largely focused on energy and transport infrastructure, and grants supporting healthcare and humanitarian aid. These amounts are not reflected in the infographic.[135]

There is limited real-time data on the activities of multilateral institutions. Of those for which data does exist, eight donors including the Global Fund, drove the increase in multilateral donor aid disbursement to Uganda in 2020 (Figure 2). The type of assistance is divided into Official Development Assistance (ODA) and Other Official Flows (OOF).[136]

The health sector received the largest share (USD$205 million) of bilateral grant aid disbursements in volume terms from bilateral donors in 2020. However, this allocation represents a 10% decline from 2019 to 2020. The allocation to the humanitarian sector in 2020 was USD$163 million, representing a 20% decline from 2019 to 2020, while the agriculture and food security sector was allocated US$128 million, representing a 34% increase from 2019 to 2020. (Figure 3).[137]

A number of International Financial Institutions (IFI) such as the World Bank and African Development Bank gave loans to Uganda in 2020. The three foremost sectors in the receipt of loans from IFIs in 2020 were (i) the governance and security sector which received UDS$253 million (a 454% increase from 2019), followed by (ii) agriculture and food security which received USD$129 million (a 173% increase from 2019) and then (iii) infrastructure which received USD$111 million (a 4% decline). (Figure 4).[138]

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[135] Aligning development co-operation to the sdgs in least developed countries: a case study of Uganda, Alejandro Guerrero-Ruiz, Kadambote Sachin and Julia Schnatz, OECD DEVELOPMENT CO-OPERATION WORKING PAPER 102, October 2021
[136] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021
[137] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021
[138] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021

Multilateral donor aid disbursements (US$ millions)

WFP
- 2020: 153
- 2019: 185
- 2018: 176

UNOCHA
- 2020: 9
- 2019: 22
- 2018: 23

UNIDO
- 2020: 1
- 2019: 1
- 2018: 0

UNICEF
- 2020: 80
- 2019: 77
- 2018: 70

UNDP
- 2020: 19
- 2019: 15
- 2018: 15

IFAD
- 2020: 18
- 2019: 29
- 2018: 22

ICRC
- 2020: 4
- 2019: 5
- 2018: 5

Global Fund
- 2020: 260
- 2019: 129
- 2018: 166

● ODA   ● OOFs   ● Unspecified
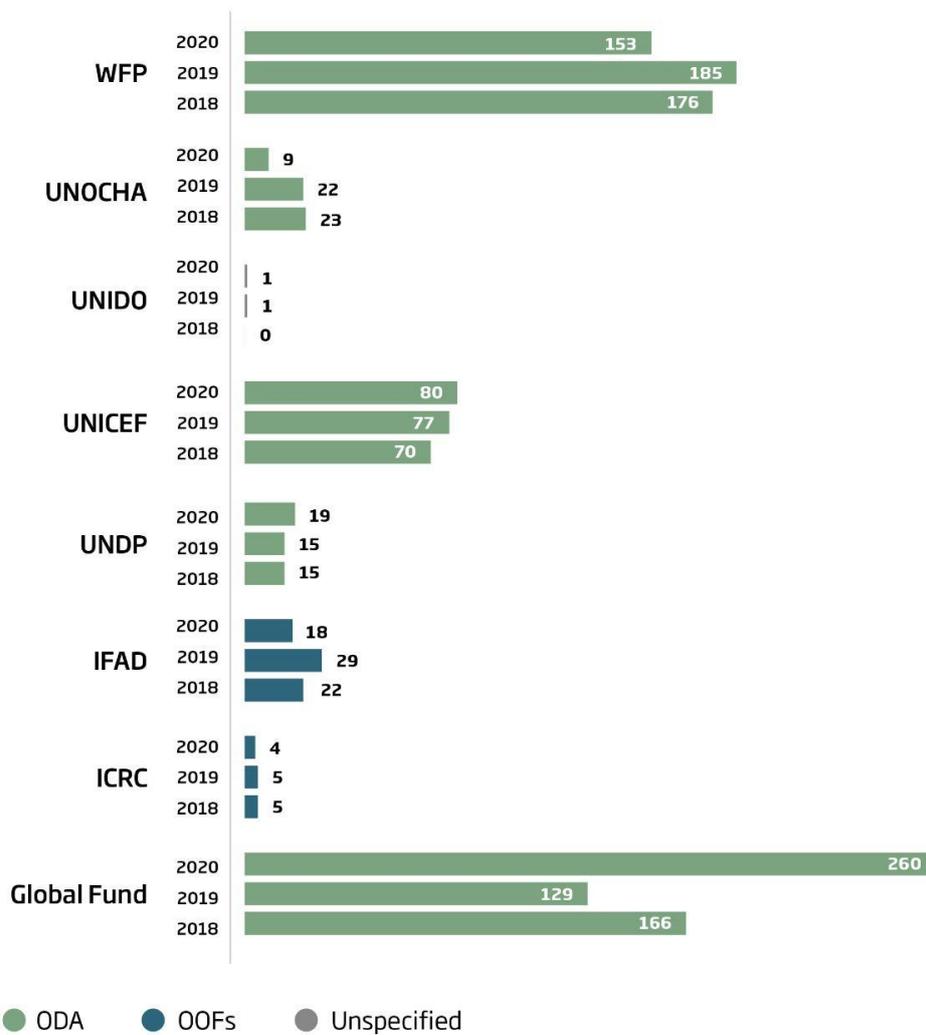
Figure 2: Multilateral Donor Aid Disbursements into Uganda 2018-2020[139]

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[139] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021
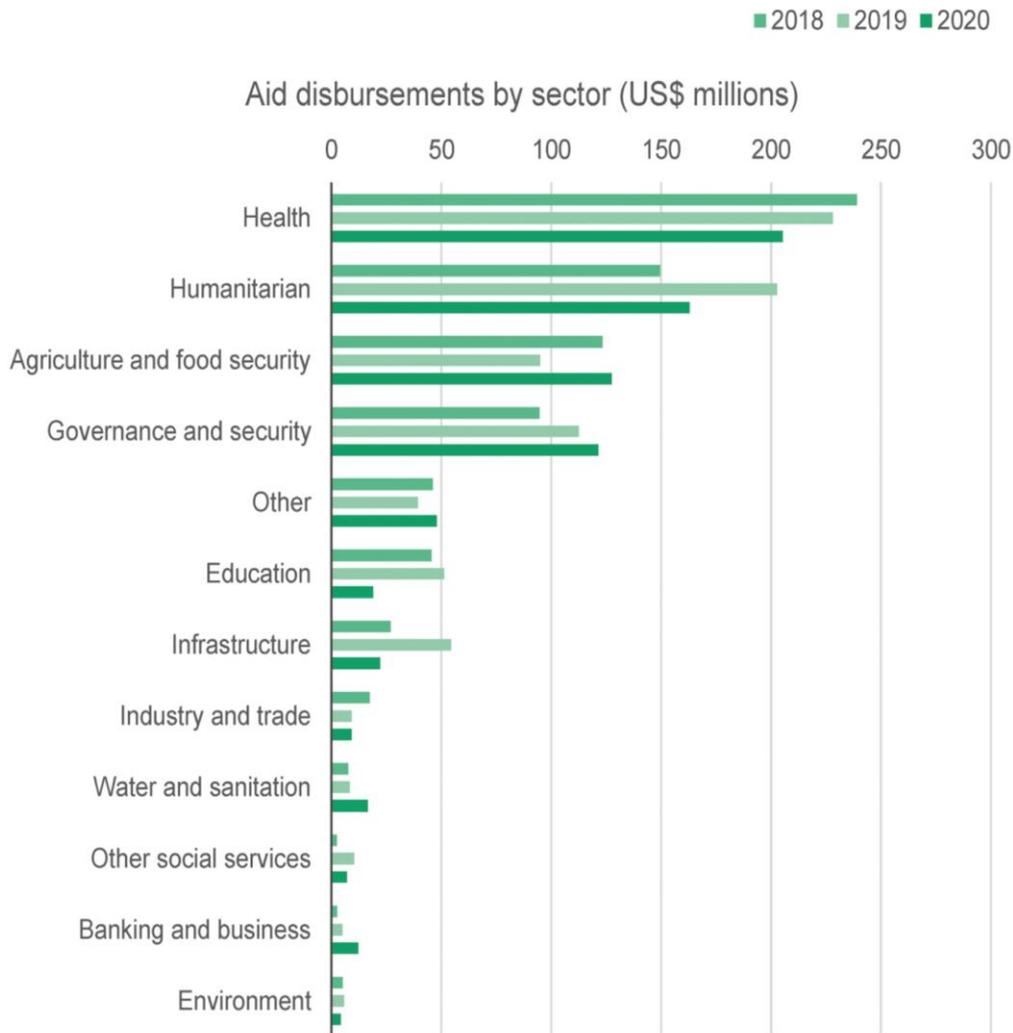
Aid disbursements by sector (US$ millions)

Figure 3: Aid disbursement in Uganda by sector[140]

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[140] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021

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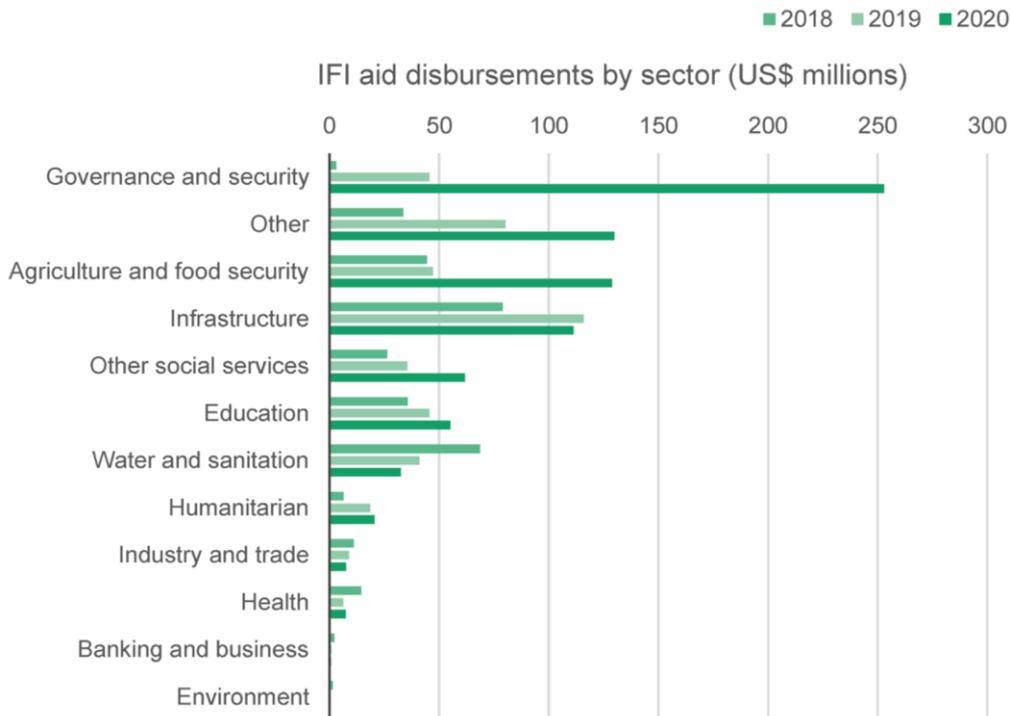
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Figure 4: International Financial Institutions aid disbursement in Uganda by sector [141]

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[141] Analysis of aid flows to Uganda before and during Covid-19, Moses Owori, Development Initiatives, 5 August 2021

8.6 Stakeholder Mapping

1. Access to Finance

Overview

Access to finance addresses the inclusion gap for smallholder farmers (SHF) who lack access to affordable, accessible, demand-driven financial products and services that drive higher productivity and income for farming households.

The financial services industry in Uganda that is accessed by the country's agricultural sector largely comprises banking, micro-finance institutions (MFIs), Savings And Credit Cooperatives (SACCOs) and cooperatives, pension funds and financial technology (FinTech) companies. According to the Uganda Bureau of Statistics' 2018 mid-year estimates, 48% of Uganda's adult population cited agriculture as their primary source of income. The country's adult population is relatively young (58% are under 36), a slight majority (55%) are female, and around 75% of the population lives in rural areas.[142]

- According to Uganda Bankers Association, Uganda has 25 million mobile money accounts and more than 260,000 mobile money agents compared to about 13 million commercial bank accounts and nearly 720 bank branches.
- According to (Financial Sector Deepening) FSDU, farmers need financial services to save money, receive money and access credit the most.[143]
- 76% of Ugandan farmers are women – the majority of which are not financially literate. Farmers are amongst the most likely customer archetype (in relation to financial products) to make poor financial decisions, not be able to fully compare the true costs of financial products, have poor understanding of loan risks or loan guarantees and have little to no credit history.
- Financial Technology (FinTech) companies in Uganda have experienced significant growth - there are now 78 FinTech companies. This is a 35% growth over the past two years.[144] There seems to be a growing focus on the financial inclusion of smallholder farmers by FinTech companies with the development of alternative credit scoring and big data to drive access to credit.
- The cost of mobile money, such as the fees charged for withdrawals and transactions, is the biggest barrier to farmer access and so, to widen access to underserved groups, mobile network operators have increasingly become willing to offer preferential mobile money tariffs to enrolled farmers.[145]
- Savings and Credit Cooperative Societies (SACCOs), Village Savings and Loans Associations (VSLAs) and Micro-finance Institutions (MFIs), which together form the backbone of Uganda's agricultural finance ecosystem, were worst affected by COVID-19, experiencing liquidity challenges due to reduced cash flows and accumulation of bad debt.[146]
- The Microfinance Support Centre promotes micro finance institutions (MFIs) and cooperatives that have agriculture sector financing as one of their priorities and provides wholesale and retail loans to Savings and Credit Cooperatives (SACCOS), Micro-finance Institutions (MFIs) and Small and Medium Enterprises (SMEs) as well as providing technical assistance support.

According to the Consultative Group to Assist the Poor (CGAP), only 10% of smallholder farmers in Uganda have bank accounts. Borrowing money is common but mostly from informal lenders. 90% of those borrowers reported using informal lenders – mainly village savings and loan associations and informal credit arrangements for goods/ services.[147]

[142] UGANDA BUREAU OF STATISTICS: 2018 Statistical Abstract, Imelda Ataai Musaana, 2018

[143] Uganda: Money in Dormant Commercial Bank Accounts Grows to Shs9.5b, Franklin Draku, 23 September 2021

[144] FinTech In Uganda, implications for regulation, Financial Sector Deepening Uganda, Cambridge centre for Alternative Finance and MicroSave Consulting, 2018

[145] Opportunities in agricultural value chain digitisation: Learnings from Uganda,, Daniele Tricarico, Panos Loukos et al, GSMA mAgri, 2017

[146] Agricultural finance in Uganda: The impact of COVID-19, Financial Sector Deepening Uganda, 24 September 2020

[147] Agriculture Finance in Uganda: Impact of COVID-19, Financial Sector Deepening Uganda September 24 2020

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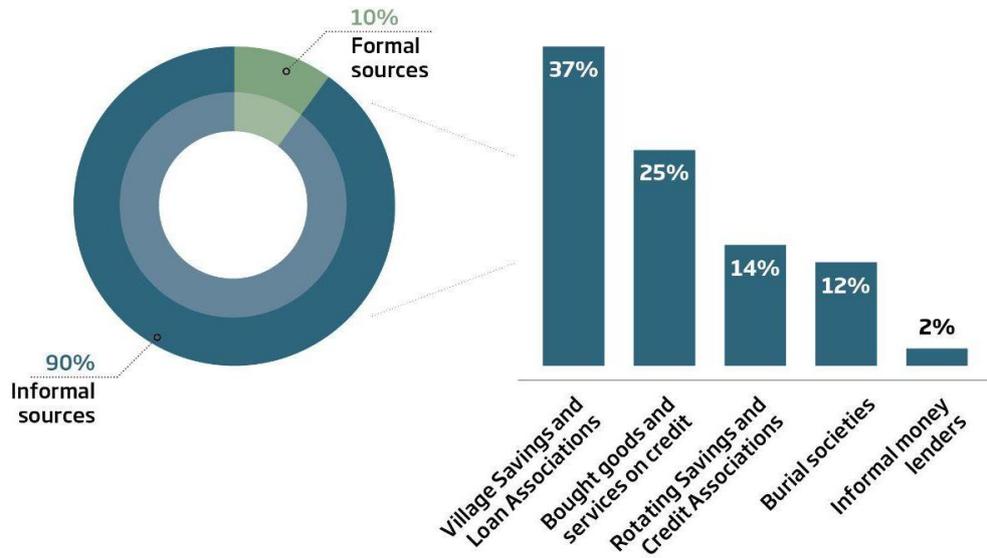
Source: Financial Sector Deepening Uganda

Figure 1: Sources of smallholder farmer credit in Uganda[148]

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[148] Agricultural finance in Uganda: The impact of COVID-19, Financial Sector Deepening Uganda, 24 September 2020

COVID-19 affected the agriculture finance sector in many ways. The following table shows a snapshot of the impact of COVID-19 on agricultural lenders.[149]

Type of Lender	Pre-Lockdown	Lockdown	Post-Lockdown
Savings And Credit Cooperatives (SAC-COS) / Village Savings and Loan Association (VSLAs) / Micro-finance Institutions (MFIs)	Crucial backbone for agricultural finance ecosystem: hundreds of savings and credit cooperatives, Village savings and Lending Associations and Microfinance Institutions present at parish/village level; farmers interact with local representatives and can speak their local language.	Liquidity challenges due to reduced cash flows and accumulation of bad debts. Microfinance Support Centre started unsecured lending at 8% to Savings and Credit Cooperatives, 13% to Micro, Small and Medium Enterprises.	Small kiosks do 94% of retail trade & SHFs are responsible for 80%+ of farming, so Savings and Credit Cooperatives are key to financing food. But creeping pre-election political subversion of Savings and Credit Cooperatives is a key risk.
Commercial banks	93% of formal agriculture lending by volume is by Bank of Uganda (BoU)-supervised institutions; but low-income borrowers use savings and credit cooperatives, Village savings and Lending Associations and Microfinance Institutions & cash loans: no data for these financing flows.	Banks have continued lending to existing borrowers, but collateral discounts by 50% (usually 65%). New borrowers were declined as only existing borrowers were served. Volume of loans has gone down.	Government of Uganda is easing policies although loan defaults is predicted to go up.
State Entities Agricultural Credit Facility (ACF) + (Micro-Insurance Challenge Fund (MCF) + Uganda Development Bank (UDB)	Uganda has no Agricultural Development Bank or Cooperative Bank, so traditionally the state has been uninvolved in Agriculture finance, leaving a capacity gap in COVID context.	Government of Uganda reportedly has sizable funding for Uganda Development Bank, but the Uganda Development Bank has limited capacity / field network. Government of Uganda also borrowing heavily in local money market, crowding out others.	Uganda Development Bank funding is for larger, export focused firms, not Small and Medium Enterprises. The Microfinance Services Company will provide Micro, Small and Medium Enterprises (MSME) stimulus.
Supply Chain Finance	All processors provide some form of credit to their farmer suppliers in Uganda, so in-trasupply chain finance is big part of the ecosystem for which there is little data.	Less willingness to extend finance with so much uncertainty over output markets. But off-takers less constrained than banks, as they have a field presence.	Supply chain finance represents the fastest / shortest route to disburse liquidity to the farmer level, but there are sustainability concerns over this.

Table 1: COVID-19 impact on access to agricultural credit

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[149] Agriculture Finance in Uganda: Impact of COVID-19, Financial Sector Deepening Uganda September 24 2020

2. Agriculture Technology (AgTech)

Overview

Agriculture technology or AgTech is the application of technology in agriculture with the aim of improving yield, efficiency and profitability for farmers and agriculture-based organizations. Agriculture technologies have upended business models and expanded the frontiers of information access in Uganda. The impact is evidenced in strides made to improve precision agriculture, digital financial services, data-driven agriculture, and mobile-enabled extension.[150]

- In Uganda, according to the World Bank, agriculture contributes to 25% of the national GDP and employs 70% of the population.[151]
- Women who make up 55% of the economically active population, play a vital role in Uganda's rural agricultural sector—contributing more than 75% of the total farm labour.[152] The digital gender divide that persists among platform users prevents effective value capture, and may be compounded by major barriers such as insecure land tenure, social norms including lack of control over their agricultural outputs, marketing and finance which are male dominated[153] as well as institutional constraints and intra-household dynamics.[154]
- Agriculture technology platforms have increased access to formal work, particularly for women and youth, but the share of women and young farmers who receive off-taker contracts remains critically low.
- In the rural areas around Gulu (North), Masindi (West), Mubende (Central), and Mbale (East), that produce most of Uganda's agriculture, access to information and digital literacy is limited. As a result, increasing productivity requires a combination of technology solutions and technology education.
- A 2017 GSMA mAgri (mobile agriculture) study has shown that agribusinesses that are more likely to adopt basic mobile money bulk payments are those with low Information, Communication and Technology (ICT) adoption, while agribusinesses that are already using ICT tools are more likely to adopt holistic last mile solutions that extend beyond payments.[155]
- Agriculture e-commerce has emerged as a critical channel for market access during the pandemic, fuelled by social distancing measures and the shift to cashless transactions and mobile money.[156]
- Farmers on agricultural technology platforms have greater access to productivity-enhancing services, such as training services and financial services.[157]
- Participation on agriculture platforms is found to facilitate access to multiple new markets but may offer fewer opportunities for product diversification (depth vs breath challenge).

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[150] Digital Tools for Agriculture, USAID, 12 July 2021

[151] Closing the potential-performance divide in Ugandan agriculture: Fact Sheet, World bank, 19 June 2018

[152] The role of Ugandan women in rural agriculture and food security, Karen McKenna University of Denver, March 2014

[153] The role of Ugandan women in rural agriculture and food security, Karen McKenna University of Denver, March 2014

[154] Role of women in agriculture: Uganda, FAO SOFA team and Cheryl Doss, March 2011

[155] Opportunities in agricultural value chain digitisation: Learnings from Uganda, Daniele Tricarico, Panos Loukos, September 2017

[156] BRIDGING THE DIGITAL GENDER DIVIDE INCLUDE, UPSKILL, INNOVATE, OECD 2018

[157] Digital Solutions Used by Agriculture Market System Actors in Response to COVID-19, Judy Payne, Marcella Willis, 26 April 2021

AgriTech categories in Uganda 2017–2018
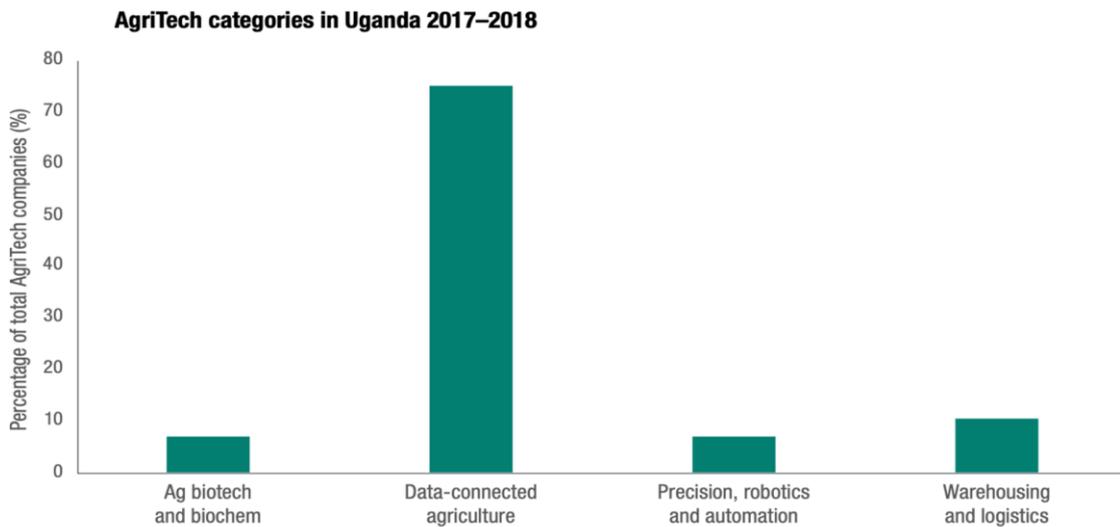
Note: *N* = 28

Figure 3: Uganda Agriculture Technology categories[158]

Various forms of Agriculture Tech platforms can be found in Uganda. In 2020, the Oversees Development Institute (ODI) collated data from 28 firms in Uganda offering Agriculture Technology (Figure 3). The majority of these firms, around 74%, fell into the data-connected device category, which includes agriculture platforms and the related use of software to digitally connect devices in a platform.

Top reasons for registering on ag-platforms
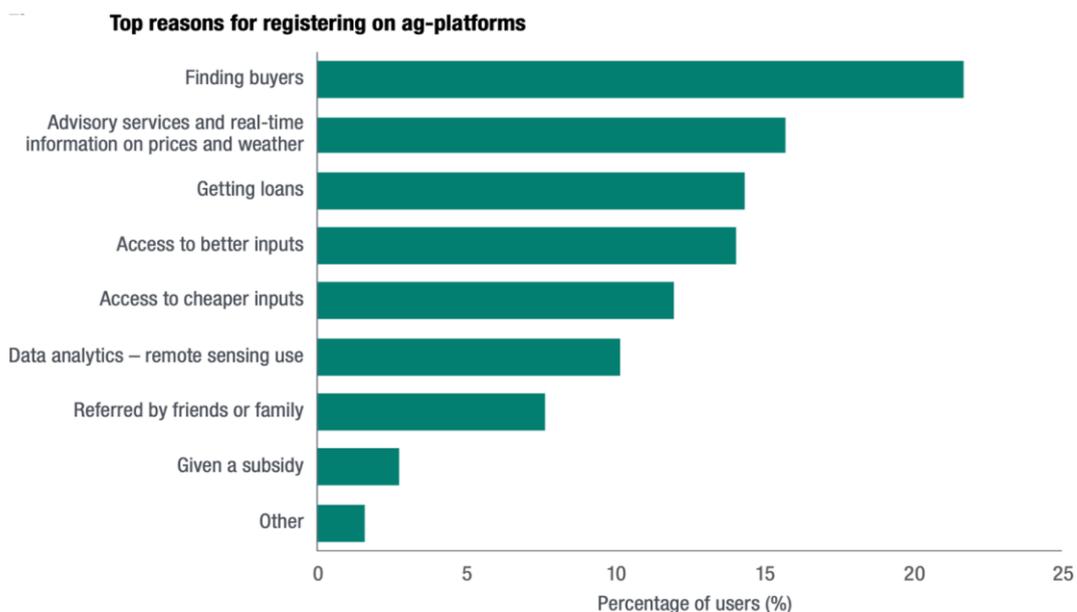
Source: Uganda ag-platform survey, 2019

Figure 4: Reasons why farmers register on Agriculture Technology Products[159]

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[158] Ag-platforms as disruptors in valuechains: evidence from Uganda, Aarti Krishnan, Karishma Banga et al, November 2020
[159] Ag-platforms as disruptors in valuechains: evidence from Uganda, Aarti Krishnan, Karishma Banga et al, November 2020

Farmers who use agriculture platforms report that their main reasons for registering relate to the sale of produce; over 20% of users ranked 'finding buyers' as the most important reason for registering (Figure 4), followed by access to advisory/extension services, information on prices and weather (15.7%); obtaining working capital or loans (14.3%), and gaining access to better inputs (14%).

3. Smallholder Aggregation

Overview

Farmer groups or aggregation can be formal cooperatives (if they are registered under the Uganda cooperative act) or informal (if formed through bottom-up action groups via like-minded farmers who come together to form a group), or top-down (if they are formed by ag-platform themselves or by village leaders).[160] Farmer aggregations include farmer field schools, rotating savings and credit associations, farmers' associations, clubs, and cooperatives.[161]

- Most produce, especially subsistence or staple products, smallholder farmers will consume themselves or trade locally within communities, whilst much regional trade is done through informal and localised collection and aggregation. There are a range of formalised aggregation models.
- In Uganda, more than 21,000 registered Savings and Credit Cooperative Organizations (SACCOs) and cooperatives that mainly service the rural population whose major economic activity is agriculture.[162]
- Smallholders mostly aggregate around value chains although other models such as the certification model exist. Some examples of this include; Utz Kapeh, Rain Forest Alliance and Fair Trade.
- The opportunity to contribute to global food security can only be realised if disaggregated smallholder farmers can be organised to achieve the efficiencies in the input and output markets.[163]
- Efficient smallholder aggregation intermediaries have proven to be critical in addressing product aggregation, provision of technical assistance and more recently as vehicles for inclusivity.[164]
- While farmer aggregation has been linked to better prices for organized farmers, a 2020 research study by the Oversees Development Institute (ODI) found that farmer groups had a negative effect on productivity. The research showed that there are intra-farmer group power asymmetries between members of a farmers' group. This leads to the formation of an elite group who capture access to information and receive most of the benefits, while others within the group are excluded. On the other hand, certain commodities like maize and potatoes (given their high-volume to low-cost ratio) often have fewer farmer groups and these are not well funded, which reduces their impact.[165]

[160] Ag-platforms as disruptors in valuechains: evidence from Uganda, Aarti Krishnan, Karishma Banga et al, November 2020
[161] Working with smallholders: A handbook for firms building sustainable supply chains, International Finance Corporation
[162] Digital Agriculture Maps 2020 State of the Sector in Low and Middle-Income Countries, Abbie Phatty-Jobe, GSMA, September 2020
[163] Food and nutrition security and role of smallholder farms: challenges and opportunities, Laura Riesgo et al, European commission 2016
[164] Factors leading to Agricultural Production Aggregation and Facilitation of the Linkage of Farmers to Remunerative Markets, Steve Wiggins, Julia Compton, April 2016
[165] Ag-platforms as disruptors in valuechains: evidence from Uganda, Aarti Krishnan, Karishma Banga et al, November 2020

Are you a member of any of the following groups or associations?

Group	Percentage
Saving and credit group	20%
Women's group or association	7%
A planting, weeding, and harvesting group	7%
SACCO	4%
Farm implement group	2%
Cooperative/Producers' group	2%
Trade union	0%
Processors group	0%
An exporting group or association	0%
Other	4%
None	55%
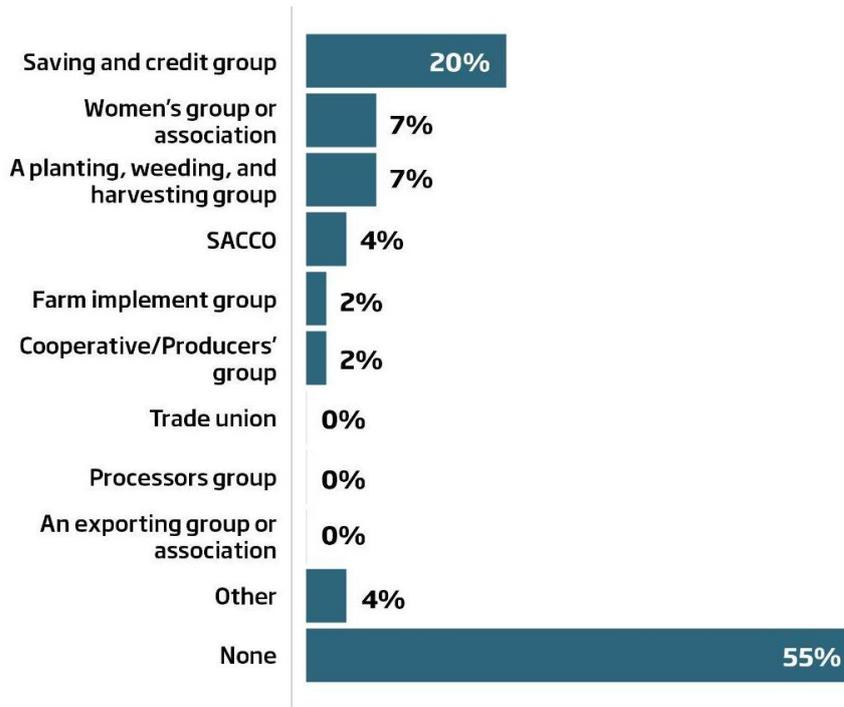
Sample: Smallholder farmers who participate in household's agricultural activities, n=2,296
Multiple responses allowed

Figure 5: Uganda smallholder groups and associations[166]

Only a small portion of smallholder farmers in Uganda (both men and women) turn to any groups or associations related to farming, saving or credit; the majority of smallholders are not members of any of these. The highest percentage, one-fifth, are members of a saving and credit group.

4. Digital Accessibility

Overview

Digital accessibility is the process of making digital products (websites, mobile apps and other digital tools and technologies) accessible to everyone. It is about providing all users access to the same information, regardless of the impairments they may have or economic background they come from.[167]

● Mobile connectivity in Uganda as of January 2021 stood at 60.3% while internet penetration was at 26.2%. GSMA estimated that Uganda had a smartphone adoption of 16%, markedly lower than the 30% average for Sub-Saharan Africa.[168] Uganda's telecommunication market is dominated by 2 players, MTN which controls 50% of the market share and Airtel which controls 43%. In 2021, Africell, the third largest operator, mainly serving the rural market announced its exit – similarly, Vodafone Uganda, Warid Telcom, Smart Telcom and Orange Telcom have exited the market in recent years in 2018, 2021, 2013 and 2018 respectively. The fact that user numbers are still rising while operators are being forced out of business highlights the dominance of MTN and Airtel.[169]

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[166] National Survey and Segmentation of Smallholder Households in Uganda, Jamie Anderson et al, April 2016

[167] Digital Accessibility 101, Engines, 03 April 2019

[168] Mobile Growth: Mobile penetration in Uganda, Frankline Kibuacha, 9 Sept 2021

[169] Uganda loses number 3 Cellco, Pete bell, 28 September 2021

- Restrictive costs of internet connection, calls and SMS remain a major barrier to usage of available services.[170] Effective 1st of July 2021, Uganda introduced internet taxes – users will pay a 12% tax on data packages, bringing total tax on internet use to 30% after factoring in the existing 18% Value Added Tax (VAT.)[171]
- In Uganda, 65% of farmers have a mobile phone and 90% of farming households having access to a mobile phone.[172]
- 75% of smallholder farmers in Uganda recognise mobile phones as "very important" to their households, or their agricultural activities.[173]
- There is major NGO and partner interest in connectivity solutions converging in the Northwest region of Uganda. This need is related to the burgeoning influx of refugees within that region, along with the active response and attention from donors including United States Agency for International Development (USAID), Canadian International Development Agency (CIDA) and others and both public and private sector institutions.[174]

Regardless of what you have, how important is it to your household/agricultural activities to have a mobile phone?
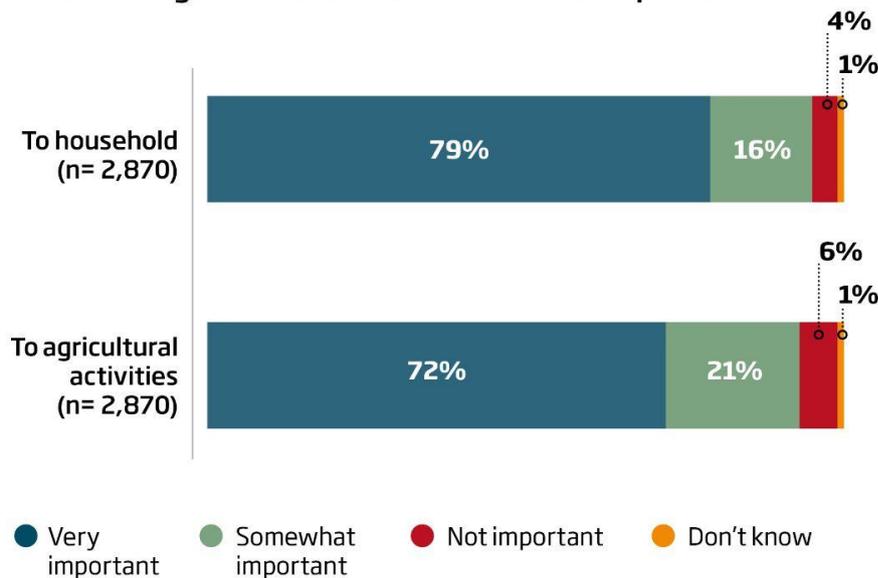
Sample: Smallholder households, n=2,870; Smallholder farmers, n=2,771

Figure 6: Farmers attitude towards mobile phones[175]

Roughly 75% of smallholder farmers in Uganda recognize mobile phones as "very important" to their households, or their agricultural activities (Figure 6). The remainder (approximately 25%) do not believe mobile phones are as important, or do not see their value to the household or farm. While importance is high overall, it still means that a portion of the marketplace does not have enough context for how they would benefit from a mobile device.

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[170] State of mobile internet connectivity 2020, Anne Delaporte and Kalvin Bahia, 2020

[171] To control speech, Uganda is taxing internet usage by 30%, Stephen Kafeero, Quartz Africa, 3 July 2021

[172] The Potential of Mobile Phones in Transforming Agriculture for Smallholder Farmers, MercyCorps, 30 January 2013

[173] National Survey and Segmentation of Smallholder Households in Uganda, Jamie Anderson et al, April 2016

[174] Nethope opens the world in Northern Uganda, Nethope, 9 July 2018

[175] National Survey and Segmentation of Smallholder Households in Uganda, Jamie Anderson et al, April 2016

What are the benefits to having your own mobile phone or SIM card?
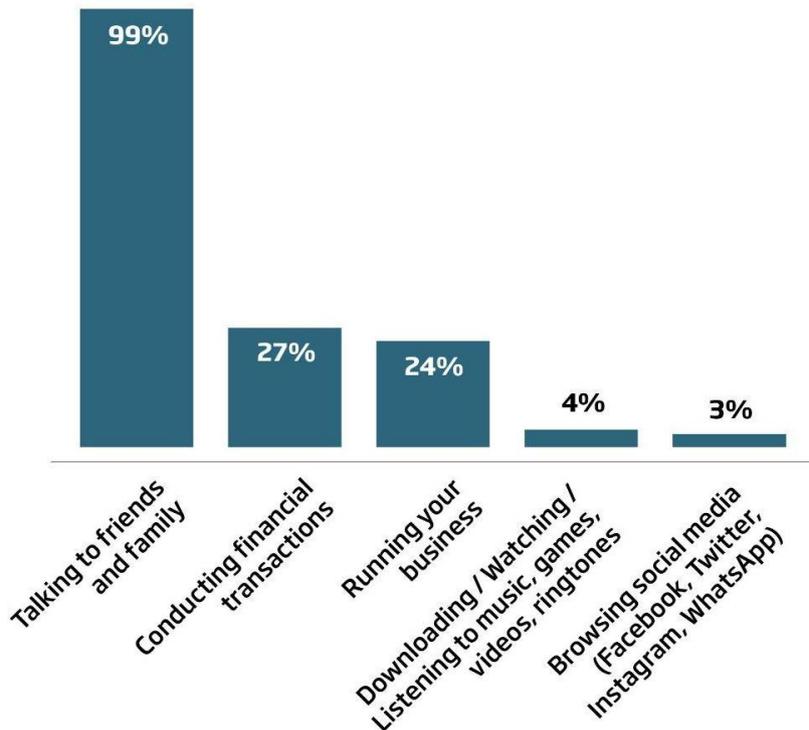
Sample: Smallholder farmers who have ever used a mobile phone, n=2,104
Multiple responses allowed

Figure 7: Farmers perceived benefits of owning a mobile phone or having access to a SIM card[176]

Smallholder farmers mainly see mobile phones as a channel for communicating with friends or family. Utility for business and financial transactions is contained to small portions of the population (Figure 7), which demonstrates a disconnect between the perceived importance of mobile phones to their households and agricultural activities, and the use of advanced phone activities. It is imperative to build knowledge and the connection between phone and household and financial transactions and farm.

5. Government Agencies & Policies

Overview

- Through the National Payment Systems (NPS) Act implemented in September 2020 and gazetting of the NPS Implementing Regulations in March 2021, Bank of Uganda commenced licensing of Payment System Operators, Payment Service Provider and Issuers of Payment Instruments. The new law seeks to enhance financial inclusion especially for poorer and rural people to access financial services by allowing non-telecommunication players to establish more payment services.
- Section 49 (6) of the NPS Act, 2020 and Regulation 14 of the NPS Regulations, 2021, provides for interest to be paid to e-value account holders. Going forward, holders of mobile money accounts will earn interest on their accounts.[177]

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[176] National Survey and Segmentation of Smallholder Households in Uganda, Jamie Anderson et al, April 2016
[177] What does separation of mobile money from telcos mean?, The independent, 26 May 2021

- Data Protection and Privacy Act, 2019, which regulates the collection and usage of personal data as well as assigning control to the National Information Technology Authority - Uganda ('NITA-U') aims to protect individuals and their personal data by regulating processing of personal information by state and non-state actors, within and outside Uganda.[178]
- As of March 2020, the existence of Uganda's data protection law has not resulted in state or non-state actors taking measures to change their policies and practices as per the obligations under the Act.[179]
- In 2009, the Government of Uganda (GoU) established, in partnership with the private sector, a long-term funding facility (the Agricultural Credit Facility) which provides interest-free loans to participating financial institutions (PFIs) for on lending to farmers and agri-processors at favourable terms. In addition, the Governments of Uganda and Denmark set up a credit lines, a partial credit guarantees scheme and a technical assistance program for financial institutions including MFIs and SACCOs to support investment in the sector. To expand the access to agricultural insurance to small-holder farmers, the GoU in partnership with private insurance companies launched the Ugandan Agriculture Insurance Scheme (UAIS). UAIS has rapidly expanded in its initial 18 months, selling more than 67,000 policies. The insurance scheme is supported by a premium subsidy ranging between 30-80%.[180]
- Agricultural Credit Facility (ACF) is the government's main intervention to support the provision of agri-finance in Uganda. Loans under the scheme are disbursed through the partner financial institutions, which then seek reimbursement from the Bank of Uganda (BoU) for the government's 50% guarantee.[181]
- The Agricultural Business Initiative Finance (aBi Finance) was established by the Government of Uganda with support from Denmark as a nonprofit entity to support agribusiness development and agriculture finance with credit lines and partial credit guarantees; it is currently supported by Danish International Development Agency (DANIDA), United States Agency for International Development (USAID), Swedish International Development Corporation Agency) (SIDA) and German Development Bank (KFW).[182]
- The government has also launched the Uganda Agriculture Insurance Scheme (UAIS), as a five-year pilot programme in 2016. The objectives of the programme are to support Ugandan farmers by limiting their exposure to the effects of agriculture-related risks, especially production risks; to increase farmers' access to credit; and to make crops, livestock, and aquaculture insurance affordable to smallholder producers. The UAIS offers a range of crop, livestock, poultry, and aquaculture insurance coverage to Ugandan farmers, and is promoted by the government through the provision of premium subsidies.[183]
- Bank of Uganda, through its April 2020 Monetary Policy Statement pronounced several credit relief measures during the pandemic period. These measures, granted within the 12-month period with effect from April 1st 2020, include: Debt restructuring (covered in existing regulations) such as extension of loan tenor and a max. 12-month repayment holidays, credit repayment holidays and arrear prepayment as a condition for restructuring a credit facility was suspended for 12 months from April 01, 2020.[184]
- The Uganda Communications Commission operational guidelines on SIM card registration implemented in 2017 are still highly prohibitive and are thought to limit smallholder farmers access to SIM cards and mobile phones.[185]

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[178] Uganda Data Protection Overview, Rita Nakalema, July 2021

[179] One year on, what has Uganda's Data Protection Law Changed?, Privacy International, 3 March 2020

[180] The Financial Sector's Role in Unlocking Uganda's Agriculture Finance and Insurance Transformation. (Tenin Fatimata Dicko, Barry Patrick Maher)

[181] COVID-19 and access to Agricultural Finance in Uganda, Financial Sector Deepening, September 24 2020

[182] Agriculture Finance in Uganda: The impact of COVID-19 Webinar presentation and discussion, Financial Sector Deepening Uganda, 24 September 2020

[183] Agriculture Finance in Uganda: The impact of COVID-19 Webinar presentation and discussion, Financial Sector Deepening Uganda, 24 September 2020

[184] Agriculture Finance in Uganda: The impact of COVID-19 Webinar presentation and discussion, Financial Sector Deepening Uganda, 24 September 2020

[185] What you should know about new SIM card registration, The monitor, 15 January 2021

6. Innovation Support Services

Overview

Agricultural innovation can be derived through collaboration with several support services in the agriculture sector. These support actors include, education and research institutions, extension service providers, agro-dealers, input manufacturers and processors, warehousing and accelerators, incubators and co-working spaces.

- Despite a start-up boom, Uganda has a low start-up success rate[186] and only about 1% of start-ups have been successful from 2016.[187]
- Accelerators and incubators have the largest potential to provide the required training to improve efficiency and obtain funding from domestics and foreign investors.[188]
- Whilst co-working spaces have increasingly gained prominence over the last decade across the world, the business of co-working spaces in Uganda is still at an early stage.
- Challenges in agricultural logistics compounded by insufficient capacity of the Ugandan Warehousing Authority to store farmer produce or provide commodity receipts remains one of the biggest barriers in digitizing agriculture value-chains in Uganda. The provision of logistical and storage facilities has been shown to improve the incomes of farmers in other parts of Africa.[189]
- Research into sustainable agriculture and food security is predominantly undertaken by the National Agricultural Research Organisation (NARO) and Makerere University's Faculty of Agriculture.[190] There are six National Agricultural Research Institutes (NARIS) under the policy guidance and co-ordination of the National Agricultural Research Organisation (NARO).[191]
- During COVID-19 as government imposed lockdown for most of 2020, seed companies could not access seed or provide extension services resulting in revenue losses. An important training services that requires in-person attendance is access to demonstration gardens which displays the latest farming technologies, seed certifications and farming techniques. In addition, seed farmers could not deliver produce to clients due to challenges in logistics during this time.[192]
- Uganda's Cabinet created a new government agency in July 2015, the Directorate of Agricultural Extension Services. In 2018, the agency ratified the newly National Agricultural Extension Policy and Strategy. The policy itself aims to create an extension service that is larger, better trained, and more coordinated. Since its formation in 2015, the directorate has hired an additional 1,750 personnel and plans to hire an additional 2,080 more. To equip agents with the skills they need, the policy includes an accreditation program for extension agents. It will also bolster university education, for example by adding a course in extension management to the existing scientific degree programs in fields like agronomy and entomology. [193]
- Agriculture grows at an average of 2% annually, which is well below the National Development Plan of a 6% average. The low performance has been partly blamed on the increasing supply of counterfeit and substandard agro-inputs. It is estimated that farmers in Uganda loose up to $7m to fake seeds alone, $18m to fake herbicides and $2m to fake fertilizers annually. It is also estimated that the prevalence of counterfeit farm inputs on the market is greater than 50%, which explains the loss of trust by farmers and low adoption of agricultural technologies in the Ugandan context which is less than 20%.[194]

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[186] A look at Uganda's investment environment, high rate of business failure, Raymond Mugisha, The Monitor, 17 June 2019

[187] 6 reasons why most startups in Uganda fail, Mugambe Michael, Mugambe Business Technology, 16 June 2021

[188] 6 reasons why most startups in Uganda fail, Mugambe Michael, Mugambe Business Technology, 16 June 2021

[189] Ugandan startup scene report 2015-2020, Africo and Weetracker

[190] Research Institutes in Uganda, CommonWealth Network, 2020

[191] National Crops Resources Research Institute, National Resources Institute, University of Greenwich, 2021

[192] Agriculture Finance in Uganda: The impact of COVID-19 Webinar presentation and discussion, Financial Sector Deepening Uganda, 24 September 2020

[193] A new agricultural extension policy takes root in Uganda, Chemonics, 15 January 2018

[194] Agro-input dealer charged over forging trademark, Juliet Kigingo, Monitor, 27 August 2021

7. Investment Landscape

Summary

Uganda's investment climate continues to present both important opportunities and major challenges for investors. With a good market economy, ideal climate, ample arable land, young and largely English-speaking population, and at least 1.4 billion barrels of recoverable oil, Uganda offers numerous opportunities for investors. However, impact of the COVID-19 pandemic and related restrictions, the locust infestation, and the negative economic effects associated with Uganda's recent elections continue to affect the country's ease of doing business and conducive investment environment.[195]

- The number of investments also varies widely across types of investments: for instance, grants account for the highest number of investment rounds. Over a 6-year period (2015-2021), Ugandan start-ups received 254 grants out of 343 investment rounds in total.
- There is an evident lack of funding, due both to underdevelopment of the financial sector and to concentration of pools of capital in monopolising firms. As at 2020, Uganda has created USD $57MN in ecosystem value or economic impact over the last two and a half years with fintech being the foremost sector for start-ups.[196]
- Started in 2017, the Kampala Innovation Week is an annual event which brings together entrepreneurs, innovators, investors and corporates from all over Uganda to Kampala for three years now. It is by far the largest gathering of the start-up ecosystem in Uganda. This event is jointly organized by the United Nations Capital Development Fund (UNCDF), Startup Uganda, and the Ministry of Science, Innovation and Technology.[197]
- Another recent initiative is the Uganda Entrepreneurial Ecosystem Initiative (UEEI) by the Aspen Network of Development Entrepreneurs (ANDE) in March 2018. UEEI is a two-phase initiative to bolster entrepreneurship in different regions of Uganda. The first phase aims to assess the operating environment of small and growing businesses in Kampala and Gulu and develop a strategy to strengthen the entrepreneurial ecosystems. The second phase aims at effective implementation of the planned strategy through a multi-year, multi-stakeholder, multi-million-euro program starting in 2019. This two-phase initiative aims to strengthen start-up growth and improve the survival rates.
- Uganda has access to start-up ecosystem initiatives like the StartHub Africa. With its base in Uganda, StartHub Africa aims to boost entrepreneurship and innovation across the African continent. It enables start-up growth by providing African start-ups with a network of investors and potential business partners.
- During the COVID-19 pandemic, investments in the Uganda were stifled. The total number of investments reduced to 35 in 2020 compared to 131 in 2019.[198]
- In July 2021, USAID Uganda launched the Strategic Investment Activity, a five year program that strives to improve the livelihoods of underrepresented and marginalized people by accelerating private investment in the country's agriculture, health, and energy sectors. The program works to accelerate and grow the investment ecosystem by increasing transparency, lowering transaction costs and risks, and creating partnerships that unlock commercial investments. The Activity creates a pipeline of up to 40 investable companies operating in agriculture, health, and productive use of energy and screens them for gender, youth, and social inclusion impacts.[199]

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[195] 2020 Investment Climate Statement: Uganda, Seth Miller, Bureau of Economic and Business Affairs, 2020

[196] Ugandan startup scene report 2015-2020, Africo and Weetracker

[197] Kampala innovation week for start-ups in Uganda

[198] The start-up scene: Uganda's Small and Medium size enterprises account for sizeable share of Uganda's impact investing market.

[199] Growing Uganda's Investment Ecosystem, Chemonics 2020

## Investment Activity of Startups in Uganda 2015-2020
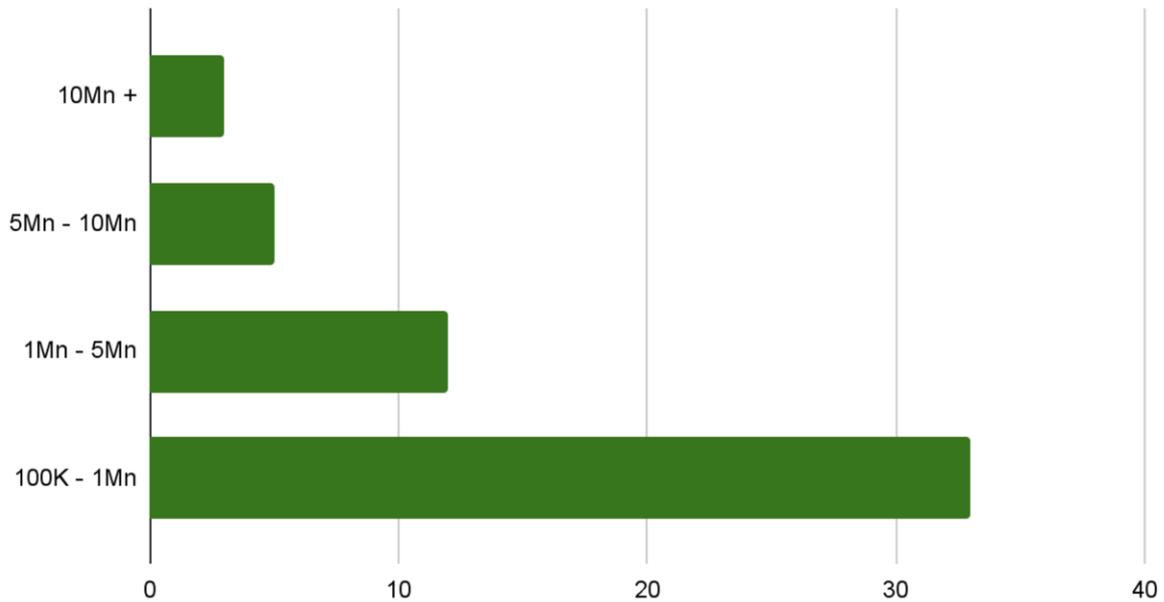
Figure 8: Number of investment raised by Ugandan start-ups[200]

The start-up investment data for Uganda shows 343 start-up funding rounds in total from 2015 through 2020 amounting to ~USD 85 Mn (excluding the funding rounds where the amounts invested remain undisclosed).

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[200] Ugandan startup scene report 2015-2020, Africo and Weetracker

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## Number of investments per industry in Uganda
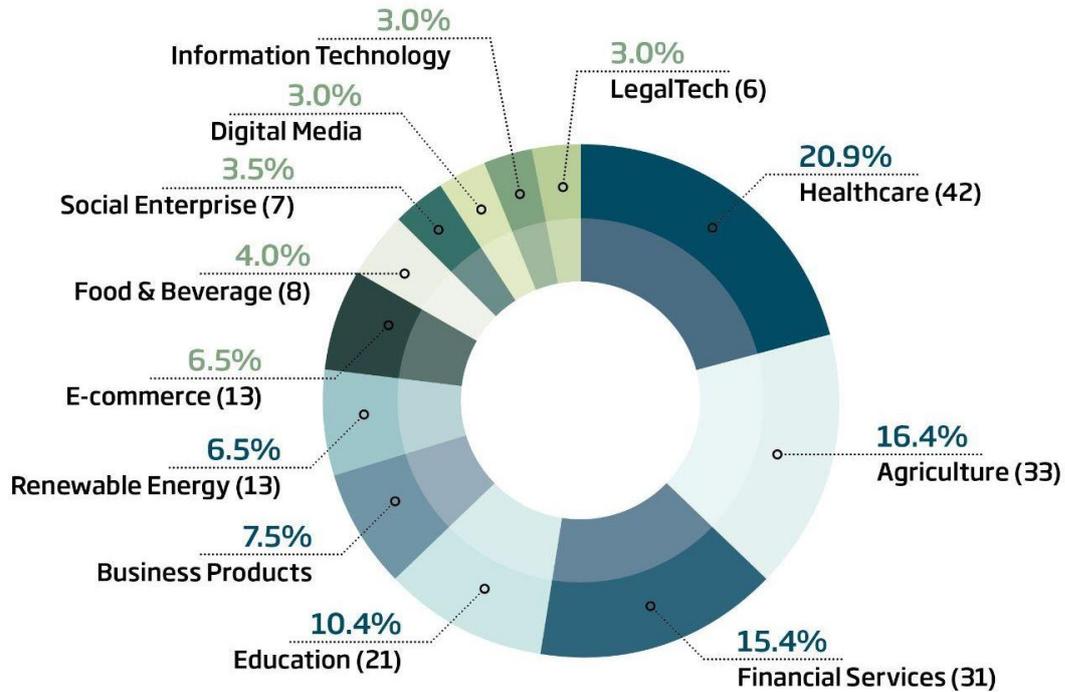
Figure 9: Startup investment by sector[201]

By 2020, healthcare had the highest number of investments with 42 start-ups in the industry receiving investments in total over the past six years. This number is much higher than the 33 start-ups in the agriculture sector (including the agritech industry) which received funding over this period.

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[201] Ugandan startup scene report 2015-2020, Africo and Weetracker

8.7 List of Key Informants

#	Key Informants
1	aBi
2	AGRA
3	Airtel
4	Asigma
5	Bank of Uganda
6	DAI
7	Emata
8	Ensibuuko
9	Equity Bank
10	EzyAgric
11	Green Gold Company Ltd
12	Innovation Village
13	Kisaakye - Mubende
14	Mercy Corps
15	Metajua
16	Opportunity International
17	Ritwika
18	TetraTech
19	Uganda Agri-Business Alliance
20	United Nations Capital Development Fund
21	We Farm
22	World Food Programme
23	Yo Uganda
24	ZAABTA (Village Agents)
25	ZAABTA (Farmers)